The impact and importance of emerging digital technologies within the open source communities

Το αντίκτυπο και η σημασία των αναδυόμενων τεχνολογιών στις κοινότητες ανοιχτού λογισμικού στην Ελλάδα

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Abstract

The open source movement has brought unprecedented disruption to the world in terms of sharing information for the greater good of the community and not just the individual. As technology is evolving, the applications and their impact that are emanating from the open source movement core values, are disrupting our world (society, business, government). Open source code and open data have been until today the forrunners of openness. Nowadays, a new form of technology is emerging, that one of the distributed ledgers (commonly known as blockchain) which changes the way information is transmitted over a network and thus, this new shift enables the principles of open source movement to flourish into our society.

This dissertation explores how Greece is performing in this respect, by collecting the views of experts of the Greek “open” ecosystem - key players, best practices, bottlenecks, legislation and previsions for the future - and by discussing the most prominent Greek applications of the open movement, the decentralized government of Heraklion and the transparency portal “diavgeia” of the Greek government.

Έχω διαβάσει και κατανοήσει τους κανόνες για τη λογοκλοπή και τον τρόπο σωστής αναφοράς των πηγών που περιέχονται στον Οδηγό συγγραφής διπλωματικών εργασιών του ΤΜΟΔ. Δηλώνω ότι, από όσα γνωρίζω, το περιεχόμενο της παρούσας διπλωματικής εργασίας είναι προϊόν δικής μου δουλειάς και υπάρχουν αναφορές σε όλες τις πηγές που χρησιμοποίησα.
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1. Introduction

The present thesis explores and emphasizes on the importance of open data and open knowledge in our society. The supporting literature together with the experts’ opinions highly regard this type of data, the main reason being its transparency, which is crucial when considering its contribution to the growth of both the economic and social aspects of our society.

The present thesis intends to examine and apprehend the opinions shared by the experts. This paper does not intend to offer the definitive conclusion about the research topic but rather to examine a certain approach of regarding and interpreting the connotations on the concepts and ideas which are considered and explored. This thesis was based on the following research questions:

- How important is the role of open source / open licensing for software and hardware in a collaborative environment?
- What is the contribution of open source communities and how they boost innovation in societal and business environment?
- What are the opportunities and challenges for Greece to implement big data openness, governance and growth?
- Is big data openness and emerging technologies like blockchain in favor of open source community projects?
- How do the open source communities perceive the blockchain?

The comprehension and recognition of open data and open knowledge, is essential when striving to achieve the involvement and engagement of each member of society. This will further lead to a society, which works as a whole and in harmony, towards achieving common goals and benefiting all its members.

With regards to transparency, the experts highlight its importance especially relating to the government-citizen interaction and relationship overall. On the one hand, citizens need to familiarize themselves with expenditures and revenues of the country which in return, will help with keeping an overview and a greater sense of accountability on the administrative actions. On the other hand, governments will have a sense of responsibility with regards to managing the operating systems of the public institutions. At the same time, transparency encourages democracy by allowing the citizens to have a clear picture on the transactions of the public bodies, the expenses and the decisions taken by authorities. However, this would only be possible if citizens have constant and complete access to government data. Therefore, the data should not only be available but also free and shared with all the citizens, in order for them to both access it and have the possibility to reuse it, either as a basis for building different applications or as fuel for innovation. Moreover, in order to support the reuse and redistribution of the data from the government, this should be integrated as part of analytical tools, such as portals and platforms, to facilitate the access.
This present thesis also supports and brings arguments on the idea that data plays a major role in the modern world, bringing both social and commercial value. Thus, the digital era should be characterized by free access to such data.

Data is a key resource in the contemporary world. Furthermore, this digital era requires perpetual updates, in order for the data to remain relevant when applied and processed in different sector. At the same time, irrespective of the type of data, it can sometimes be pervasive. Additionally, although there are multiple sources of data in the digital era, not every source is reliable. Data can also be manipulative, misleading or even both. Therefore, it is important and highly recommended to search for and identify trustworthy and respectable sources before using or applying any kind of data.

The current thesis is focused on the Greek case. Thus, when it comes to the information literacy of the Greek people, according to the experts, this should be improved and regarded with a greater importance. In order to do so, education is the key, as it plays a major role in shaping our future, as well as our understanding of data and the tools which come along with it.

Furthermore, sharing data encourages participation and support for government projects. Thus, instead of mostly being concerned about each other's social life, the citizens will also have the opportunity to focus on their national state. For instance, they could focus more on politics or the revenues of their country, as they will be able to access such data and follow up on the government's decisions. In Greece, such an example, and a first step towards facilitating access to this type of data, is the DIAVGEIA portal which ensures transparency from and within the government. More specifically, the portal serves as a platform where all the decisions and acts that are approved or signed by the government, need to be uploaded, in order for them to be considered as active and to be allowed to be implemented.

Moreover, open data leads to both a participatory governance and a healthy interaction between users and manufacturers. Sharing data offers a central area of participation and decision-making where systems have an increased likelihood to function properly and effectively. One other example of sharing data for the greater good of the society is the smart city initiative and especially its implementation which can be remarked in Heraklion, Crete. There, open data and open governance is the answer and the proof of good governance and smoothly-working systems.

Finally, the present thesis presents and analyses the Greek open ecosystem, through an open-ended questionnaire, focusing on the key players, best practices, bottlenecks, legislation and previsions for the future. Additionally, based on thorough interviews, opinions of handpicked experts are also presented and interpreted. As a final point, the research questions based on which this thesis was developed, are addressed, answered and concluded.

This paper will be divided into six parts:

Chapter 1 includes the motivation, introduction and the research questions of this paper.

Chapter 2 addresses the notions of free and open source software, open data, emerging technologies such as blockchain technology and how their core principles are related. It reflects on why these notions are important and what is their impact, in terms of citizens and government
participation and innovation. Furthermore, examples, activities and organizations of all of the above are stated.

Chapter 3 describes the methodology and the steps followed to conduct the research and interviews.

Chapter 4 contains a practical approach based on a series of interviews conducted with different experts within the various Greek open source communities including educational, scientific, programming communities and hub spaces. The opinions gathered from the interviewed experts are further summarized along with their analysis and perceptions. It concludes with estimations and future previsions for the open source movement in Greece.

Chapter 5 answers the research questions.

Chapter 6 presents some recommendations and the final conclusions.

As far as the flaws of this thesis are concerned, it is important to highlight that the research represents a small sample of opinions and ideas. The experts who participated in the research process, expressed their own connotations on the questions asked and further analysis and interpretation was conducted, in order to represent as clearly as possible the experts opinions and viewpoints. The pool of experts who participated is a very small sample and their opinions should not be generalized or recognized as representative opinions of the whole Open Source Community of Greece. Additionally, it is worth pointing out that the data environment by nature is fast paced, thus in 4 years from now, the elements of this thesis might seem outdated or not representing the future reality at all.

As far as the future previsions of this thesis, it would be more a more accurate representation of the community ideas and viewpoints if the research was conducted in a much broader scope, taking into account many different open source teams that are active in Greece. A bigger pool of experts would assume more valid or representative viewpoints of each question at hand.
2. Why open design matters

2.1 What is free and open source software

The ‘spirit’ of open source had already existed and had been applied for thousands of years before the term was officially established towards the end of the 20th century. In ‘ancient’ times, our ancestors shared knowledge about hunting, farming, cooking, herbal treatments, and many other subjects and skills necessary to survive. In ‘modern’ times, collaboration and sharing have reached an even higher level and has adopted a new meaning, particularly when it is connected to the subject and area of free and/or open source software (FOSS). In other words, although the terms “free software” and “open source software” refer to essentially the same set of licenses, they arrive at that set via different routes. The concept of “free software” was developed in the 1980s and the focus is on what the recipient of software is permitted to do with the software: “Roughly, it means that the users have the freedom to run, copy, distribute, study, change, and improve the software.” “Open source” focuses on the practical consequences enabled by these licenses: surprisingly effective collaboration on software development. Free software came first. Nowadays, when it comes to software development, the term “open-source” is almost synonymous. Among its many characteristics, open-source software is publicly accessible, which allows developers to exchange code & ideas in a transparent and collaborative fashion. It also enables flexibility for many businesses looking to solve a wide range of problems.

Defining Free and Open Source Software

Free and open source software (FOSS) represents software which can be categorized as both free software and open-source software. In other words, anyone is freely permitted to use, copy, study, and even change the software in any way. At the same time, the source code is openly shared, in order to encourage people to improve the design of the software, as long as they would like to do so voluntarily (Free Software Foundation, 2010). In contrast, proprietary software refers to software which is protected by restraining copyright, while the source code is typically unknown to the users.

