

Science Network of Montenegro: Open government eService based on Open data and Open standards

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Abstract

Open movement is influenced by digital revolution and its technological foundation and socio-economic impact. Open data and Open standards are the integral components of Open government (OG) paradigm, together with Open architecture, playing an important role in the creation of OG e-services. One such OG e-service, that follows Open movement principles, is the Science Network of Montenegro (SNM). SNM is an Open science type of application and also an Open government e-service, designed using Open architecture principles with an aim to publish Open data, following Open standards and using Open source software components. Its mission is to become a centralized virtual online platform for presenting and collecting information about researchers, research papers, research projects, equipment and scientific knowledge. In this paper we have presented the role that Open movements (with special focus on Open data and Open standards) play in Open government initiatives, and shown how Open data and Open standards combine in the case of Science Network of Montenegro.

KEYWORDS: *Open data, Open standards, Open government, Open source, Open Science*

1 INTRODUCTION

Generally speaking, the term “Open” assumes freedom and independence from the potential influence and control of arbitrary power. Movements for “Open” strive for transparency, participation, empowerment of individuals and knowledge for all [1]. With Information revolution, rapid development of Internet and “Digital Economy”, social and technological foundation for enabling the vision of the “Open” movement was created. Open source, Open government and Open data are the most recognized concepts of “Open” movements alongside with Open access, Open science, Open innovation, Open education, Open knowledge, Open linked data and Open architecture. As the Internet became a fully open and global phenomenon paving the way to easily accessible digital technologies, governments now

have the opportunity to transform their services by making them more efficient and more accessible to their users. Also, every government should be open and transparent with regard to its decisions. Furthermore, those decisions should be logical and easy to explain to citizens as well as evidence based i.e. data-driven. Many governments have recognized that information increases in value as it becomes shared. Therefore sharing and reusing data can reduce the effort in data production and it is introducing quality assurance process on published data by making them freely accessible. Publishing government’s data means opening opportunities to use data in new and innovative ways, thus creating economic value [2, 3] out of the published data. Since government is the major source of open data, open data provided by governments becomes Open government data (OGD). Open government data goes hand in hand with Open standards movement. The use of Open standards provides interoperability and enables open access to Open government data. Therefore the three main components of Open government are Open Data, Open Standards and Open Architecture [4]. The idea of Open Government is to establish cooperation between public administration, citizens and private sector by enabling transparency, participation and collaboration.

The aim of this research is to analyse the impact and present the role that Open movement (Open data, Open source, Open science and Open standards) plays in Open government initiatives and its services.

2 OPEN DATA

Open data (OD) is the concept by which data is made freely available to the public, and where ‘anyone is free to use, reuse, and redistribute it, without any legal, technological or social restriction’ [5, 6]. The term “Open data” refers to data beyond governmental institutions alone and includes those from other relevant stakeholder groups such as business, citizens, NGOs, science or

education. The goal of OD movement is to allow citizens and organizations outside government to use and re-use information extracted from data and/or combine it with other information in ways that provide added value to the public.

In 2007, thirty Open government advocates came together to develop a set of OGD principles that that would underscore the importance of OGD for the society (Fig. 1). Therefore, data is made public in a way

File Format	Recommendations
CSV	* * *
XLS	*
PDF	*
DOC	*
XML	* * * * *
RDF	* * * * *
KML	* * * * *
SHP	* * * * *
CDS	* *
KMZ	* * * * *
JSON	* * *
TXT	*
HTML	*
TIFF	*
JPEG	*

Tab 1. Tim Berners-Lee’s star scale for selected file formats [7]

that complies with the following principles [6]:

- Data must be complete,
- Data must be primary,
- Data must be timely,
- Data must be accessible,
- Data must be machine processable,
- Access must be non-discriminatory,
- Data formats must be non-proprietary, and
- Data must be license-free.

