

An open data and open services repository for supporting citizen-driven application development for governance

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Abstract

Open data portals have been a primary source for publishing datasets from various sectors of administration, all over the world. However, making open data available does not necessarily lead to better utilisation from citizens and businesses. Our paper presents a new framework and a prototype system for supporting open application development by citizen communities, through gathering and making available open data and open web services sources from governmental actors, combined with an application development environment, training material and application examples.

1. Introduction

The increasing release of public data is strongly correlated with the advent of openness in every aspect of software development. According to the Open Data Handbook, the definition of the Open Data [1] as “data that can be freely used, re-used and redistributed by anyone” is based on the principles of openness as a means to maximize interoperability [2]. The ability of diverse systems and datasets to inter-operate has been feasible through the emergence of web services and communication protocols among them, i.e. APIs [3]. Web services is the major technology being utilised for deploying automated interactions between distributed and heterogeneous applications and for enabling interoperability among business processes, which might span administration’s boundaries [10].

Open web services can contribute to the co-design and co-creation of applications in various domains, leveraging the vast amount of publicly available data. Therefore they can increase the innovation capacity and stimulate engagement of citizens, building upon the open data advantages (e.g. [11-14]). Despite the fact that numerous open data portals have been developed [14, 15], only few existing open data platforms actively facilitate the interaction between open data providers

and open data consumers in the form of service and applications creators. Most organizations providing governmental data merely publish this data on a platform, without being concerned on how this data can be used in business logic. Nonetheless, through proper APIs, services can be consumed by other people and be reused for building innovative applications. Furthermore, dependent services can be combined to each other. Therefore, it is of major significance to gather all available resources in a single repository, where citizens will be able to share information and collaborate.

Data and services coordination and integration demands time, effort and cost [16]. A system, whether it is between a government and its citizens (G2C) or any other cooperative system, has to bear the administrative burden for collecting and providing such mechanisms [17]. Furthermore, there is a limit in how much information a person or an organisation can process (cognition wise) [18], even with the use of state-of-the-art infrastructures. There have been numerous studies concerning how a data repository should be properly designed [19-21], and their findings should be taken into consideration when targeting to a well-designed system.

There have been some attempts towards the reusability of the above resources to foster innovation [4-8]. However, they are mainly concentrated on research projects developing servers for facilitating the creation of mobile applications for governance [28], or supporting the co-creation in public services design and delivery [29] and the enhancing access to Open Government Data [24] and amalgamation of different open data sources [25, 26]. A lack of an appropriate ICT infrastructure for supporting open innovation in production of government applications has been identified, providing access to all reusable aspects, i.e. open data, services and applications [27, 28], which will act as a data and services registry. A registry provides a system the ability to record what is known about specific (e.g. open, application, interoperability [9]) data and what is required to understand that data. Using the registry, data developers and collectors can document

data for which they are responsible for, so that there is no need to repeatedly explain the data to each organization or individual interested in the data (unless the system changes).

In the current paper, we present a recent initiative carried out by the University of the Aegean¹ and Microsoft Innovation Center², in Greece, which develops a registry of data and services with the aim to support and foster development of applications for governance. The so-called Gov4All is a repository where all open data stakeholders could meet and access open data sources, services and applications developed upon open data, as well as, provide their own enhanced open datasets, services and applications. It must be noted here that the Gov4All acts as a directory of open data repositories providing only references to external sites and datasets, and as such, data storage and curation is out of the scope of its infrastructure. The aim is to present and analyse the added value of this approach, while in parallel identify any shortcomings and limitations and finally to provide general guidelines with respect to necessary features of such marketplaces and repositories.

This paper is structured in five sections. In the following section, the results of a review on existing open data and services registries are presented as the background of our research. Section 3 provides the proposed architecture for enabling the repository of open data and services, while the functionality of the Gov4All platform and its application are outlined in section 4. Finally, section 5 summarises the conclusions and proposes next steps for reusing and expanding the application, by prescribing further work in the field.