To be considered open-source, the source code of the program — the underlying code that makes up the design, functionality, and defining attributes of an application — must be publicly accessible. Those with access to the source code can then study it, “fork” (copy) it, change it, and share the modified version with others. For example, any business might use the collaborative software to improve its own. (Fogel 2005, pp 38)

- First, developers will look into a project that promises some type of application improvement or technical solution.
- Then, they will further study the project’s source code to ensure compatibility, security, and compliance.
- After that, they will copy, or fork, the source code before modifying it to meet their specific needs.

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1 Source: https://opensource.org/
• Finally, developers will implement the modified source code into the business’s proprietary software.

They may choose to share the modified source code with the public or keep the modifications for themselves. It depends on how the source code is being used by the business and the licensing terms of the original project. These software projects vary in size and scope, depending on the purpose of the initiative and the number of contributing developers. Thousands of developers may contribute to a large-scale database project designed for the global enterprise, while just a handful of developers may contribute to a smaller initiative, like DIY smart home automations designed for fellow smart home enthusiasts.

Some of the most notable projects since the dot-com bubble include Mozilla’s Firefox (an open-source internet browser developed at Netscape) in 2002 as well as Git (a source code version-control system created by Linus Torvalds) in 2005.

More recently, a growth of development has been witnessed on open-source databases, open-source infrastructure-as-a-service like Ethereum\(^2\) and Hyperledger\(^3\) and even open-source machine learning libraries like TensorFlow\(^4\).

### 2.2 What is open data

Data is the foundation of any modern society. While there are standards to types and presentation of data, social relations within economic sectors have a significant influence on data. Perceptions and actions of people are largely dependent on type of data. Therefore, it is important to understand how people in a society think and behave as well as how they sit on data.

Data is widely used in private and public sectors. The term is common in the corporate and commercial world; it relates with information and knowledge. Data is a collection of facts and theories towards establishing an understanding, which is suitable information, crucial in decision-making. Continuous access to information and applying it in different aspects of life is the definition of knowledge. According to Beynon-Davies (2002), knowledge involves the ability to apply information in appropriate places, which comes with experience in a specific subject.

Data is being used in all fields. It can be pervasive and manipulative. Different social sectors and contexts are shaped by varying production and consumption patterns, which explain the flexibility of data. To many people, data, information, and knowledge are broad and abstract terms, which have more similarities than differences. While this is true, there are distinct characteristics from collection and processing methods, which are key elements in defining the terms. (Coera 2016, pp 19-24)

The definition of information society and its features demonstrate how data is the basis of growth and development in society. Technical networks, digital technology, economic and social

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\(^2\) [www.ethereum.org](http://www.ethereum.org)

\(^3\) [www.hyperledger.org](http://www.hyperledger.org)

\(^4\) [www.tensorflow.org](http://www.tensorflow.org)
networks and relating information are key features in the modern society. All sectors of the economy are dependent on type of information and rules governing flow of information. Any small step concerning innovation and growth in society is dependent on information, which is the basis of knowledge. It is a necessity; an individual has to be conversant with structures of information to apply it relevantly in different sectors. Relevance of data in society is dependent on familiarity with relating information. While interest and external support, which include finance, are crucial to innovation, the greatest motivation and success feature is information. Whether it is in production or service industry, one has to understand the value of information and interpret it for relevance in the modern society.

Open data is data that can be freely used, shared and built-on by anyone, anywhere, for any purpose. This is the summary of the full Open Definition, which the Open Knowledge Foundation created in 2005 to provide both a succinct explanation and a detailed definition of open data (Open Data, 2017).

Open can apply to information coming from any source and about any topic. Anyone can release their work under an open license for unrestricted use and refinement, so that knowledge is shared and the public—the people—can benefit from. Despite the fact that public institutions and governments are the first ones to come in mind for releasing their data as public information (such as statistics, budgeting etc), or even researchers sharing their research results and publications, any group of people (community groups and individuals, NGOs, startups, companies or corporate structures) can open information.

Figure 1: Types of Open Data
(Source: www.blog.okfn.org)
The full Open Definition provides a precise definition of what open data is. There are two important elements to openness:

Legal openness: one must be allowed to get the data legally, to build on it, and to share it. Legal openness is usually provided by applying an appropriate (open) license which allows for free access to and reuse of the data, or by placing data into the public domain.

Technical openness: there should be no technical barriers to using that data. For example, providing data as printouts on paper (or as tables in PDF documents) makes the information extremely difficult to work with. So the Open Definition has various requirements for “technical openness,” such as requiring that data be machine readable and available in bulk.

There are a few key aspects of open which the Open Definition explains in detail.

- Open Data is useable by anyone, regardless of who they are, where they are, or what they want to do with the data; there must be no restriction on who can use it, and commercial use is fine too.
- Open data must be available in bulk (so it’s easy to work with) and it should be available free of charge, or at least at no more than a reasonable reproduction cost. The information should be digital, preferably available by downloading through the internet, and easily processed by a computer too (otherwise users can’t fully exploit the power of data – that it can be combined together to create new insights).
- Open Data must permit people to use it, re-use it, and redistribute it, including intermixing with other datasets and distributing the results.

According to the Open Knowledge Foundation, Open Definition generally does not allow conditions to be placed on how people can use Open Data, but it does permit a data provider to require that data users credit them in some appropriate way, make it clear if the data has been changed, or that any new datasets created using their data are also shared as open data.

The “code of conduct” of openness is as follows:

- Availability and access: the data must be available as a whole as and at no more than a reasonable reproduction cost, ideally by downloading it over the internet where the interested parties can easily retrieve it. The data must also be available in a convenient and modifiable form, both for humans and computers.
- Reuse and redistribution: the data must be provided under terms that permit reuse and redistribution including the intermixing with other datasets. The data must be machine-readable. If this condition is not met then the data is not considered “open”
- Universal participation: everyone must be able to use, reuse and redistribute — there should be no discrimination against fields of endeavor or against persons or groups. (Weber 2014, pp 29-33)

If restrictions – even minors ones (such as use for certain purposes or applications) – would prevent the data to be freely used for private or commercial use, then it is not perceived as open and thus this would prevent knowledge to be shared, explored and published
**2.3 What is blockchain**

Humanity has advanced from recording the transactions from clay tablets to paper medium to finally the digital form. Now, these advances are capable to digitally manage the transactions to buy/sell assets. Distributed Ledger Technology (DLT) is one of key technologies responsible for bringing the openness of web back without compromising its security. The commercial and legal transactions can now be handled completely on the web as DLTs provide more secure and accountable environments for exchanging digital assets in the forms of currencies, popularly known as cryptocurrency.

Distributed Ledgers are popularly known as blockchain, ever since Bitcoin was invented by an unknown group of people in 2008, under the pseudonym Satoshi Nakamoto. Bitcoin was the first decentralized digital currency that can be exchanged without a central controlling authority. A blockchain is essentially a list of records called blocks, which are linked and secured using cryptography. Each block maintains an encrypted hash of the previous block and timestamp along the transaction data. Every modification request is processed by all nodes and the data in any given block can be altered only when the networked nodes achieve consensus (consensus is the process by which a number of computers come to agree on some shared set of data and continually record valid changes to that data) that the change is indeed valid. Thus a blockchain is robust against the tampering of the data. The Bitcoin blockchain introduced the concept of truly decentralized ledger that can be maintained securely without necessarily being controlled and administered by a central authority. (V. Buterin 2015)

Figure 2 elaborates the how centralized ledger help in maintaining records of traditional commercial and property dealings. Governments, banks, institutions may act as clearing house with complete control on ledger.

Figure 3 illustrates transaction handling with the distributed ledger technology (DLT) such as Blockchain where a ledger is shared among the parties. Distributed ledger is maintained based on consensus of users. There is no central authority/clearing house or centralized data storage. In fact digital data is replicated, shared and may be spread across multiple physical locations or nodes.

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5 Hash = Encryption is a two-way function; what is encrypted can be decrypted with the proper key. Hashing, however, is a one-way function that scrambles plain text to produce a unique message digest. With a properly designed algorithm, there is no way to reverse the hashing process to reveal the original password.
Blockchain represents a perfect opportunity to benefit from open source, since the concept of trust is woven deeply into all blockchain technologies. Blockchain systems are engineered to enable direct, peer-to-peer transactions between parties who do not fully trust one another, or don’t trust any central authority to validate transactions or settle disputes. Therefore, it’s essential for these parties to trust in blockchain technologies. We believe that an open, collaborative approach that invites participation from all stakeholders is the most effective way to build trust for enterprises—enough trust for them to widely and rapidly adopt blockchain technologies. (L. Rosen 2004)

2.3.1 Linux Foundation – Hyperledger project

Hyperledger serves as a “greenhouse” that brings together users, developers, and vendors from many different sectors and market spaces. All these participants have one thing in common: All are interested in learning about, developing, and using enterprise blockchains. While blockchain is a powerful technology, it is not one-size-fits-all. Every enterprise needs special features and modifications to help a blockchain achieve its intended purpose. Since different organizations have different needs, there will never be one single, standard blockchain. Instead, we expect to see many blockchains with different features that provide a wide range of solutions across many industries.

