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1 Introduction

The WaterInnEU Marketplace is a market led innovation platform that screens relevant products and services for River Basin Managers and accelerates their uptake through targeted dissemination and support services (see <https://marketplace.waterinneu.org/en>).

The platform seeks to bring together all elements of the river basin community including researchers, SMEs, industry and public bodies in order to achieve effective dissemination and market transition of EU funded innovation outputs (tools, products, services, best practice guidance etc.) and to support improvements in the implementation of the Water Framework Directive. A screenshot of the WaterInnEU Marketplace landing page is shown in Figure 1.

The WaterInnEU Marketplace provides the following core functionalities:

- searching for and filtering on entries, i.e. products, services, projects, and organisations
- browsing through linked entities and through result lists
- common panel for showing upcoming events
- user registration and management with different roles, i.e. author, moderator, administrator, translation manager
- collaborative creation and editing of products, organisations, projects, and events; tracking of edit history
- service requests and service offerings linked to products
- user feedback in the form of comments and a forum for open discussions about products or other related information
- an integrated e-learning platform
- contact brokering between registered users and between non-registered users and product/service providers
- alerts about new products or services or updates of them by a subscription system

A detailed description of the functionalities is given in WaterInnEU Final Virtual Marketplace Report (D6.2). The Marketplace is enhanced by the provision of active matchmaking and professional support services. These facilitate product selection and implementation via “hands on” introduction and follow on dialogue between end users and supply chain providers, provision of one-on-one expert advice, targeted dissemination, development and provision of appropriate training modules (e-learning), and discussion forums.

The general exploitation plan for WaterInnEU including the additional services, e.g. matchmaking support, e-pitch events, and management structure is described in D4.4 - Exploitation plan for beyond the life of the project. This report complements D4.4 by describing how the virtual platform can be sustained beyond the project from a technical perspective.

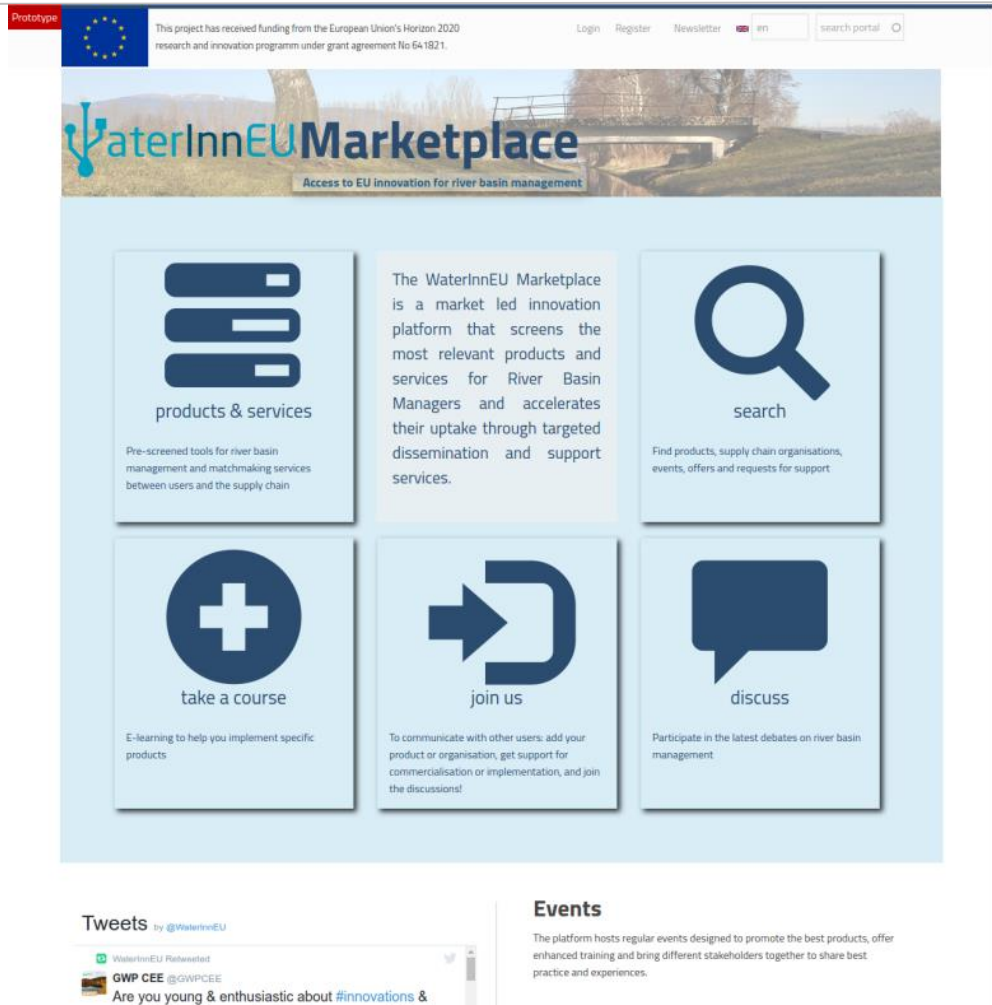


Figure 1: Screenshot of the WaterInnEU Marketplace prototype

The remainder of this report is structured as follows:

Section 2 introduces the competitive advantages of the WaterInnEU Marketplace prototype compared to similar portals or marketplaces. Afterwards, the sustainability of the Marketplace prototype is described including a description how to host the Marketplace or to re-use parts of it or the underlying data (Section 3). Then, the content management needed when running the portal is described in Section 4. Section 5 provides an overview on the costs needed for running the WaterInnEU Marketplace. Finally, conclusions are given in Section 6.

2 Competitive Advantages of the Marketplace Prototype

There are a number of similar portals that offer similar data and functionality. Examples are the EIP-Water Marketplace¹, AquaKnow², or national portals such as WaterWindow³. A comprehensive overview on related platforms and the relationship to the WaterInnEU Marketplace is given in Section 2 of D4.4 – WaterInnEU Exploitation plan. However, there are a number of functional differences distinguishing the WaterInnEU marketplace from these similar portals. These are as follows:

1. **Conceptual distinction between products & services:** Several platforms, including the EIP Water platform, treat both products and services as same entry types. In contrast, the WaterInnEU Marketplace makes an explicit distinction between products/services being promoted by the innovators, and third party service providers who may have the relevant skills and capabilities to support an end user in adopting or implementing an innovation. As an example, the product resulting from a research project may be a new simulation tool that is available as open source software. However, in order to make use of the tool, it needs to be integrated in existing water management software. The integration work may be supported by an independent third party service provider whose profile is included on the Marketplace. Using the conceptual distinction, end users can search or subscribe for notifications about new or updated information on certain services offered for a specific product.
2. **Product Specification Sheet (PSS):** Based on the analysis of market requirements, Work Package 4 defined a Product Specification Sheet that defines the metadata for products based on the users' needs. For example, the stakeholders consulted in WP3 mentioned several times that the potential application and purpose of a product is very important information for them. Though this may be provided in a general textual description of a product, having this information in a dedicated field enables an explicit search for it. A dedicated field also directly provides the information to users without having to search for it in a - perhaps extensive - general description. Similarly, dedicated fields are specified for a number of metadata elements that are considered as important by potential users.
3. **Fine-grained email alerts:** To allow users to receive alerts if new products, services or events are added to the Marketplace or if a certain entry has been updated, the WaterInnEU Marketplace allows for the definition of subscription using different filter options.
4. **Collaborative editing of entries:** The WaterInnEU Marketplace allows for collaborative editing of entries, with the author and moderator roles for registered users defined. By default, a registered user is an author that can add new entries or edit existing entries. In both cases, a moderator checks whether the information of the entry is correct, before it is publicly available in the Marketplace. If a user has created or updated an entry, he is able to use the alerting functionality to subscribe for further edits of this entry.

¹ <http://www.eip-water.eu/>

² <http://aquaknow.net/>

³ <https://waterwindow.org/>

5. **Support for user feedback:** Registered users can add free text comments to all entry types and can hence provide comments on usability, applications, or any additional feedback. The forum can be used for more general discussions on certain water-related issues. Entries available in the portal can be linked from the discussions in the forum.
6. **Integrated e-learning platform:** The consolidated version integrates the e-learning platform in the Marketplace. This allows providers of products to directly offer e-learning material about these products and potential users of these products to learn more about usage, applications, etc. in the e-learning courses.
7. **Open data access:** The information that is publicly available in the WaterInnEU Marketplace is also provided as open data in a machine-readable way through a well-defined and publicly accessible API. Other portals can thus utilize the API to harmonize their underlying data with the data published in the WaterInnEU portal. For example, in case a product is available in several portals, the other portals can subscribe for new entries in the WaterInnEU Marketplace and can use the API to automatically fetch the new data and integrate it in their own database underlying the portal.

Since the implementation of the portal is available as open source software, the portal may either be run by third parties or some implementations of the functionalities may be reused as outlined in the next section.