The first practical implementation of Open data initiative was launched in the USA in May 2009, and open data website (Data.gov) [8] aimed to improve access to data in machine-readable format. Following the successful launch of Data.gov, the United Kingdom’s open data portal was launched in January 2010. Since then there have been many, internationally implemented, Open data initiatives. As a result of widespread recognition of the importance of Open data within context of Open government, a multilateral initiative Open Government Partnership was created in 2011 [9]. At the Gov 2.0 Expo in Washington DC in 2010, Sir Tim Berners-Lee presented his 5-Star Model [10] as a roadmap of how to move from Open

(government) data to linked Open (government) data (LOD) (Tab. 1). LOD [11] facilitates knowledge creation from interlinked data. The idea of Open Data is developed as part of a social web, whereas the idea of Linked data is associated with the semantic web. Therefore, it can be noted that LOD brings these two major movements together. However our ability to fully utilize the value of government data depends on open standards [12] including data modeling standards, metadata

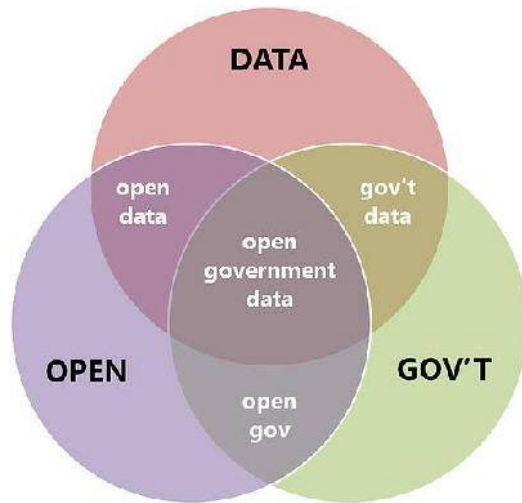


Fig 1. Open Government Data Venn diagram [17]

standards, standard for software and user interfaces etc.

3 OPEN STANDARDS

Even though the concept of “Open standard” does not have a universally accepted definition [13] we can accept the following one: “Open standards are transparent descriptions of data and processes that are enabling seamless exchange of information between different information systems”.

In essence, Open standards provide the basis for interoperability, where interoperability means the ability of information and communication technology (ICT) systems and business processes they support to exchange data and enable information and knowledge sharing [14, 15]. Open standards can be implemented either by Open source or proprietary systems where there are no barriers in combining those systems, assuming that they use same Open standards [16]. Most of proprietary and Open source products have implemented Open standards to access Open data.

To reach interoperability in the context of pan-European e-Government services [18], the following are the minimal characteristics that an Open standard must have:

- The standard has to be adopted and maintained by a not-for-profit organisation, and its on-going development has to occur on the basis of an open decision-making procedure available to all interested parties (consensus or majority decision etc.).
- The standard has to be published and the related standard specification document has to be available either for free or at a nominal charge. It must be permissible to all to copy, distribute and use it free of charge for no fee or at a nominal fee.
- Every intellectual property - i.e. patents possibly present within (parts of) the standard has to be made irrevocably available on a royalty-free basis.
- There must be no constraints to the re-use of the standard.

Open standards have provided support for the creation of many technological innovations. Even the Internet and the “www” are based on Open standards [13] such as TCP/IP, HTTP, HTML, CSS, XML, RDF, POP3 and MTP.

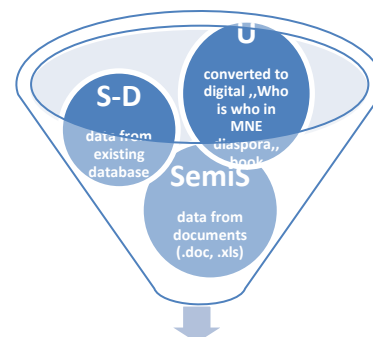
Open standards and Open source [18] are the key elements of an open concept which combines them and leverages openness while supporting interoperability, flexibility and choice.