Hyperledger provides a greenhouse structure that can incubate new ideas, support each one with essential resources, and distribute the results widely. A greenhouse structure can support many different varieties while consuming far fewer resources. As the greenhouse organization for open source blockchain development, Hyperledger provides these benefits:

• Help keeping up with developments
• Better productivity through specialization
• Collaboration to avoid duplicate efforts
• Better quality control of code
• Easier handling of intellectual property
Help keeping up with developments

Hyperledger helps the companies to keep up with developments. In an open source environment, it can be hard to navigate through all the developments. This is primarily because of high complexity and expense associated with it. Communication is streamlined in a collaborative environment created by Hyperledger, eventually reducing the burden of research. The experience of keeping up is enhanced by better communication when important information is easily accessed. The development for the community’s benefit is accelerated when these participants involve in collaborative effort.

Better Productivity through Specialization

Ever since Adam Smith, higher productivity as a result of labor division or specialization serves as the foundation of economics. With the help of specialization, individuals are able to concentrate on specific tasks that they are good at and eventually mastering them. This approach is better than partaking in numerous tasks at once and becoming expert at none. The advantages, such as creating more wealth as a result of adding more value and more expertise, are offered by specialization. The economic development throughout the world has been significantly influenced by specialization. If participants specialize in a specific domain of new technologies, such as blockchain, they can gain those advantages. This would be much harder if there was no greenhouse organization in an open source environment. To accomplish enhanced productivity, specialization can be used in the greenhouse structure of hyperledger. In this context, there is no competition among the participants specializing in similar domains. To carry out research and development activities at a rapid pace, specialists are encouraged to join forces in a greenhouse organization. (Hyperledger 2019)

Collaboration to Avoid Duplicate Efforts

The efforts of people can be unwittingly duplicated in a siloed environment. The talent pool of experienced developers is not quite deep in a new industry, such as blockchain, thus it is considered negative to duplicate efforts of each other. The participants are motivated to collaborate with one another in a greenhouse organization. In this manner, duplication can be avoided, new project’s development can be streamlined, and formation of mutually beneficial components can be encouraged. The project’s understanding enhances interoperability among different distributed ledgers. The disputes related to interoperability, that may take place, can be solved with the help of Hyperledger’s governing structure. (Christopher Ferris, 2019)

Better Quality Control of Code

The high quality of open source software is its eminent feature. In order to achieve high quality, a code should be carefully reviewed, and substantial debugging may also be required to do this. The projects, all through their life cycles, are reviewed by a technical governing committee that ensures quality control for Hyperledger. To allow the developers to enhance their knowledge from the current projects, all the new projects are critically reviewed by the committee. The new projects may be innovative and beneficial for long-time project members in a sense that they can improve their own projects with the help of it. The interoperability among existing and new projects is fostered through this structure of greenhouse.
Easier handling of intellectual property

Intellectual property can be easily and consistently handled with the help of benefits provided by the greenhouse structure. The code and content of Hyperledger works under an Apache 2.0 license and Creative Commons Attribution 4.0 International license, respectively. The enterprise-friendly nature of these licenses is widely recognized. The members are able to free themselves of contractual relationships that are costly and complex because of this easy and consistent approach. There will be no threat of facing secreted legal impediments while building and using hyperledger technologies because the expectations of the participants would be openly communicated.

![Greenhouse structure of Hyperledger](https://www.hyperledger.org)

**Figure 4: Greenhouse structure of Hyperledger, including frameworks and tools needed to build blockchain applications**
(Source: www.hyperledger.org)

Open governance

Open governance means that technical decisions—such as which features to add, how to add them, and when to add them—are made by a group of community-elected developers drawn from a pool of active participants. Anyone can participate in Hyperledger by becoming a contributor and/or maintainer. Becoming a developer or maintainer translates into one thing: trust. You know how decisions will be made and how people will be selected to make these decisions. Hyperledger is vendor-neutral and technical contributions are based on meritocracy. Companies deploying blockchain internally, and those building products and services based on Hyperledger projects, trust Hyperledger because the technologies are built in the open by a broad community. (Coera 2016, pp 19-24)
Open source promotes interoperability

“Interoperable” means that a program can work with other programs—even those from other organizations—to quickly and easily perform a function. In today’s connected world, this is a must-have. And in the future, we believe that many blockchains will support many business processes for many organizations. Hyperledger eases interactions between blockchains. The open source Hyperledger technologies are designed from the start to support interoperability across various blockchains. In particular, Hyperledger Quilt is expressly designed to support cross-chain transactions. (Dutta 2017 pp 59-75)

Open source makes sense for blockchain

Both economics and common sense are on the side of a collaborative effort like Hyperledger. Enterprises need robust, feature-rich, modular blockchain platforms they can tailor to meet their requirements. Businesses as diverse as banks, car and airplane makers, and healthcare companies make a broad ecosystem of enterprises, all cooperating with the global Hyperledger developer community. When many different users and vendors collaborate to co-create common technologies, everyone can enjoy the proven benefits including lower risk, higher quality, and faster time-to-market. It is believed that more initiatives can take place in order to advance blockchain technologies by working together than by working in isolation. (Z. Zheng, S. Xie, H. Dai, X. Chen, H. Wang 2017)

2.4 Digital Evolution Index 2017

EU28 is explored in terms of its Open Data Maturity level in the European Data Portal’s report. Open Data was strongly prioritized by the European governments in 2017, and they are trying to make it an even bigger priority in the present. The data economy is significantly impacted by Open Data and most of the countries clearly understand its importance.

There are two primary indicators that provide basis for the methodology of Open Data Maturity: Open Data Readiness and Portal Maturity. The first one is used to assess the degree of licensing norms and policies related to Open Data in a country, and the extent to which these guidelines and approaches receive national coordination. In fact, Open Data’s impact is a sub-indicator of Open Data Readiness. The second key indicator is used to assess how portal can be used to evaluate the functionalities, for instance the way data is spread across domains, and how datasets are read and accessed on the machine.

The countries are grouped by Open Data Maturity into several categories: Beginners, Followers, Trendsetters and Fast-trackers. In 2016, a total of 8 European countries were regarded as trendsetters, however this number has doubled in EU28 in 2017, as demonstrated by the reports. The two key indicators, i.e. Open Data Readiness and Portal Maturity, were used to assess the countries across Europe. For this purpose, their policies and portal maturity were evaluated with regards to Open Data. In 2017, the Open Data expedition to reach Open Data maturity was completed by the European countries for up to 72.5% which is an impressive percentage as compared to 58.7% in 2016 and 44.2% in 2015. In terms of Open Data Readiness and Portal Maturity, Greece is categorized in the fast-trackers group (https://www.europeandataportal.eu 2017).
Table 1: Open data maturity clusters and evolution 2015-2017 in EU28

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Profile</th>
<th>No. 2017</th>
<th>No. 2016</th>
<th>No. 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginners</td>
<td>Country shows early stage of maturity on both dimensions, with an Open Data policy in place as well as an existing portal with basic functionalities and a low number of datasets. The level of re-use is low as well.</td>
<td>1</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Followers</td>
<td>Country has already an Open Data policy in place (albeit basic in terms of breath and depth) as well as an Open Data portal with functionalities that go beyond the basic features. There are still visible limitations in terms of publication and re-use.</td>
<td>8</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>Fast-trackers</td>
<td>Country has made substantial progress in terms of Open Data with progress made one or both maturity dimensions. Some barriers are still available in both terms of release and re-use.</td>
<td>8</td>
<td>8</td>
<td>✓</td>
</tr>
<tr>
<td>Trendsetters</td>
<td>Country has an advanced Open Data policy in place, going beyond the EU legislation (revised PSI) as well as a sophisticated Open Data portal. The country has an advanced Open Data ecosystem in place and shows no considerable limitations to either publication or re-use.</td>
<td>15</td>
<td>8</td>
<td>10</td>
</tr>
</tbody>
</table>

Figure 5: Portal Maturity and Portal Readiness in EU28
(Source: www.europeandataportal.eu)

In a more detailed view in Open Data Readiness the average score of EU is 873/1220 points and Greece scores 915 points, well above the EU average score. According to the European Data Portal’s 2017 report for Greece, the most important portal is the data.gov.gr. With regards to open data policy, Greece follows the PSI Directive, there is a 5 year plan for it and it includes 12 identified domains (categories of data sets) and there are 5486 datasets available. According to the report, there is a predefined approach to ensure data sets are up to date but less
than 25% of datasets are uploaded automatically. Supporting the open data policy are the 5+ related events held annually (like the Google Summer School of Openness, Hackathon events organized by the Central Municipality and others).