2. Current status in open data and open services repositories

There have been a lot of portals that provide open data and open services repositories. They can be distinguished in three types: (i) portals offering repositories on national level (Canada, UK, Greece, etc., [29-32]) (ii) ones that categorize their repositories according to their content topic (geospatial data, health data, etc., [33, 34]) (iii) portals that act as search engines, where a user can enter any search term (Canada, health) and get open data or services results (e.g. [35, 36]). These portals are being enriched by experts or governmental bodies.

Most of the portals in all categories mentioned above provide a public API for information extraction and as

well as lists of already deployed applications, taking advantage of a certain dataset, or open service. They present a menu option for listing applications containing government, community and business tools. The majority of the examined sites support user profiling. Content can be personalised, based on user custom preferences, and scalable, by providing a registration – login process.

Most sites offering data services [37, 38], are focusing on a specific topic only (e.g. City information, [39] and hence provide an API for gaining information on this topic. There are also other sites that provide services as well as open data on a specific term (e.g. City information [40]). Only a few portals (e.g. [41]) have been identified that act as open service repositories, including a search engine, where a user can search any open service, regardless the topic or nationality.

The above analysis has revealed the absence of a combined approach in the design and features of open data portals. In particular there doesn't exist a portal that contains a repository for both open datasets and open services, including also a list of public APIs for the above data or services and already deployed applications that utilize such APIs. Apart from that, they do not provide use cases, training material and support, which, according to literature [42, 51, 53, 54] consist basic elements for an envisioned open data repository. Moreover, existing approaches lack functionality that has been characterised as essential for the creation of such infrastructures [42] in terms of: (a) open services repositories providing connections to consumed data, (b) citizens' application repository, (c) classification schemes for apps and services in order for the user to locate more easily and (d) capabilities for users to provide input, needs, upload datasets, applications and services themselves.

As far as Greece is concerned, there are a lot of web applications providing information derived from a certain dataset (e.g. open data), however there is a lack of publicly available web services for developers or citizens to consume. The most active and innovative Ministries offering such web services are the Finance Ministry, the Ministry of Interior, the Ministry of Infrastructure, Transport and Networks and the Ministry of Citizen Protection [52]. Some indicative examples of web services offered are the service providing information about a company based on their Tax Identification Number [48], the Electronic submission of declarations for the Customs Office (ICISnet) [49] and the Recovery of vehicle owners data (not publicly available).

¹ <http://www.icsd.aegean.gr/is-lab/>

² <https://www.microsoftventures.com/locations/mic>

In contemporary governance at any level (local, regional, national, European, as well as international), all open data should be publicly distributed through a web service. Developers would be able to consume these services and a lot of new and diverse web applications would then be offered to citizens.

Following a holistic approach, all previously described features should be incorporated in a single portal, that will allow users to choose between the data, the service or even a predeployed application to reuse, depending on their needs [43]. The Gov4All portal proposed in the subsequent sections, should it be developed, will fill the gap in this area.

3. The proposed Architecture

In order to fill the gap described in the previous section, the current study presents a complete governance framework in order to illustrate the clear benefits of ICT-driven public sector innovation and the take-up of the open and participative governance model [44] where both governments and third parties can collaborate and share responsibilities in designing, producing and delivering personalized services of public value, according to the accepted principles of subsidiarity [45]. The proposed governance framework follows open innovation principles and is capable of guiding public administrators in adopting the ICT-driven public sector innovation approach to collaborative development of public services, as it provides the following:

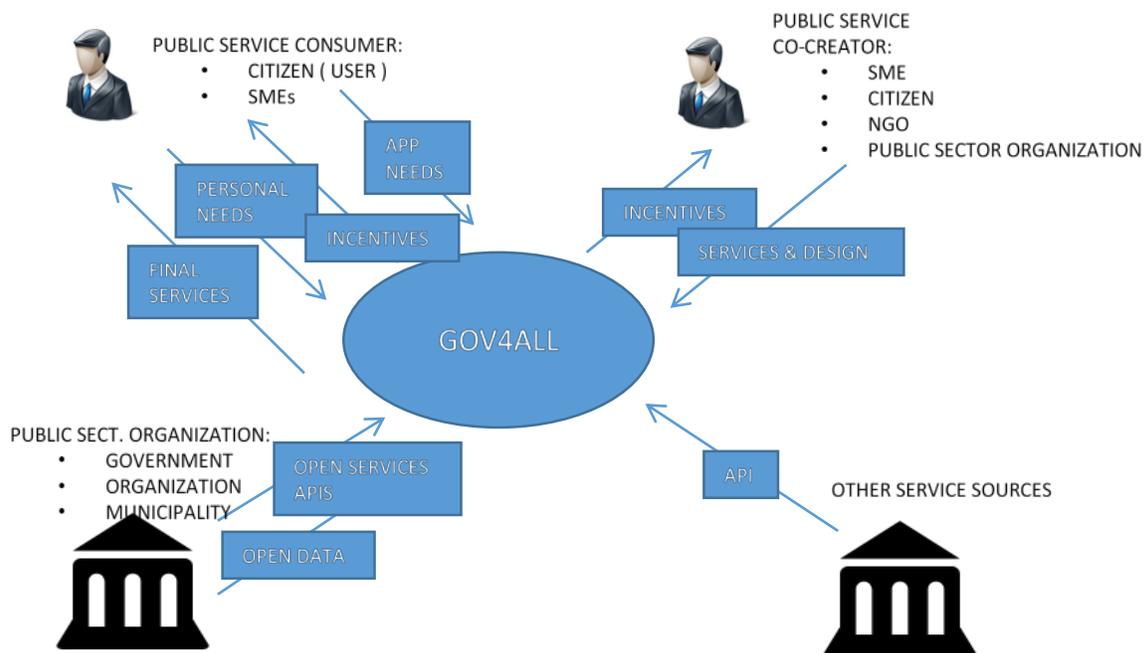


Figure 1: The Gov4All Governance Framework

- An analytical guide for understanding how governments can involve citizens, businesses, CSOs in public service delivery, including planning and change management, success factors and risks in adopting public service co-production.
- Identification of categories of promising public services and the potential benefits of their co-production.
- A cost-and-benefit analysis for the adoption of public service co-production by the public sector.
- Best practice co-production engagement strategies and initiatives for both public administrators and third parties.
- Specifications for an integrated ICT infrastructure capable of supporting open innovation and co-production of personalised public services in an effective and efficient way.
- A sustainable business model that offers financial incentives to citizens, businesses-SMEs, CSOs, and, public administrations for innovation generation through collaborative personalisation of public services.

The first priority for the Gov4All³ initiative is to establish the necessary substantiation for the case of collaborative production and delivery of public services, targeting, mainly, at mobilizing the public sector, but also the third parties to be partnered, i.e., citizens, businesses, and CSOs. In other words, Gov4All aims to promote open and collaborative governance in Greece, through the development and dissemination of a modern and open platform for the voluntary development and utilization of governance applications from individuals and businesses, with the ultimate aim of improving the quality of citizens' life and growth of Greek economy, saving resources and protecting the urban and natural environment.

Figure 1 presents the Gov4All governance framework in terms of involved stakeholders, provided assets and user actions and the overall concept towards the creation of new web services based on open data stimulating public value.