The digital revolution has triggered a widespread use of technology providing citizens with continuous access to government services across all devices [19]. There is a growing trend in the use of Open source software for the creation of Open government service. Open source uses the same principles as Open government [20, 21] i.e. the code is transparent so that it can be used or tailored for a specific purpose. Open source software (OSS) is where the source code has been made available to licensed users, allowing them to tailor the software to their needs and make iterative improvements. The key benefits of Open source software are the promotion of innovation and cost saving but without compromising the usability or effectiveness.

4 Applying Open Data and Open Standards – The Case of Science Network of Montenegro

The main goal of the Open science movement [22] is to make scientific research data available and accessible to both scientific and non-scientific communities. Open science can therefore be observed as part of a wider Open government paradigm, considering the fact that most governments publicly support research programmes realizing that public sponsorships invested in research and development lead to economic and social development. The Open science concept [23] should adhere to a set of important principles such as: a) open access to research outputs; b) open access to the usage/impact statistics of research outputs; and c) open access to basic research assessment data accumulated for outputs, researchers and organizations.

In Montenegro it has been recognised that a practical approach to Open science and Open government should include the promotion of collaboration, participation, joint projects and joint use of the research infrastructure by developing a dedicated electronic service – SNM [3]. The second and enhanced release of the SNM project is a part of Higher Education and Research for Innovation and Competitiveness Project (HERIC) (www.herice.me) funded by Ministry of Science of Montenegro [24]. SNM is an interactive web portal that will enable scientists to exchange information, collaborate and find relevant information about research infrastructure in Montenegro. This information system was created under the strong influence of the “Openness” concept [25], therefore the concepts of the Open architecture, Open data



Data for Scientific Network of Montenegro

Fig 2. SNM data collection process

and Open standard were used where Open source software served as building block for the information system. SNM is a Current Research Information Systems (CRIS) (www.eurocris.org) and it represents an Open science type of application.

In addition to researchers and scientific research institutions, important users of the SNM portal at a national level will include: large, medium and small companies, entrepreneurs, agents from both public and private industry, local, regional and national governmental bodies and civil society. The Open data movement concerns datasets that are in a structured and tabular format. Therefore, we have stored our data in a structured way [26] having in mind the fact that we have dealt with three types of data: structured (from legacy database), unstructured (documents with data obtained from the book titled “Who is who from the Montenegrin diaspora”) and semi-structured data from documents and spreadsheet files (Fig. 2). We have collected and converted all three kinds of data and then created SNM database which represents the core of the information system. It is important to mention that the database of the system was designed using entity-attribute-value (EAV) model [27].

SNM also uses CERIF (Common European Research Information Format) standard [28] as a model format for managing Research Information and it is used to connect OGD and data produced by scientific and research projects. The use of the CERIF format is an EU recommendation to its member states. The core CERIF entities are Person, Organisation Unit, Result Publication and Project. Besides these four entities, in SNM we have included an additional entity representing the research infrastructure i.e. equipment. Part of the HERIC project includes a Study on the existing research equipment capacity and the creation of a joint research facility in Montenegro. Optimal use of research equipment is one of the greatest



Fig 3. Pilot Google map presentation

challenges faced by a majority of scientific groups.

Study on the existing research equipment capacity provides information about equipment in laboratories of scientific research institutions in Montenegro i.e. the documents and information about the relevant institution (address, e-mail, web) as well as detailed information about the equipment (purchase price, maintenance costs for the equipment, the condition of the equipment, how often it is used - weekly, monthly, daily, information about which areas of scientific equipment can use the primary function of that equipment. The collected data, as dataset, is presented in XML and CSV format in the first Montenegrin Open data web portal (<http://www.open-data.me/>) [7]. This data will be a part of our SNM database and it will be integrated with the rest of scientific data and visually presented using Google maps (Fig. 3). After its full implementation, SNM will become a trusted source of data related to equipment in laboratories of scientific research institutions and it will feed Montenegrin Open data web portal with up to date datasets. Once it is fully operational, SNM will help utilize and manage equipment effectively; research institutions will increase the quality and productivity, and reduce operational costs. Considering data formats presented so far and the fact that most of the information related to research papers and thesis will be presented in PDF format, we can have SNM star rated table (Tab. 2).