With regards to the licensing norms, Greece is following the “main stream” norm the one of CC licensing where 90-99% are open licensed and access is 100% free of charge.

On Data Maturity, the average score of EU is 214/280 points and Greece scores 165 points which is below the EU average. As for the Portal Usability metric, the report recognizes that 70-89% of the datasets are machine readable, all of them are searchable and downloadable and there is an API for accessing and sharing of the datasets. However, the report highlights that there is no possibility for feedback and for contribution to the portal's functionality. There are 2,500 on average unique visitors monthly (6% are foreign) but their profiles cannot be categorized as the typical profile of visitors is a bit of everything. The most downloaded dataset is “Registry of Accountants” by Economic Chamber of Greece and the top 5 consulted domains are finance and contracts, geospatial, statistics, education, governmental accountability and democracy.

As for the social impact, the report demonstrates that there is high impact on environmental sustainability and medium impact of inclusion of marginalized groups. As for the economic impact the report highlights that Greece is following the Zero Cost Model for the use and administration of the portal.

The barriers of the portal is the small awareness of the public and the lack of personnel in specific Public Sector bodies, competent for the diffusion of data. Main bottleneck is a cultural obstacle to further promoting open data policies. As for overcoming those barriers, there will be further promotion of open data policies both in the private and public sector as part of the 2017 Action Plan with specific communication and training actions. Also, the number of events related to open data policy is growing so there will be more awareness spread in regional and national level. The report highlights the decentralized administration of Heraklion, in Crete as an example of best practice.

The report identifies that there should be further activation of Public Sector Entities of major importance (eg in areas of ministries, local government, justice etc), the existing datasets should be upgraded and enriched in quality and “force” the use of metadata on the national Open Data Portal. As for the portal, it needs to transition to an upgraded infrastructure that should promote the reuse of open data in both the public and private sector.

To conclude with, after exploring the notions of open data, open knowledge and that of blockchain technology, the theoretical ground is set in order to explore the expert’s opinions and viewpoints of these topics, why are they significant, how are they connected, what is their impact within the Greek ecosystem of open source communities.
3. Methodology

This chapter focuses on describing the research methodology. More specifically, it highlights and explains the method utilized to conduct this research, while presenting, at the same time, the reasons for choosing this particular method. Furthermore, the present chapter offers insight related to the various stages of the research, among which were the selection of participants, the data collection process and the process of data analysis.

This research studied the impact of open source projects and initiatives in the past and future within Greece. Additionally, the communication and collaboration between the researcher and the experts was realized through open dialogue where the ones interviewed shared their experiences and perspectives.

The research methodology or approach is defined by the nature of the research questions and the subject being explored. As a consequence, the research layout used in any study should be perceived as a tool to respond to the research questions. The present thesis intends to examine and apprehend the opinions shared by the experts. This paper does not intend to offer the definitive conclusion about the research topic but rather to examine a certain approach of regarding and interpreting the connotations on the concepts and ideas which are considered and explored. This thesis was based on the following research questions:

- How important is the role of open source / open licensing for software and hardware in a collaborative environment?
- What is the contribution of open source communities and how they boost innovation in societal and business environment?
- What are the opportunities and challenges for Greece to implement big data openness, governance and growth?
- Is big data openness and emerging technologies like blockchain in favor of open source community projects?
- How do the open source communities perceive the blockchain?

Furthermore, regarding the type of the research chosen, a qualitative research approach was preferred as the main part of the methodology. The primary reason for this choice was that this type of approach both highlights and strengthens an understanding, interpretation, as well as clarification of connotation together with the intents and purposes essential to human interaction. In addition, the necessary data was gathered by means of detailed and comprehensive interviews.

Qualitative research is a multidimensional research technique which comprises an interpretative and realistic approach to the subject matter. The multidimensional nature of qualitative research permits researchers to have access to a complete image of the topic addressed. Moreover, qualitative research was considered appropriate for this particular thesis especially due to its purpose. More specifically, the purpose of this research study is to understand and dive deeper into the opinions and perspectives of a group of experts and professionals who are closely working with a multitude of open source software, hardware, design and governance projects. What is more, dialogue analysis was utilized in order to recognize and categorize the
numerous constructions regarding Greece’s environment, legal framework and implementation of new technologies.

For the purpose of the current research project, the primary approach of data collection consisted of interviews. Therefore, the method chosen was that of conducting partly structured interviews in order to enable and smoothen the apprehension of the research matter from the viewpoint of the experts selected for the study. Throughout the process of interview conduct as the primary method of data collection, the researcher aimed and expected to deepen the comprehension on the perspectives the experts offered, through dialogue and through the specific language they chose to utilize when expressing their answers and beliefs. Additionally, the chosen approach for conducting the interviews also permitted the researcher to search for clarity, while exploring and seeking for deeper understanding.

The researcher originally reached out to experts and professionals whom were known or suggested, with the hope and aim that they were more likely to become participants in the research project. This was achieved through an active selection of experts who complied with the criteria for being part of the study, i.e. being Greek professionals working with or as part of open source or open design or open hardware projects.

Furthermore, the participants were offered a detailed explanation of the purpose and context of the research, together with the options and reassurance that they are entitled and free to withdraw at any point during the interview if that may be their wish. Permission to record the interviews was also kindly requested and easily granted by all the experts interviewed, everyone being comfortable with the recordings.

With regards to the venue or place where the interviews were conducted, the participants were granted the opportunity to choose and decide wherever it would be more convenient and suitable for them. This was the case during the entire research process and especially during the data collection phase. As a consequence, each expert was interviewed at the venue of their choice and at the time most suitable to them. Based on this freedom of choice, most of the participants preferred to have the interviews conducted at their workplace.

The language chosen for the interviews was Greek, as this was most comfortable for the participants, as it was their mother tongue. In addition, all the interviews were conducted directly by the researcher. Conducting the interviews in Greek permitted the researcher to transcribe them easily and the answers as communicated by the participants. They were further translated into English, during the transcription stage. The researcher considered the translation a necessary step so that all the materials would also be available in English, in order to facilitate their accessibility to anyone who may not understand Greek.

The main interview questions were:
1. For how long has the Greek open source community existed and who are the main contributors?
2. What is the vision of open source communities and how these communities are developed in Greece today?
3. Can you recommend three best practices for open communities for using and sharing of knowledge that turns into actions? Is the infrastructure in Greece sufficient for accelerating and implementing open source community projects?

4. Is the Greek law in favor of boosting innovation through the open source communities in Greece?

5. Please elaborate on the three most notable open source projects happening in Greece right now.

6. What is your opinion about data / technology literacy of Greeks and how is this affecting the innovation in open source communities?

7. What are the biggest obstacles to public institutions responding more effectively to the data needs and interests of civil society groups? How might these be addressed?

8. What would you like to see in the future happening or being implemented in the Greek open source communities?

9. How are the new technologies like blockchain will shape the future of open source communities, collaboration and projects?

The entire process of conducting the interviews lasted over a period of ten months, which also coincided with the period of literature review and consolidation. While the literature was being reviewed and especially when the stage of data analysis started, it became obvious that there is a need for additional interviews to be pursued. The purpose of the additional interviews was that of verifying whether the new subjects and topics encountered during the literature reviews and during the data analysis stage would appear as well within the additional interviews. Moreover, with regard to time, the interviews were lasting, on average, approximately one hour.
4. Research findings on the past and the future of Greek open source communities

1. History of the Greek Open Source Community and main contributors

The most commonly mentioned Greek open source contributors are Hellenic Linux Users Group (HEL.L.U.G.), Open Technologies Alliance (GFOSS), Hackerspace and the several Universities teams, such as Aegean Open Source community (FOSS Aegean). There are plenty of other small or big Greek teams of people associated with openness but those four were the ones outlined by the experts as main contributors.

Most of the respondents mentioned that, in Greece, open source communities started to be formed almost at the same time as the open source movement was created, meaning during the 1980s and 1990s along with the first Linux users. The supporters of the open source movement officially established the first Greek Club (or Association) in 1997, namely the HEL.L.U.G. Club (Hellenic Linux Users Group). Moreover, two of HEL.L.U.G. founding members, commented that before GFOSS was established, “we were the first Club and the only community that existed in Greece with an interest in open software and openness. When you build something and publish it, the community grows through the dissemination of knowledge or information.” It is important to highlight the Club’s contribution to the Greek schools, by implementing Linux OS into computer laboratories hardware, they are able to “revive” old computers and tools in order to accommodate the modern needs of the students and professors. Nowadays, HEL.L.U.G. is under the legal umbrella of GFOSS and their goal is to grow the community by spreading knowledge and educating schools (and other groups) with understanding and using the Linux operating system.