To achieve this, Gov4All has come up with an appropriate ICT infrastructure for supporting open innovation in collaborative production of public services. This constitutes a realization of the specifications found in the governance framework that can be achieved through integrating and customizing the results of relevant research and innovation projects. The proposed Gov4All ICT infrastructure consists of two main components: the Data, Services and Applications Directories; and the Community Engagement Environment. In particular:

The Data, Services and Application Directories provide access to open data, open services and applications offered by all levels of governance (central, regional and local) which have, fully or partially, adopted the open governance model. Access to available open data and open services is offered through web services APIs. Furthermore, the Data, Services and Applications Directories constitute a single access point to open data and open services for Greece adhering to the vision of the connected, networked and fully joined-up European public sector. Gov4All itself doesn't collect, store or process any of these datasets but rather lists data and services that are already available in other places. As it refers only to open data, which by definition is freely available to everyone to use and republish as they wish without restrictions, Gov4All fully abides with data privacy and confidentiality principle. Users register their apps on their own and thus give their consent to publish this information adhering to a prescribed by the Greek data privacy regulation. Finally, the Data, Services and Applications Directories

provide access to commercial services, such as GoogleMaps, which could be combined with open public services and data in order to create innovative services of public value.

The Community Engagement Environment provides a Web 2.0 participative environment that allows the users of the proposed open innovation platform, including citizens, businesses-SMEs, NGOs, and public administrators themselves, to engage in the specification of new personalized services of public value. The forms of engagement will vary as the community of users will be able to record the needs of a new service of public value or even needs for opening specific datasets by public sector providers. The users of the platform will be inspired by the discussions about public service delivery going on in the social media in a comprehensive way. Analytics about the engagement of users in the creation of new personalized services of public value will be produced and will be reported to the public sector policy makers.

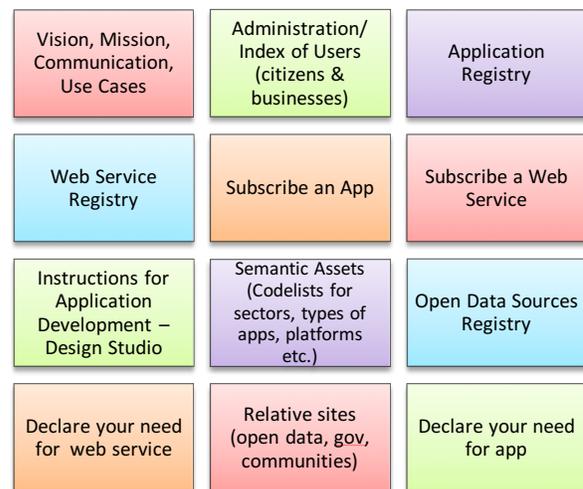


Figure 2: The Gov4All modules

Figure 2 illustrates the Gov4All basic modules and functionality. There are 5 basic categories of functionality consisting of additional sub-modules: (I) Declaration of needs in terms of (a) data, (b) web services and (c) applications; (II) Subscription of user developed assets or user identified assets, in terms of: (a) data, (b) web services and (c) applications; (III) Registration of (a) data, (b) web services, (c) applications, (d) semantic assets and (e) users; (IV) Addition of extra material (Use Cases, Educational Material and list of relative sites) and (V) Design of the application development. These five categories and their modules have been transformed into four major pillars

³ <http://gov4all.azurewebsites.net/en>

(Applications, Services, Open Data and Community) in order to provide a friendly user interface according to [38, 42, 43] and it is depicted in Figure 3. Furthermore, Gov4All has been designed in order to meet the following technical characteristics:

- Web and mobile operation: compatibility with all platforms
- Mobile friendliness for all operating systems and devices
- Greek as basic language. English version is under development
- Social media-like user interface
- Maintenance without further development
- Three user roles: visitors, registered users, moderators
- Rating and comments capabilities for applications, data and web services from registered users and visitors
- Integration with Facebook, Twitter and LinkedIn social media platforms (users can use their own accounts for publishing their comments).