File format	Recommendation
PDF	*
Google map	*
CSV	**
XML	****

Tab 2. Open data formats in SNM

Furthermore, SNM uses a standardised Research and Development (R&D) classification, such as Frascati [29]. The Frascati Manual provides internationally accepted definitions of R&D and the classifications of its component activities. It is based on the experience gained from collecting R&D statistics in OECD member countries.

In addition SNM was designed according to standards set up by Open architecture with the aim of creating an Open government compliant application. It is important to mention that the software architecture of the system is based on DRUPAL-LAMP (www.drupal.org) [30] combination of Open source software components, or better known as DAMP. DRUPAL is an Open source Content Management System (CMS), whereas LAMP is the acronym of the names of its

original four Open source software components: the Linux operating system, the Apache HTTP Server, the MySQL relational database management system (RDBMS), and the PHP as the object-oriented scripting language. In this case we used the enhanced version of DAMP stack (Fig. 4) with a collection of the best known Open source tools to drive SNM web portal with focus on security, performance and functionality. Therefore to improve security features we added antivirus ClamAV, software firewall CSF and Apache ModSecurity modules.

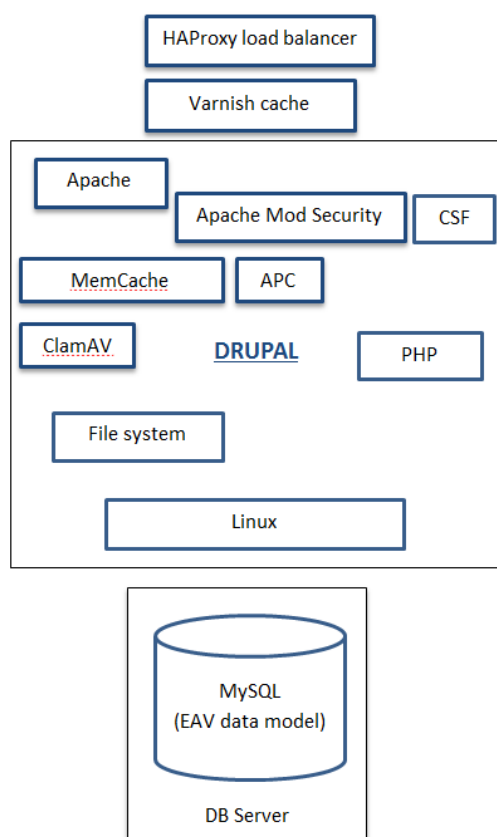


Fig 4. Enhanced DLAMP software architecture

To speed up the overall IS we used two complementary caching components APC and Memcache, whereas to improve the performance of SNM web portal we used Varnish which is an HTTP accelerator designed for content-heavy dynamic web sites. Furthermore to improve the reliability we used HAProxy, which stands for High Availability Proxy.

5 CONCLUSION AND FUTURE WORK

Open data and Open standards are the essential part of the Open government initiative. Combined with

other Open movement initiatives, especially Open source initiative, they can lead to the development of powerful applications. Open source has proven to be a suitable choice for many Open government initiatives [31], due to the inherited use of Open standards, the rapid application development and ability to publish Open data. One such Open source platform, which is used for the development of SNM, is DAMP that consists of Drupal and LAMP. SNM is an Open science type of application and it is an Open government e-service designed using Open architecture principles with the aim of publishing Open data, following Open standards and using Open source software components. SNM is intended to become a centralized virtual online place to offer and collect information about researchers, research papers, research projects, equipment and scientific knowledge. In this paper we have presented how SNM, developed using the concepts of Open movements, is to be used at a national level. However, we anticipate that in future, the scope of SNP application can be expanded and internationalised through efforts invested in regional collaboration.

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