Moreover, a great milestone in the Greek open ecosystem was the founding of the Open Technologies Alliance (GFOSS or EΛ/ΛΑΚ), in 2008. GFOSS was created to foster the cause of Free, Open Source Software (FOSS) and Openness and spread it throughout Greece. The respondents described that the effort started in the Greek universities in the 1990s, the same way it started around the world in most Universities, where there were groups of young people working with open source software and constantly spreading it as open content or open data. In the 2000s these groups took a more complex form. Therefore, in the larger Greek Universities (N.T.U.A., A.U.E.B., Uni.Pi., A.U.Th. and others) there were teams created to build an organization that would aim towards openness and sharing of knowledge. This organization was then founded in 2008 by a coalition of Universities and Research Centers. In addition, the experts highlighted that the main goal of GFOSS has been to promote Openness through the use and the development of Open Standards and Open Technologies in Education, Public Administration and Businesses within Greece. Therefore, GFOSS is a platform supporting openness; Open Standards, Open Governance, Free Software, Open Content, Open Data & Open Hardware. The major Greek Universities and Research Centers participate in GFOSS – Open Technologies Alliance – while leading members of the Greek community of developers play a key role in the implementation of its policies. As a VP of GFOSS – indicated, the “spirit” of open source had already existed and had been applied for thousands of years before the term was officially established towards the
end of the 20th century. In ‘ancient’ times, our ancestors shared knowledge about hunting, farming, cooking, herbal treatments, and many other subjects and skills necessary to survive. In ‘modern’ times, collaboration and sharing has reached an even higher level and has adopted a new meaning, particularly when it is connected to the subject and area of free and open source software (FOSS).

Besides HELLUG and GFOSS, another great contributor to the Greek open source software, hardware and design space has been the Hackerspace project which represents a place for creativity, collaboration, research, development and, of course, education. It is more than just a physical space: it is a dynamic community of ideas inspired by the Open Source philosophy. The idea is derived from the Free / Open-Source Software culture and from the people’s desire to share experiences and knowledge. This is also emphasized in their slogan: “We want to share our ideas, exactly like we share our code”.

Another indicative community, is FOSS Aegean, founded in Samos. FOSS Aegean or the Free and Open-Source Software Community of the University of the Aegean was set out to raise awareness of the open source, both within and outside the academic environment, to exchange technical knowledge, as well as best practices. One of the team’s core initiatives is to spread awareness about open source within the tertiary education sector by collaborating with other University teams and professionals around Greece.

There were various teams running specific projects in other words, people with common interests in a collaborative environment trying to solve a problem such as, the Gnome team (team promoting software freedom), the KDE team (an international free software community developing Free and Open Source software) etc. The main focus of these teams was the Hellenization, or in other words, the translation of the applications for the Linux operating system into Greek, in order to cover the need for Greek language support; for example Greek keyboard, fonts, etc. Later on, within the next 5 years, it all became easier as the Unicode encoding system was introduced as the standard for handling of text expressed in most of the world’s writing systems. At the same time, there were also distribution teams (focusing on development in creating usable open-source tools for software developers and system administrators, while providing a user-friendly desktop and feature-rich server environment) such as Fedora, Ubuntu (from 2004 onwards), Gnome, Open Suse (2008) and afterwards, numerous other projects that were associated or in collaboration with these. Such projects were mostly focused on the development of statutes, making the code open in shared repositories, and propagate information regarding use of free software as the main reason being that back then, in Greece, there were no companies that contributed with code for the community. Thus, most major applications had to be developed from scratch. There were only a few companies offering fonts, which were designed and sold commercially, without being made open.

Based on the results of the interviews, this section argues that the first open source communities in Greece started forming almost at the same time as the open source movement was created, meaning during the 1980s and 1990s along with the first Linux users. The first Greek Club dedicated to sharing the values of openness was HEL.L.U.G., which until today is operating mainly in the educational field, by integrating Linux OS into public schools’ computer hardware. A
decade later, a milestone for Greek open source communities was the formation of GFOSS, a non-profit organization, which goal is to promote openness with Greek society. GFOSS operates as an umbrella under which many communities and teams are coordinated, pushing to the masses initiatives and delivering projects related to openness; such as events, conferences, workshops and platforms used by public bodies and private companies. Other important teams related to openness are the Hackerspace and FOSS Aegean communities whose role and contribution is significant. The following question explores the governance and structure models of such communities.

2. Structure and Governance of Open Source Communities

As far as the projects related to OSS (Open Source Software) and their community governance is concerned, a high degree of diversity is involved. Each project has unique wide-ranging considerations consequently leveraging distinctive concepts and structures of governance. The separation of duties, centralized decision-making distribution, decentralized decision making distribution, health and sustainability, and operational management are some of the factors used in shaping community governance. There are numerous shared concepts among governance structures, even if these structures are used variedly. In this context, a set of governance concepts and motivations/objectives related to them are emphasized in this study.

In order to provide effective service to the members of a community, it is important that their social and technical needs are governed in open way. Community governance is a need of community members through which it can be ensured that other members are upholding the values of the community. The establishment and maintenance of a community’s identity is facilitated with the help of governance. The concept of fairness is also guaranteed by governance. It is necessary to ensure that the governance acknowledges value system of the members, so that the members are encouraged to participate in the community activities. For this purpose, the identity of community should be made clear. The governance structure varies from community to community depending on different motivations and factors, such as desired leadership, ideologies, financial support, and community size.

The relevant arguments related to the need of governance are the objective and motivations of the community governance. I conducted research on a few communities, and the objectives and motivations listed below are relevant to my findings:

- **Shared Purpose:** The activities of a community should be based on a shared-purpose. In most cases, community is served using this specific shared-purpose. GFOSS is an ideal instance in this case; it was established to facilitate the use of Open Technologies and Open Standards in Business, Public Administration and Education in Greece to encourage Openness. The GFOSS’s shareholders comprise up to 36 research centers and universities.

- **Values Representation:** The values of a community should be represented by community governance as this is the primary demand of majority of the members. In this case, HELLUG can be used to give the best example, their member’s knowledge on Linux
environment and issues is enhanced through educational campaigns and activities that they conduct.

- **Involvement**: In order to represent that community governance focuses on broader interests, it is important that all the members of the community are involved in the governance participation through governance activities.

- **Evolving**: Community’s governance should evolve with the evolving needs of the members.

- **Consistent**: The first step in building trust of the members is to ensure consistency of the processes and structures of community governance.

- **Transparent**: The transparency of governance activities plays a significant role in building trust of community members. Therefore, openness is the key to achieve this goal. The timely upload of decisions on the websites of GFOSS and HELLEG help them accomplish full transparency with their members.

- **Simple**: The manner in which community operates is better understood by members if the governance is straightforward. FOOS Aegean uses best practices, exchanges technical knowledge and aims to increase awareness.

**Leaders (leadership turns into initiatives)**

The individuals who initiate Open Source projects usually begin with implementing one of their ideas. The role of primary decision maker can be taken by the leader in order to actively contribute and direct when the project is small. However, leadership turns into initiatives’ prioritization, product roadmaps, and technical vision as the project grows. The members will be encouraged to serve for the project if they are clear about the priorities related to it, to ensure this; it is important that the leader serves as an enabler and recognizes the project’s and community’s strengths. The technical decision making will often be the responsibility of the leader, however the leader should always ensure that the decisions he takes represent and engage with the members of the community. The interest in the initiatives or product grows as the community or project expands which requires the leaders to merge with the project’s Board Committee so as to accomplish diversification of opinions.

**Foundations (oversight of functions of the team)**

The non-profit foundations are usually approached in case of open source projects. This is because various supportive oversight functions for advisory, operations, health, stability, growth and stewardship are performed by these foundations. The basis of the functions may vary, however the functions can include navigating licensing needs, event sponsoring, handling project financing, and representing project infrastructure tools. To facilitate in evaluating health of a project, data and metrics are often established by the foundations. The partnerships of multidisciplinary nature in case of GFOSS can serve as the ideal example in this case.

GFOSS is affiliated with:

- MyData’s local hub (MyData helps people in knowledge development, informed decision-making, and conscious and efficient interaction with each other by empowering them, this community comprises developers, public agencies, listed corporations, academics, activists, and entrepreneurs.),
• OW2 Consortium’s Associate organization (an open source, global, and independent software community),
• Eclipse Foundation, Associate Organization of Free Software Foundation Europe (FSFE),
• Open Policy Network’s member (https://openpolicynetwork.org/),
• Open Budget Initiative’s member (it enhances constructive governance and reduced poverty by using advocacy and budget analysis through the collaboration with civil society throughout the world)
• GP (Open Government Partnership) Network’s member,
• FLA - FAB LAB ATHENS (organizations and people cooperate through this platform from all over the world),
• Creative Commons,
• and is COMMUNIA’s founding member (COMMUNIA supports policies aiming at expanding public domain and increasing the possibility of accessing culture and reusing knowledge).