4. Application

The Gov4All prototype has been designed with the aim to provide capabilities of interest for all involved stakeholders. The Governance Framework, including all

relevant actors and their connections towards the creation of new web services based on publicly available data, is presented in Figure 1. Starting from this framework and its unique characteristics and moving forward to an application model of the previously described architecture, the Gov4All initiative provides the following re-usable assets and functionalities:

- Registration of open government applications developed by citizens and businesses, through equal and open participation of groups, individuals, businesses or organizations.
- Gathering of available open data and web services provided by the public sector, aiming to the voluntary development of open, free applications.
- Promotion of new technologies in open government, especially regarding mobile devices (mobile platforms), open web services and open governmental data.
- Provision of training on the use of open data and services for applications development.
- Supporting cooperation between citizens, government and businesses in order to promote the above objectives.

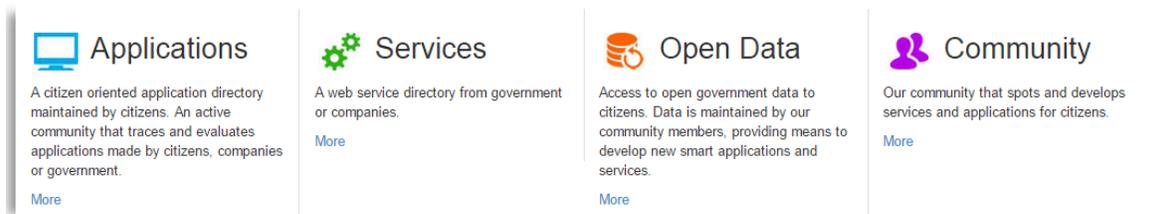


Figure 3: Gov4All Home Screen Pillars

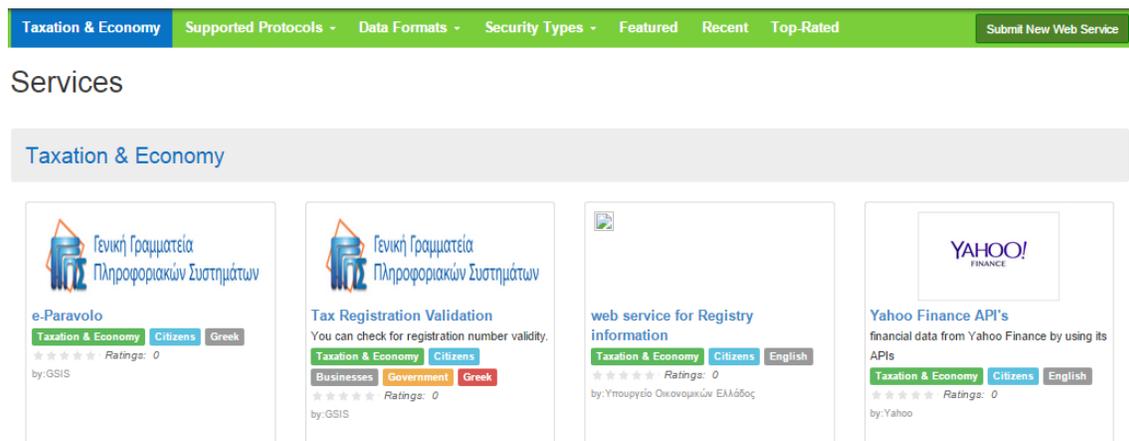


Figure 4: Registered Taxation and Economy Services and Service submission Functionality

As an ongoing initiative, Gov4All will continue to be developed and engage stakeholders among open data and open service communities providing incentives and a space for service and application co-production, as well as new business models and guidance.

From a technological point of view, the Gov4All platform is based on Microsoft Azure Cloud Platform⁴. Microsoft Azure offers virtual machines for advanced computing, web and mobile services hosting and support, unlimited data storage and stream analytics for real-time processing. These features are essential for the development, scaling and expansion of the Gov4All solution. The Gov4All initiative maintains its own directories of open data, open services and applications regarding Greece at the moment. It has developed custom metadata schemata for the subscription and hosting of open data, open services and applications.