3 Sustainability of the Marketplace Prototype

This chapter describes what is needed to technically maintain the Marketplace beyond the project's end (Section 3.1). It also lists options for re-using parts of the Marketplace (Section 3.2) and describes how the Marketplace may be linked to other portals/websites (Section 3.3). Afterwards, options for exchanging the underlying data of the portal are given in Section 3.4. Finally, future directions for extending the Marketplace are given in Section 3.5.

3.1 Hosting the Marketplace

The implementation of the WaterInnEU Marketplace is based on Drupal⁴, an open source content management system implemented in PHP, which is easily extensible. For hosting the WIEU Marketplace, two options are considered:

- Running and maintaining a virtual machine/on a server
- Deploying the Marketplace in the cloud

During the WaterInnEU project, the first option has been chosen and the virtual Marketplace is currently hosted in a virtual machine maintained by 52°North. The setup of the virtual machine is shown in Figure 2. The Marketplace is using a MySQL database⁵ for storing the information of the portal and is therefore re-using Drupal's default support for

⁴ General information about Drupal can be found at: <https://www.Drupal.org/>

⁵ More information about MySQL can be found at: <http://dev.mysql.com/>

MySQL. For executing Drupal code, PHP 5.6.17 is used. The portal uses apache Solr⁶ for indexing and searching. Drupal is deployed in an nginx Server⁷, which is run on a Linux Server based on Debian GNU/Linux 8.2 “Jessie”.

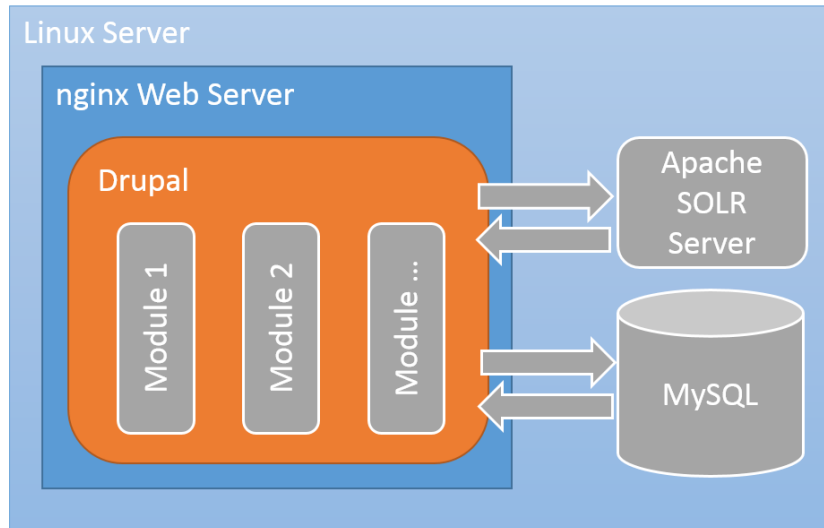


Figure 2: Schematic overview on the virtual machine setup for hosting the WaterInnEU Marketplace

Instead of hosting the Marketplace on a virtual machine that needs to be maintained by technical staff, the Marketplace can also be deployed in a cloud-based environment. Several providers who specialize in Drupal cloud environments exist. They vary in the functionalities and tools offered and the price is usually depending on user load⁸. For deploying the WaterInnEU Marketplace, support for Apache Solr and MySQL needs to be provided as described above.

3.2 Partial Re-Use

Since the EIP-Water Marketplace already existed at the beginning of the project, several online meetings were held between the technical partners of the WaterInnEU consortium and the technical members of EIP-Water to discuss options for collaboration. The preferred option in the WaterInnEU consortium was to extend the existing EIP-Water Marketplace as illustrated in Figure 3. Since the EIP-Water portal is based on Drupal, WaterInnEU could have developed several additional Drupal modules adding new functionality and re-using the existing modules of the EIP-Water portal.

⁶ More information about Apache Solr can be found at: <http://lucene.apache.org/solr/>

⁷ More information on the nginx server can be found at: <http://nginx.org/>

⁸ Examples of cloud-based Drupal hosting providers are OMEGA8.CC (<https://omega8.cc/pricing>) or Acquia (<https://www.acquia.com>).