Special Interest Groups

An important way for the distribution of community’s responsibilities is represented by Special Interest Groups. These groups can be used in advisory, working, or technical capacities as they serve technical as well as social needs.

A charter and clear focus area is used to sanction such groups. These groups assist the community in the evolving process as its needs grow. The activity amount decides the size and structure of the group, however the needs of the community members should be considered in the group activity. The communities are engaged by the groups through the use of issue queues, open meetings, meeting-notes posting, and more.

Boards

The advisory needs of communities are served by boards. The community efforts are steered and informed with the help of collaboration between the leader and different groups facilitated by a board. In order to assist in informing community strategy, a greater role, as compared to the groups, is assumed by boards. The composition of boards should be diverse. In order to guarantee routinely changes of membership and new ideas’ influx, periodic elections should be considered by composition of the board. For instance, to ensure diversification of decision-making, the members with broad business, scientific, and educational experience are included in the GFOSS board.

Governance Documentation

The value system of members should be acknowledged by the activities of the open source community. The community’s identity is easily communicated when documentation is leveraged. There are various ways to represent this:

• **Mission Statement:** It is used to capture community’s goal and purpose.
• **Vision Statement:** The long-term goals and objectives of the community are defined in the vision statement.
• **Diversity Statement:** The community’s intent of promoting equality and inclusivity are included in diversity statement.

• **Code of Conduct:** Community member’s expectations regarding the community are defined in these guidelines.

• **Conflict of Interest Statement:** The exclusive interests of an organization or individual are mitigated or removed with the help of these guidelines.

• **Conflict Management Policy:** For efficient conflict management within communities, this policy describes various guidelines and processes.

• **Community Guidelines:** The basic expectations that should be followed by the members are included in the community guidelines. In addition, community members can access some tools described in these guidelines.

• **Contribution Guide:** The guidelines encouraging participation of the members.

• **Contribution standards:** The standards of contributions are clarified.

The GFOSS Open Design, Open Governance, Open Source Software, Open Technologies, Open Content and various communities represent the types of engagement mentioned above. Thus, it is the goal of GFOSS to serve as a platform and a knowledge hub for discussions regarding Free Software and advantages of using it.

Engagement

To engage members of the community, different tools and activities are used by Open Source projects. There are different ways to perform engagement:

• **Code:** The communities can be served by the technical individuals in form of code contributions.

• **Voting/Elections:** The members can provide their valuable feedback, through community voting, about any membership or initiative.

• **Meeting Notes:** The community members who were unable to attend a meeting can use meeting notes to know what they missed.

• **Open Meetings:** The members can be informed and partake in the open meetings held by groups and boards.

• **Retrospectives:** To give feedback, it is important that members are provided with an opportunity. The learning progress of people is shared through retrospectives that also assists in identifying further steps that need to be taken for the evolvement of community efforts.

• **Issue Participation:** Issue tracking systems comprise various documentation needs, plans, and bugs which can be organized with the help of community members. In this manner, an approach can be tested through collaborative work of the members before it is finalized.

• **Documentation/Wikis:** The wikis should contain communal knowledge, such as; community member should update it periodically.

• **Direct Messaging Channels:** The members can communicate with each other in an effective manner through one-on-one message as well as specific and generic groups set up by the tools like IRC or Slack.
• **Notifications/E-mail List:** Web archival tools or email can be used for notifications and threaded communication.

The GFOSS’ operation and organization is reflective of its activities regarding engagement and documentation. The subsidiaries and communities also demonstrate same practices. There is one key topic that is the point of focus of each team. The respective activities of each subsidiary are coordinated and organized by a devoted team. Similarly, the subsidiaries also have online code, wiki, content or repository as well as a website. Any activity can be chosen by the community members in which they can partake and contribute. The members remain in touch with overall activities of GFOSS and the team through conferences, events, newsletters, and mailing lists.

*Based on the results of the interviews, this section argues that there is a great deal of diversity in community governance of Open Source Software projects. While the use of governance structures may differ, there is a substantial amount of concepts shared among them. Effective governance must acknowledge the diverse technical and social needs of the community to effectively serve members. Members of the community need governance to ensure that the communities’ values are upheld by other members. Governance ensures fairness and helps the community to establish and maintain an identity. This identity must be made clear so community members, often volunteers, feel confident they are participating in something that aligns with their value system. Community governance is not one-size-fits-all between communities. Community governance can change based on the size of the community, financial support, application of free and open source ideologies, desired leadership, and much more. A prime example of effective governance can be observed at GFOSS’s multidimensional structure as different teams with different objectives operate under one umbrella while driving results and pushing the notions of openness further into Greek society, through a number of different projects being delivered. The next question explores specific activities within the Greek Open Source Community that boost knowledge sharing and innovation.*

**3. Activities of the Greek Open Source Community that boost knowledge sharing and innovation**

The basic characteristics for a community to flourish is to allow freedom of expression, promote fairness, set clear policies and obligations and have a crowd-centric model of growth. Open source is based on the logic of open cooperatives (whoever want - whenever and for whatever reason they want to participate). There is the famous Active contributor’s general rule: 1% (are active contributors) - 9% (are occasionally active contributors) - and the rest 90% (are the end users); that is in general how an open source community is operating. The Greek Open Source Community has been engaged in three types of activities aiming to facilitate knowledge sharing and innovation.

*The first practice is the notion of Linked Open Data and how it facilitates the sharing of knowledge. The second practice is the Smart City approach to developing today's*
society where public bodies and local authorities use open source technologies in order to improve the quality of life of citizens. The third practice for boosting innovation is the organization of hackathon events, supported by the Central Union of Municipalities of Greece (KEDE).

As one expert stated, “...having open data and access to it is essential but is not where we should focus on. We should use the availability of data as our base and built on top of these data sets or even better compose from existing data and extract new knowledge. In other words, in today’s society everything can be - and has to be - linked and as a result we have the Linked Open Data”. The term Linked Open Data (LOD) refers to a structured data set which is interlinked with other data set so that becomes more useful to anyone who wishes to use. In other words, Linked Open Data is a compilation of datasets which previously were not connected. Essentially, Linked Open Data is a set of design principles for sharing machine-readable interlinked data on the Web.

The interviewed experts, outlined the action steps needed towards the openness of the linked data of each public and private body. Firstly, analyse the data, the models and the metadata before they are published to the public repository and clean up the data and have one unified format (database, XML, CSV etc). Secondly, choose appropriate naming for each dataset, which identifies the content or a particular resource. It is essential to always provide human-readable descriptions of the data sets to make the data sets “self-describing” for easy and efficient re-use. Thirdly, specify licenses to ensure broad and efficient re-use of the data. If possible, specify an existing license that people already know. This enables interoperability with other data sets in the field and in other areas which previously were not taken into consideration. For example, Creative Commons is a commonly-used license for open government data. Fourthly, convert it to RDF format. RDF is a graph-based representation standard format for data publishing and interchange on the Web. Fifthly, link the data with other data. Before publishing, it is essential that data is linked to other data sets and to third party data sets that can be useful. These links ensure optimized data processing and integration for data (re-)use and they allow for the creation of new knowledge from existing data sets by putting them into a new context with other data. This provides richer queries as well as boosting untapped knowledge discovery and efficient data-driven analytics. Datasets can be cross domain such as, geography, life sciences, government, linguistics, media, social network, user-generated content etc. Final step is to publish and promote the LOD (Linked Open Data). Publishing the data on the web and promoting the new LOD sets to ensure wide re-use – even the best LOD will not be used if people cannot find it! Alongside other ways of promotion it is a great idea to add LOD sets into the LOD cloud, a visual presentation of LOD sets by providing and updating the meta-information about specific data sets on the data hub.

Through designing and implementing Linked Open Data openness, public institutions and private bodies can connect different data sets aiming:

- to create an open digital platform to support the documentation of the results of training programs and events, and to engage participants in the activity of sharing their knowledge in a public repository that is accessible to all;
• to activate an open process in which members of digital social innovation projects could start exchanging knowledge
• to make the results of the training programs available in a raw format to other researchers and organizations that are developing studies in the field of digital social innovation;
• to provide a user-friendly interface that enables GitHub illiterates to share content and connect with a larger community of open software developers.