Finally, Gov4All provides a unique user interface, as well as, guidance for using it through the provision of training material, scenarios and use cases. Through these and the usability requirements, listed in the previous section, Gov4all attempts to address the challenges of the integration of ICT infrastructures with human infrastructures. Such challenges are identified in [50] concerning research practices and their alignment with technical capabilities. However, the same applies on Gov4all, which can form an e-Infrastructure with the potential to be expanded and empower research community to access resources and services. As an open data repository, it can foster the emergence of e-Science and promote open collaboration between researchers and scientists across different disciplines.

Gov4All has been launched after meeting the following milestones:

- Name, URL, Facebook, Twitter, LinkedIn and Google+ reservation
- Basic functionality for all modules
- Basic codelists for metadata fields descriptions
- 50 registered apps following the developed metadata prototype
- 15 registered web services following the developed metadata prototype
- 22 registered open data sources following the developed metadata prototype
- 50 registered users

- Cooperation with other initiatives, developers, research centres, companies, public sector bodies, other communities etc.

As presented in the figure 3, the overall concept has been implemented on four major pillars: (a) Applications, (b) Services, (c) Open Data and (d) Community, thus, realising the proposed governance framework. Figure 4 presents the services pillar filtered for the registered taxation and economy services along with the services submission button (Gov4All maintains its own metadata schemata for the detailed description of services, open data and applications during their registration). Different information for the registered services is provided, such as: supported protocols, security types and data formats. Figure 5 shows the open data pillar with information about the datasets: to which categories it belongs; its data format; its data source; which is its rate by the users; how a user can submit a new dataset and a new resource; and how a user requests information from public authorities. Finally, figure 6 presents an active user's profile with all the available information: how many and which services, applications and open datasets they have registered and finally, which public activities they have performed.

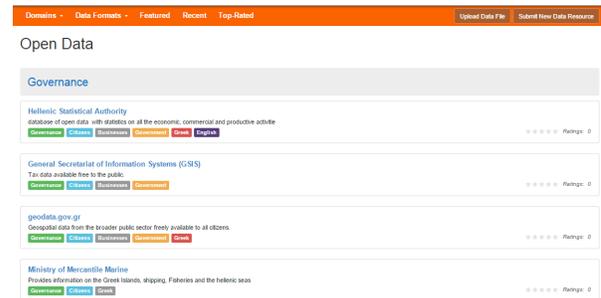


Figure 5: Classified Open Data Sources

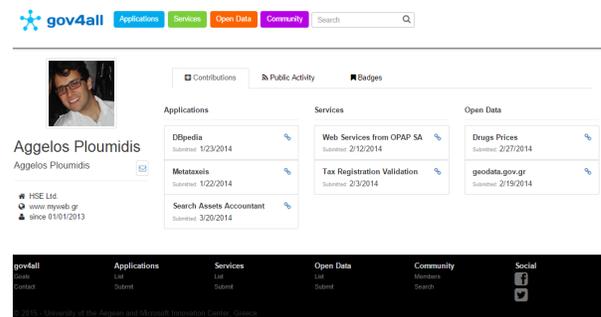


Figure 6: User Profiling

⁴ <http://azure.microsoft.com/en-us/>

5. Conclusions and further steps

In the previous sections, Gov4All has been presented as a unique and innovative initiative, merging the two worlds of open government data and open government services within a single governance framework. As part of it, the Gov4All governance framework has been designed, which aims at stimulating the creation, delivery and use of new services on a variety of devices, utilising new web technologies, coupled with open public data. It also supports the creation of more personalised public services that better suit the needs of users through the collaboration space offering advanced web 2.0 – communication and rating – functionality. The Gov4All initiative makes a step forward to enable users develop and publish their own assets of public value. This step is focused on providing ease of development by addressing phased difficulties by mainly creating a single user interface and classification schemes for open data, open services and applications, hosted in a cloud database.