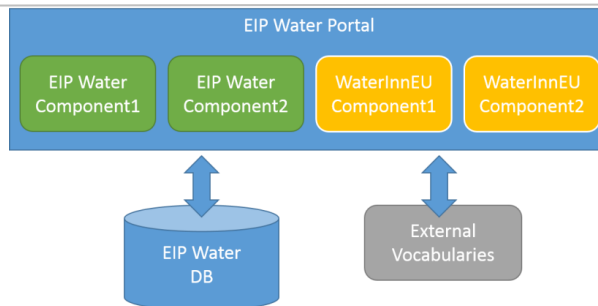


Figure 3: Extending the EIP Water Portal

Since the source code of the EIP-Water portal was not opened by the members of EIP-Water to the WaterInnEU consortium, the option for extending the EIP-Water portal by the WaterInnEU concepts was discarded and it was decided that WaterInnEU implements its own Marketplace. However, to still provide the option to re-use some of the functionality developed in WaterInnEU, the WaterInnEU partners decided to rely on the same base technology as EIP-Water, i.e. the Drupal CMS, and to provide an easy-to-use API that allows integrating the data gathered in the WaterInnEU portal in the EIP-Water database at the backend (Figure 4).

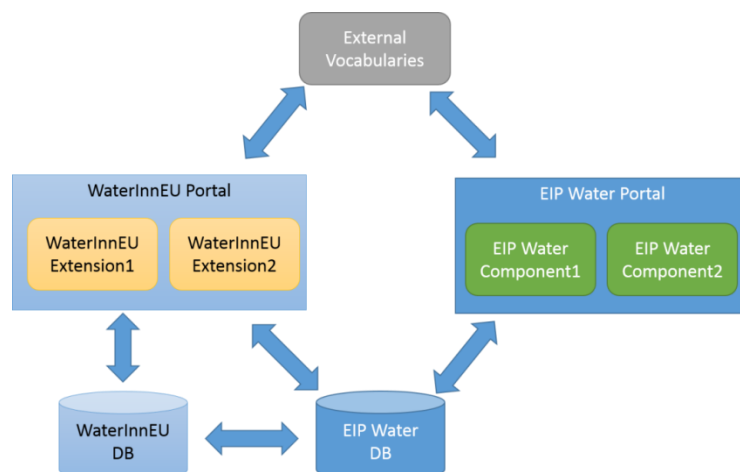


Figure 4: Loose Coupling of the WaterInnEU Portal and the EIP-Water Portal

Thus, some of the Drupal modules developed in the WaterInnEU Marketplace may be re-used by other portals relying on Drupal. The source code of the Marketplace implementation is available as open source software under the GNU Public License (GPL) version 2 in a GitHub repository⁹. An overview of all Drupal modules developed or reused is given in Annex B of D6.2 – Final Virtual Marketplace report. The integration of the data sources at the backend via an open API is described in the Section 3.4 below.

3.3 Linkage to other Portals/Websites

As described above with the example of the EIP-Water portal, there are several existing portals providing similar or related information on water research projects and their outcomes.

To avoid duplicating information, it is thus essential to provide functionalities for linking the WaterInnEU virtual Marketplace with other platforms providing related documents,

⁹ The source code of the WaterInnEU Marketplace is available at: <https://github.com/52North/waterinneu>

services, or other relevant information. Table 1 outlines which content types can be linked to external sites and how.

Table 1: Listing of content types that may link to external resources.

| Content Type | Can be linked? | How (# and type) |
|------------------|-------------------------------------|--|
| Event | <input checked="" type="checkbox"/> | Web links (∞) |
| Organisation | <input checked="" type="checkbox"/> | Internal (projects, products, and service offerings) and external web links |
| Project | <input checked="" type="checkbox"/> | Web links (∞) |
| Product | <input checked="" type="checkbox"/> | Internal (via terms from controlled vocabularies, project, organisation) and external Web links in different categories (e.g. tutorials and supporting material) |
| Service Offering | <input checked="" type="checkbox"/> | Internal (via service categories, product, organisation) and external Web links (∞) via URLs in plain text |
| Service Request | <input checked="" type="checkbox"/> | Internal (via service categories, product) and Web links (∞) via URLs in plain text |
| Comment | <input checked="" type="checkbox"/> | Web links (∞) via URLs in plain text |
| Forum Post | <input checked="" type="checkbox"/> | Web links (∞) via URLs in plain text |

Events can be linked to anything including Web sites with additional information or booking systems. An *Organisation* entry can be linked to other organisation entries using terms from controlled vocabularies. In addition, the Web sites of the organizations can be linked in explicit link attributes or in the description. A *Project* can be linked to its relevant Web sites using unlimited link attributes. The *Product*, the core entry type in the WaterInnEU Marketplace offers several possibilities for the users to link to other Marketplace content and relevant external resources. *Service Offerings* and *Requests* also offer options to link to external resources. Also *Comments* and forum posts may link to external information. Finally, the e-learning *Courses* can link to an product on the platform or may link to external resources.