Moreover, the best practices for openness are actually embedded in the definition of open source. Open source software is defined by “four essential freedoms”:

• The freedom to run the program as you wish, for any purpose.
• The freedom to study how the program works, and change it so it does your computing as you wish. Access to the source code is a precondition for this.
• The freedom to redistribute copies so you can help others.
• The freedom to distribute copies of your modified versions to others. By doing this you can give the whole community a chance to benefit from your changes. Access to the source code is a precondition for this.

By applying those principles, a community is set up to grow and develop applications and services through the use, re-use and sharing of information. A community can be defined as a small team or a city or even a municipality as a whole. “We have the knowledge and the technology on how to achieve the notion above” the experts argued.

The second practice for boosting innovation and knowledge sharing is the Smart City approach to developing today’s society where public bodies and local authorities use open source technologies in order to improve the quality of life of citizens. By turning the city into a “smart city” a great accomplishment is possible; making the city more attractive to citizens, businesses and tourists because of the development of an innovative environment. A smart city is an urban area that uses different types of data and then re-use that data to manage assets and resources efficiently, aiming to improve the quality of life. In other words, a smart city is a city that solves administrative issues by the use of information technologies and communication on the basis of a cooperative procedure. In Heraklion, Crete, the city’s actors are working together harmoniously, but this effort must be stepped up by acquiring a more permanent character through specialized partnerships based on the needs of the local community.

Encouraging Participation is one of the key challenges for Heraklion to encourage the citizens, businessmen and players of the city to participate in the life of the city. The Municipality already has a Municipal Committee of Consultations as well as thematic committees such as the Smart City Committee, the Tourism Committee, etc. which encourage participatory planning at the institutional level. At the same time, the Municipality encourages the participation of citizens through the Volunteer Networks that already have a strong presence in city life, as well as the encouragement of independent interventions of groups of citizens. Social cohesion in a smart city means:
• Covering the needs of the "smart city" for the largest possible part of the city’s inhabitants (balanced investments - changes, balancing inequalities in accessibility, etc.). Emphasis on people with limited mobility and accessibility to services (elderly, children, people with disabilities, etc.)
• The upgrading of public and social structures is aimed at serving all residents regardless of economic order, spatial and social origin, place of residence and accessibility to services. The aim is to upgrade the quality of life with horizontal application to the citizens.
• Participation in shaping the development path of the city involving all citizens (development of consultation, participation, etc.).
• Innovations / new areas of research include and relate the social dimension of the desired outcomes to a wide range of social groups and societies.
• Rational resource allocation: A smart city uses information as a basic principle of planning, organizing and servicing the functions it is required to perform. Comparing, compiling, and analyzing information with reference to space can highlight the patterns of occurrence and change of phenomena over time, facilitate the identification of shortcomings and weaknesses, and thus direct the rational commitment of resources (human and financial).

The third practice for boosting innovation is the organization of hackathon events, supported by the Central Union of Municipalities of Greece (KEDE). The word Hackathon is a contraction of “Hack” and “Marathon”. “Hack” may be used in the sense of hacking into a computer system, but a more accurate meaning would be the broader sense of finding a quick solution (a “hack”) to solve a particular problem. Hackathons are an innovative proving ground type of event for new ideas. They stimulate the creativity of participants and foster problem-solving and risk-taking in a casual environment. The diversity of participants guarantees a multitude of perspectives and the time limit on hackathons creates a uniquely productive atmosphere that forces participants to distil their visionary concepts down to actionable solutions. All this increases the chance of finding innovative fixes to persistent problems.

A hackathon is a Marathon for the Development of Innovative Applications and Services, during which participants are to develop pilot services and applications solving problems that Local Authorities face and support local and national development through new technologies. The idea is to gather motivated people, form teams, give them a challenge to solve in a short time-frame (usually a day or a weekend) and award the best ones. After the end of the event the results of the competition are made available to everyone.

Young people, developers, designers, analysts and everyone wanting to share an idea or solution for practical issues or to develop a trial innovative product or service are welcome to participate. In June 2018, the Central Union of Municipalities of Greece (KEDE) held the 2nd Innovation Marathon for Smart Cities, which was attended by more than 1,500 participants and 112 teams. Understanding the needs of Greek society and local government for digital transformation and strengthening of the local economy, KEDE is holding for the third consecutive year the 3rd Innovation Marathon for smart cities, KEDE crowdhackathon. The contestants are to develop pilot services and applications solving problems that Local Authorities face and
supporting local and national development through new technologies. Additionally, the Marathon hosted special events such as a student innovation contest and local citylabs in 16 cities of Greece.

The 2nd Innovation Marathon for Smart Cities launched the KEDE Innovation Lab which is the first accelerator for smart cities and digital innovation in Greece. The aim of the innovation lab is to implement innovative and state-of-the-art applications with the support of new Greek teams and companies, provide applications and services through a central marketplace in order to achieve economies of scale, interconnect with foreign operators to share know-how, provide training on modern technologies as well as counseling and support for Municipalities on innovation and digital technologies. Great emphasis is placed on the introduction of disrupting technologies (e.g. AI, blockchain, VR, augmented reality, open APIs) in local government as well as the promotion of open data as it can be used by new developers and startup companies to create innovative applications.

The innovation lab supports youth, outward-looking and innovative entrepreneurship as well as teams, such as those participating in open innovation marathons, by helping them develop their solutions and form new companies.

Such hackathon events are supporting the local economy, as contestants from all Municipalities of Greece can participate, who can then start their own business. It is a good opportunity to improve an existing service or application or build it from scratch. It is of great importance that such events are supported by KEDE, essentially highlighting and creating smart and innovative solutions to problems that citizens and municipalities face. The topics of such events may vary but the core idea is to improve people’s lives within the municipality. Thus, contestants are competing in creating solutions including but not limited to Electronic services of Municipalities – e-government – open data, Promotion of transparency and accountability, Protection of the environment and management of resources, Development of tourism, Services for businesses, Development of applications for the local economy and sustainable development and others.

Based on the results of the interviews, this section argued that the first practice for boosting sharing of knowledge is the notion of Linked Open Data and how it facilitates the sharing of knowledge. The term Linked Open Data refers to a structured data set which is interlinked with other data so that becomes more useful to anyone who wishes to use it and extract new knowledge. The second practice is by improving the urban environment of the cities, namely transforming them into smart cities aiming to improve the quality of life. A smart city is a compilation of open source software and open hardware (such as IoT devices) used seamlessly in order to produce data about the city life. This kind of data is open to anyone interested in it and it is used in order to find innovative fixes to persistent problems, such as the administration of public authorities, transactions between citizens and state, environmental protection and others. In addition to Linked Open Data and a modern urban environment, hackathon events contribute to sharing knowledge and boosting innovation within municipalities. Through brainstorming and a safe competition, great emphasis is placed on the introduction of disrupting technologies (e.g. AI,
blockchain, VR, augmented reality, open APIs) in local government as well as the promotion of open data as it can be used by new developers and startup companies to create innovative applications. All of the above need a technological, institutional and educational base for a successful implementation.

4. The role of supporting infrastructure in Greece

The majority of the respondents suggested that Greek infrastructure - the administration and structure of public sector - is not sufficient enough for accelerating and implementing open source community projects because of the obsolete structure of the public bodies, meaning a multitude of actors interacting on several levels. This system prohibits innovation and smart processes because of existing old and redundant processes. The experts agree that the Greek National Science and Innovation System tends to have a strong international orientation and a high degree of internationalization, which is not represented on the way decisions are being taken from the Greek public bodies. In Greece, many government procedures lack proper documentation, leading to multiple interpretations by public administrations across the country. This in turn creates delays and uncertainties for citizens and companies dealing with public bodies.

In the current decade of economic austerity, traditional solutions and processes (paper based activities, obsolete / unnecessary processes), that until recently have produced results, are no longer sufficient to address the problems and maintain a satisfactory quality of life by providing an economic stability and a healthy administration profile.

According to most of the experts, in the current difficult economic situation Greeks need to stop their “business as usual” approach and build a more competitive infrastructure at national and European level. They argued that in Greece the technology and the method is already known and explored for developing and implementing open source projects, however, the nature of the problem is a matter of political will; to support flourishing of such initiatives. At the administrative level there is the will but at the executive level there is often a conflict of interest among the members of the decision-makers group and thus decisions are blocked or being paused for decades. Political parties are promoting their own interests instead of collaborating together to overcome obstacles for the rest of the society. “Hacking” the infrastructure and changing the way the system works is a tough problem to solve. Public institutions should have smaller size of share and the statehood societal model created during the 18th century is obsolete, when technological progress had a very different impact compared to todays. Thus, it is almost impossible to apply logic and policies of the industrial revolution era to the modern age issues. In the era of blockchain technology, new mindset and policies should incorporate the previous experience along with today’s tools and knowledge. The correct use of technology can replace a lot of bureaucratic procedures that are happening within Greek public institutions. By improving the way decisions and acts are approved and implemented, the overall efficiency and effectiveness of the Greek infrastructure will be improved, serving the citizens in a more meaningful way than today. A step towards improving the overall efficiency of the public sector is

- by creating awareness around open source technologies and
by educating employees.