Moreover, Gov4All has developed a set of reusable and innovative assets that can be summarised in the following four points: (a) architecture for governance framework implementation, (b) functionality capturing and supporting citizens' needs towards minimising administrative burden and maximising transparency, (c) managerial processes for the maintenance and management of such initiatives and (d) implementation of the quadruple helix involving academia, business, public sector and citizens in the service co-creation, overcoming the resistance to open innovation.

Gov4All platform is characterised by some limitations and shortcomings in order for the initiative to proceed on full scale: (a) there are only a few web services deployed in Greece, (b) there are only a few datasets with actual value for building added-value services in Greece (c) there is lack of interoperability mentality in the public sector and (d) there exist multiple platforms for developers. Furthermore, it is widely accepted [46], that to improve the innovation capacity of the public sector it is not enough to simply create a state-of-the-art technological solution – for the simple reason that without tangible evidence of success, governments will be reluctant to adopt collaborative open innovation – no matter how good the platform or its marketing. In the end, public administration should embrace this initiative by opening more data and providing better metadata upon

them in order to strengthen this action and provide more incentives for users.

In order to address them, Gov4All foresees a three-prong approach to achieve its objectives and plan its further developments, illustrated also in figure 7:

1. Provide the means to demonstrate the clear benefits, including cost and benefit analysis, of ICT-driven public sector innovation. This will be achieved by creating an effective methodology or **Governance Framework** for engaging stakeholders in the innovation process in a scalable and cost-effective manner. Additionally, this will be enriched by the creation of more educational material.
2. Deploy this Governance Framework in conjunction with a state-of-the-art ICT infrastructure for open innovation in 3 pilot locations to substantiate and prove the **Business Case** for the collaborative production and delivery of public services. This will be achieved by organising targeted competitions / hackathons on specific open services provided by public administration, in order for users to develop applications.
3. Use tangible results from the deployment of the Framework and ICT Framework to drive the **dissemination activities** of the final Gov4All solution. This step will convince public administration to develop and publish new web services.

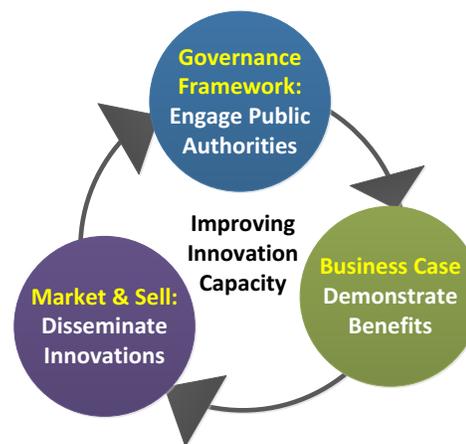


Figure 7: Gov4All's Virtuous Circle of Innovation Capacity Finally, the next steps of the initiative will be the development of the designing studio, the implementation of the public value services marketplace and the engagement activities towards (a) the public sector stimulating the web services

development through the communication of citizens' needs and (b) other communities, such as open software, in order for third-party applications to be realised.

The Collaborative Service Design Studio will allow the design and implementation of new personalised public services. It will offer to its stakeholders the opportunity to: (a) design and create their own applications and (b) to create mashup applications, combining already existing applications and web services. The user, which could be either a citizen or a business or a public body, will be able to connect different provided services in order to create one of its own interest and, of course, publish it back for others to use. This will be achieved by analysing APIs of public sector online services, providing an extremely easy process for any user to create a devoted online service in one step. Thus, making citizens' every day transactions with the government less time consuming and more effective.

The Public Value Services Marketplace offers created personalized services under commercial terms. It implements the vision where governments, citizens and businesses in Europe mutually benefit from services of public value. The proposed marketplace will offer services of public value created collaboratively by the public and private sector, within a flexible and sustainable business model. It will demonstrate the exact economic impact and financial sustainability of the proposed Gov4All governance framework.

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