3.4 Data Exchange

The WaterInnEU Marketplace provides a REST API to access the underlying data of the Marketplace in an easy and machine-readable way¹⁰ (Figure 5). Technical documentation of the API is available in Section 5.2 of D6.2 – Final Virtual Marketplace Report.

¹⁰ The Marketplace REST API is accessible at: <https://Marketplace.waterinneu.org/en/api>

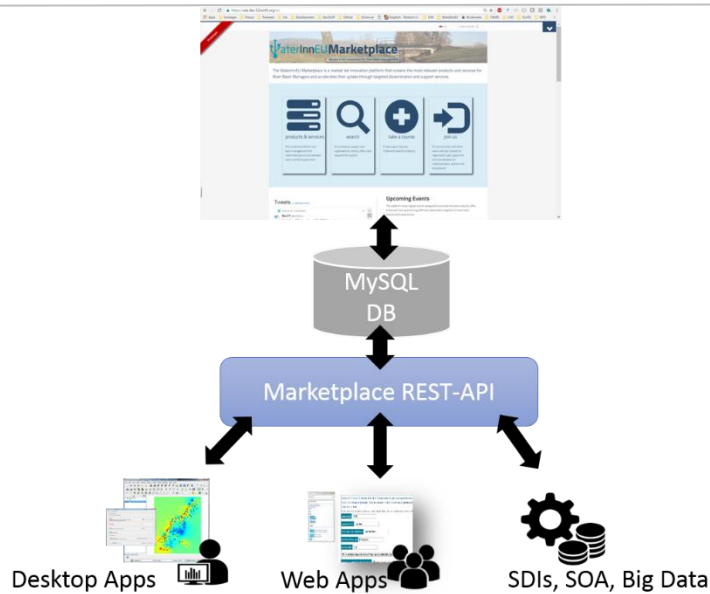


Figure 5: Illustration of the Marketplace REST-API

As sketched above, the REST API allows retrieving the different content types that are created and provided by the WaterInnEU portal. The current version only allows the retrieval of information, but may be extended to a transactional API that allows automatically inserting data from other portals. Another option for exporting the data is, of course, using the default MySQL functionality for creating a database dump.

Since several portals are providing similar content, an informal initiative has been launched at the EIP-Water conference 2015 with the goal to identify the subset of common information that is provided in all portals and to harmonize this information. An approach that illustrates how information provided in several portals may be integrated is shown in Figure 6. The idea is to harvest the data from several portals automatically in a common database that provides a common entry point (API) for accessing the information. The open WaterInnEU Marketplace API is able to support such an automated integration.

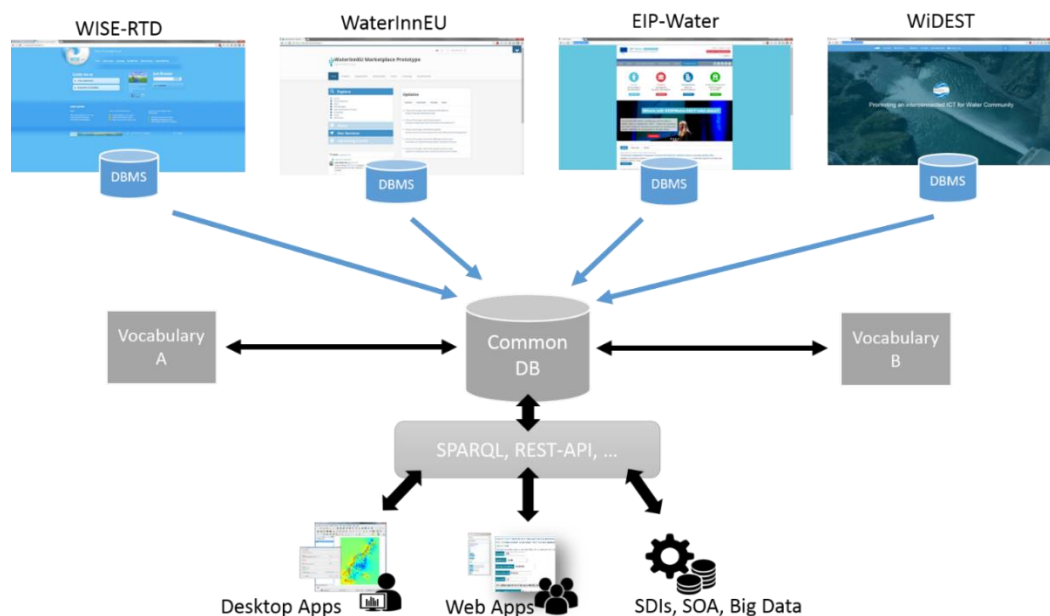


Figure 6: Approach for integrating data provided in different Water platforms

3.5 Extending the Marketplace

The WaterInnEU marketplace has been developed as a prototype demonstrating the concepts developed in WaterInnEU for facilitating the uptake of research project results in the Water sector. Being a prototype, there are several issues and extensions that may be addressed by future developments. Examples are as follows:

- **Simplification of adding new entries:** Currently, all fields of the product specification sheet are presented in the form for adding new entries. This may be simplified by focusing on the mandatory fields; in addition, a wizard may be implemented that guides users through the process of creating new entries.
- **Simplification of advanced search:** The advanced search requires a number of fields as search parameters. A search wizard that guides users through different search fields and presents intermediate results would simplify the search for end users.
- **Automated Linking** of projects, products and services when adding new entries: Currently, links between projects and products need to be established manually when creating new content. This may be automated in future versions.
- **Provision of language translation function:** The marketplace already provides multi-language support. However, translations need to be done manually by a translation manager. This may be automated by utilizing translation services available in the Web, e.g. Google translate.
- **Extended administration user interface:** Provide graphical user interface for extended functionality, such as selecting the product of the month.

4 Content Management

This section describes the content management that is required for running the WaterInnEU Marketplace.

4.1 Guidelines for contributors

When a user registers at the Marketplace, the user is asked to accept the terms and conditions of the Marketplace. The administrator of the Marketplace is able to update the terms and conditions. If they are updated, each user needs to accept the new version before continue using the Marketplace. The current version of the terms and conditions is as follows:

“I agree with the transfer of personal data provided in this platform and its use according to Directive 95/46/EC¹¹, Directive 2002/58/EC¹², and Directive

¹¹ <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=URISERV%3A114012>

¹² <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=URISERV%3A124120>

2006/24/EC¹³ of the European Parliament. Personal data and information obtained will remain confidential and will not be transferred to third parties.”

In addition, the user needs to declare the following:

“I hereby declare that I am allowed to contribute all content that I enter in this platform.”

Before a user is able to publish any content in the portal, the user needs to be registered first. This includes adding products, service requests and offerings, and common user generated content like comments and forum posts. The users are reminded that the primary users of the platform are River Basin Managers (RBMs) and that the provided/added/updated content should reflect the reality and nothing fictional. The openness of the platform also needs to be considered by the contributors, meaning that all provided content could become part of another platform which consumes the content via one of the public Web APIs. In addition, comments are always activated to foster the community spirit and enabled documented public communication between service providers and potential service customers.

4.2 Moderation of Content

One of the initial goals of the WaterInnEU Marketplace was the option of collaborative content creation. As a result from the requirements and the stakeholder consultations, we have identified the need for moderating the Marketplace to avoid misuse or the provision of misleading information. We hence created different user roles shown in Table 2.

Table 2: User roles of the WaterInnEU portal.

| Role Name | Role Description |
|----------------------|--|
| End user | End users can access all functionality that does not require registration to the portal, e.g. exploring the content of the Marketplace, searching for products or organisations or reading service requests or offers. |
| Members | Registered users who can use extended functionality, e.g. posting comments about tools, or subscribe for new or updated entries. Members can also add or edit products, organizations, and service requests/offerings. |
| Moderator | The moderator is responsible for checking new entries and comments or any updates of them, either by doing it by herself or by delegating this task to another expert. |
| Translation Manager | The translation manager creates, assigns and reviews translation jobs with the integrated platform translation feature. |
| Administrator | The portal administrator is responsible for maintaining the portal technically and updating the general content. |
| Course Administrator | The course administrator is responsible for creating and holding e-learning courses. |
| Course Participant | The course participant is a member that signed-up for any course and is accepted by the according course administrator. The participant is able to take part in any course. |

¹³ <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32006L0024>

The user roles are hierarchical and extend from the end user to the administrator as outlined in Figure 7. Thus, a moderator has permissions of an end user, a member and the moderation permissions.

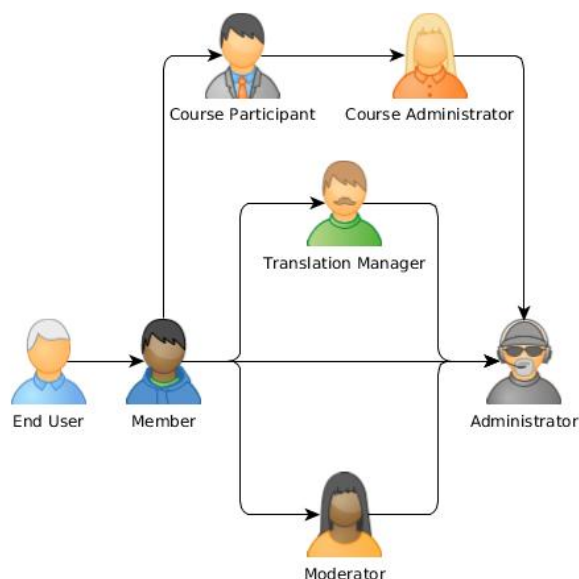


Figure 7: Development of user permission levels

4.2.1 Moderation needs

Figure 8 outlines the process of publishing and maintaining the content. Every Marketplace member is able to create content. Before the content is published in the portal, a moderator needs to review the content (Content Revision 1), might request updates (Content Revision 2) and then publishes the content. The notification that new content is available which needs to be reviewed is done automatically by the system via email. Hence, no user needs to know any moderator by mail, or username. Only moderators are able to unpublished content when it becomes outdated or must be taken offline.

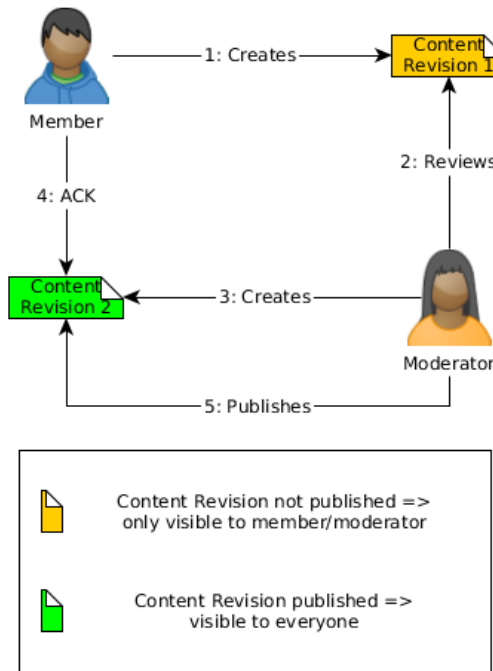


Figure 8: Content creation workflow

The lifecycle of content is outlined in Figure 9. All content is initially created as draft by a member of the platform. When the member finishes the draft, it is marked as ready for review. This review is performed by a moderator. Afterwards, the content may be either directly published or it is unpublished and again starts the cycle as a draft. Finally, content that is no longer needed, may be delete by the Marketplace administrator.

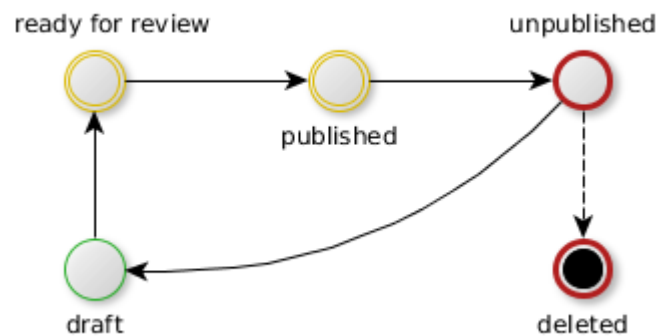


Figure 9 Content life cycle

The workflows described above are suitable for content such as products, projects, events, service requests and offerings, static pages and organisations. However, we consider comments and forum entries as more member driven. Hence, no moderation is performed for these entries in the Marketplace. However, if a user detects a comment or forum post that appears to be inappropriate, he can send a request to the moderator to unpublish them. Accounts posting bad content can be disabled/removed, too. When a comment is posted for a product, the according owner, i.e. the original author of the Product Specification Sheet, is informed via email to foster the communication between the product owners and users.

5 Maintenance and Finance

This section describes the necessary activities for operating and maintaining the technical implementation of the WaterInnEU Marketplace and provides estimates for the costs associated to these activities.

5.1 Estimation of Fixed Costs

Table 3 lists the estimated efforts and operating costs for running the WaterInnEU market place, which sum up in total to ~15-20k Euro per year. The calculation is based on an hourly rate of 95 Euro for professional services. The different cost items are explained in more detail in the following subsections.

Table 3: Estimated operating costs for the WaterInnEU Marketplace

| | | Effort per Month (in hours) | Costs per Month | Costs per Year |
|----------------------------|------------------|--------------------------------|-----------------|----------------|
| Hosting Costs | | | | |
| | Costs for VM | | 20 | 240 |
| | Maintenance VM | 4 | 380 | 4560 |
| Database/API | | | | |
| | Updates | 0.5 | 47.5 | 570 |
| | Backup/Restore | 0.5 | 47.5 | 570 |
| Failure Management | | | | |
| | System Failure | 2 | 190 | 2280 |
| | External Attacks | 2 | 190 | 2280 |
| Additional Services | | | | |
| | Bug Fixing | 4 | 380 | 4560 |
| Total Costs | | | 1255 | 15060 |

5.1.1 Hosting Costs

The Marketplace is based on Drupal and needs to be hosted on a server. Currently, it is deployed on a virtual machine that is maintained by 52°North and rented from an external provider¹⁴. We hence calculate 20 Euro/month for renting the virtual machine and calculate 4 hours of maintenance, largely for installing security updates. This is based on previous experience. For example, in 2016, there were 5 security updates for Drupal core (Highly critical: 1, Critical: 2, Moderately Critical: 2). The timespan between each incident was between one and four months. Normal updates are more often and can be performed within one day resulting in normally zero to one hour downtime. In 2016, there were 62 security updates for different Drupal modules. Following these observations, regular update sessions are required, resulting in the estimated 4 hours per month for maintenance.

Instead of hosting the Marketplace on a virtual machine that we need to maintain by ourselves, we can also deploy the Marketplace in a cloud-based environment. Several

¹⁴ The provider currently used by 52°North is Hetzner GmbH: <https://www.hetzner.de/gb/hosting/>.

providers who specialize in Drupal cloud environments exist. They vary in the functionalities and tools offered and the price is also depending on user load¹⁵. While the maintenance costs could be saved, since the Drupal updates do not need to be installed and checked manually, we decided to host the portal on a virtual machine, as this gives us more flexibility for coupling and extending it with other technologies and tools. However, depending on the future use, a cloud-based hosting may also be an excellent solution. The costs are considered to be on a similar level.

5.1.2 Database/API

In addition to the general maintenance, we consider dedicated work on maintaining the underlying database and the data access API. In particular, the database may need to be updated and an automated backup needs to be established. We consider half an hour per month for checking the configuration of the database backup and installing updates.

5.1.3 Failure Management

The Marketplace may be down due to a system failure or due to attacks by external hackers. In both cases, work is needed to solve the issue. We roughly calculate with three system failures and three attacks per year. The work needed to fix a system failure or an attack is depending on the failure's nature or the severity of the attack. Based on our experience, we estimate that one day of work is needed to fix an issue and run the portal as usual.

5.1.4 Bug Fixing

No software implementation is free of bugs that may be due to misunderstandings, wrong configurations or implementations, etc.. The amount of work needed to fix bugs is hard to estimate and should be as low as possible. However, based on our experience we calculate with an effort of half a day per month for bug fixing.

5.2 Additional Variable Costs

The costs above are estimated fix costs for operating the Marketplace. However, several additional costs need to be considered that are described below.

5.2.1.1 Implementation of new features

Each new feature requires an individual estimation of the efforts required. Hence, this cannot be part of the cost estimation for hosting the platform introduced above. 52°North currently offers software development with an hourly rate of 95 Euro. Thus, additional features may be implemented on a time and material basis.

¹⁵ Examples of cloud-based Drupal hosting providers are OMEGA8.CC (<https://omega8.cc/pricing>) or Acquia (<https://www.acquia.com>).

5.2.2 Additional Support Services

One major outcome of the project has been the intelligence that a virtual Marketplace alone will probably not be sufficient to facilitate the uptake of water-related innovations. Instead, this requires a combination of support services alongside the virtual Marketplace. As sketched above, reviewing and moderating the content provided by users of the portal is such a support service activity. The additional support services and associated costs are described in detail in D4.4 – WaterInnEU Exploitation Plan.

6 Conclusions

The WaterInnEU Marketplace prototype is operational now and has received good initial feedback from first users. It implements novel features for enabling the matchmaking between potential users (river basin managers), results from EC funded projects, and third-party service providers. The implementation is available as open source software and based on the open source Content Management System Drupal. As such, the Marketplace can either be taken up by third parties completely or they may reuse parts of it in other portals. Since it is also providing an open REST API for accessing the underlying data in a machine-readable form, the data can also easily be retrieved by external portals or applications. Besides maintaining the Marketplace technically, several support services such as moderation of user-generated content, innovation consultancy, or support for match making should be provided as well. These are outlined in the general exploitation plan in D4.4 – WaterInnEU Exploitation Plan.