Hence, technology transfer and innovation as well as measures for public awareness creation for science and technology should be given priority in policy making.

**Public Awareness for new Technologies**

In the Greek government, the Ministry of Development (MoD), the Ministry of Education and Religious Affairs and the Ministry of Economy and Finance (MEF) are the most important Government authorities in the areas of research and innovation policies. Through its General Secretariat for Research and Technology (GSRT), the MoD has the responsibility for designing and implementing research policy measures and for the supervision of national research organisations. The GSRT is responsible for the promotion of innovation, the development of funding schemes and the refinement of legal instruments. Over the last years, GSRT increasingly paid attention to the exploitation of research results. A few intermediary organisations are dedicated to technology diffusion and the creation of awareness in specific fields. In the field of open source / open hardware / open design, GFOSS serves as an umbrella for openness related strategies, at national level. GFOSS operates as a bridge between the private sector and public institutions in research and awareness creation regarding openness matters.

To achieve public understanding and support of research and innovation and to create awareness among the actors of the Science and Innovation System, policy measures to enhance communication on new technologies have been developed. The aim is to enhance the interconnection between science and technology and the Greek society and the diffusion of relevant information as a stimulant for innovation-oriented activities. Related measures aim at the propagation of patents, scientific and technological information systems and the use of analytics / statistics for future research and innovation policy and general awareness of research and technology issues. The main activities include the preparation of surveys, studies and comparative evaluations; the development of technology information systems; the dissemination of information about best practices; the organization of seminars, conferences and brokerage events as well as the establishment of expert groups and shared initiatives. The Private Sector is involved in these activities both as a participant in their design and implementation and as a target group for disseminated information and other actions.

**Educating employees**

Training new users is an increasing task for GFOSS with the multiple wiki websites contributors. They have so far trained staff working for municipalities and courts. “We have developed online open educational material, available in Moodle for public servants on how to use the platform”. (Moodle is a free and open-source learning management system written in PHP and distributed under the GNU General Public License.), a VP of GFOSS pointed out. “By crowdsourcing the documentation of public services, we are giving the opportunity to everyone to have access, amend and be informed, we create a community that takes co-ownership of the project, and a mechanism for quick conflict resolution.”
Wiki diadikasies.gr is a knowledge base that is continuously enriched with the documentation of more public sector services. It was created by the Open Technologies Alliance (GFOSS), and it follows the model of crowdsourcing like Wikipedia. Public sector employees document in a structured way the services they provide in the course of their normal duties, as well as the procedures followed until the complete delivery of each service. Each service is a wiki-based entry that contains: the official title of the service, a brief description of the service, all relevant legislation governing the service, a table with the required paper and/or electronic forms, a table with the step-by-step procedures followed in providing the service, any co-responsible administrative units and the registries updated upon the provision of the service.

The wiki is intended for use by citizens and public servants who are responsible for the delivery of the services offered by their administrative unit. The purpose of documenting the procedures is to make the information easily accessible to the citizens, to eliminate the inconvenience citizens often experience in dealing with the public sector, and to help administrative units in providing the same services in the same way throughout the Greek public sector.

At the same time, the structured documentation of the procedures in a public forum will hopefully contribute to their simplification over time, reducing bureaucracy and increasing public sector efficiency and performance. Lastly, we aspire to contribute to the efficient transition from manual to digital service provision.

To summarize, the Greek infrastructure is a rather fragmented system with considerable barriers which have limited so far the development and implementation of a consistent national research and innovation strategy on openness matters. The Private Sector is involved in the instigation of research policies and programs through informal consultations as well as through participation in the National Advisory Council on Research and Technology and the National Competitiveness Council. GFOSS is regularly engaged in research and innovation awareness creation campaigns and in formal consultations with GSRT.

Based on the results of the interview, this section argues that the experts agree that the Greek National Science and Innovation System tends to have a strong international orientation and a high degree of internationalization, which is not represented on the way decisions are being taken from the Greek public bodies. The system prohibits innovation and smart processes because of existing old and redundant processes. This in turn creates delays and uncertainties for citizens and companies dealing with public bodies. In the era of blockchain technology, new mindset and policies should incorporate the previous experience along with today’s tools and knowledge. The correct use of technology can replace a lot of bureaucratic procedures that are happening within Greek public institutions. A step towards improving the overall efficiency of the public sector is by creating awareness around open source technologies and by educating employees. Hence, technology transfer and innovation as well as measures for public awareness creation for science and technology should be given priority in policy making. The following question explores just about that.
5. The Legal framework around Open source communities in Greece

Most of the interviewees stated that the law is in favor of boosting innovation through open source communities in Greece, through the Creative Commons licensing. Creative Commons copyright licensing strives to balance the extent of protection in rights protection. The tools grant permission institutions and individual creators to make changes and share their work and all content within given copyright law boundaries.

Public copyright licenses are designed in three layers; legal code, common deed for normal readability and machine-readable that makes it easy for web to interact with humans. Every creative common license has distinguishing features to protect and increase flexibility of creators. To accomplish the balance between freedom and copyright laws, a standard way of describing licenses was developed, CC Rights Expression Language (CC REL). There are 6 License Types (Creative Commons 2019):

CC BY: In this license, copying and distributing is allowed as long as it’s based on a specific type of work. This can also be done commercially, provided the original creator is accredited. It is one of the most accommodative licenses available. The license is mainly used for maximum distribution of products.

CC BY-SA: This license allows distribution and mixing of work type within certain creations and business standards. The limitation is that the new material must be licensed under identical terms as the original work. This means that the new creations will bear the same license as the original creation such that any derivatives allow commercial use. The license is closely related to the famous ‘copyleft’ type of software, which is open and for all users. The most common example is Wikipedia.

CC BY-ND: These licenses provide freedom for redistribution of both non-profit and commercial use provided the material was checked along unchanged to accredit the original owner.

CC BY-NC: In this license, all related works of non-commercial activities both directly and indirectly are included. However, the secondary works must acknowledge a relationship with the original creator on a non-commercial basis of operation.

CC BY-NC-SA: This license type allows other secondary firms and organizations as well as individuals to mix, copy, and build work on a non-commercial basis; the only directive is they have to license their new establishments in similar terms and credit the original creator.

CC BY-NC-ND: This license has the most restrictions in this category because others are only allowed to download work and share but not make any changes. The license also prohibits using works for any commercial purpose. Still, they have to credit the original source.

A legal expert on open source matters clarified that there are open source licenses that protect the creator and depending on the licensing options, people will have the corresponding legal coverage however, there are cases where developers are using open source code to hack
it and then sell it as their own product, without giving the respective credits. Nevertheless, the Greek legal framework stems from the global framework of licenses covering these projects. When referring to software, the use of public repositories has contributed to a better understanding, especially for youth, regarding what licensing means and how it is shared. A repository is like a public folder for a project and it contains all of the project's files and stores each file's revision history. Public repositories is essentially the way open source code is spread worldwide. Github.com, as an example, contains over 100 million repositories alone.

An expert from GFOSS also suggested that within the educational and research fields “it is more appropriate to use open source tools rather than closed systems because the vision of open source is aligned with the concept of gathering knowledge and education”. For this implementation to happen on a large scale, it is not enough just to have laws supporting the concept of open source but rather they have to be enforced. Therefore, the focus should be directed towards enforcing the laws and not creating new ones. In his opinion, this can be achieved through active penalties and proactive law enforcement. The GFOSS alliance (or EELLAK in Greek), representing 36 universities and research centers in Greece, promotes the use of free and open source technologies. “Our view on open government advances access to knowledge, similar to the ethos of free and open source software,” says the President of GFOSS. Others emphasized the need to “change our culture, towards a more collaborative, transparent and open environment in the public sector”. They also noted that “we do not need more laws, what we need is the existing laws to be enforced”.

The Greek law is sufficient for boosting innovation however, the right incentives come from an overall cultural shift towards openness, integrity and transparency. For a change to happen, all relevant institutions have to agree; which in reality, the amount of bureaucracy and agreements involved for such a change is extraordinary. It is obvious that in a such complex environment, one small change can take proportionally more time to be implemented compared to the importance it carries. The new regulations that have been voted by the EU with regards to data management will strengthen the European economy by creating growth because of the elimination of barriers to the free flow of non-personal data. The major improvements in data laws are ensuring free flow of data regardless of borders, ensure the availability of regulatory control and contribute to the creation of statutes for cloud services which will make the market more flexible, data services in the EU more affordable and facilitating the development of economies of scale. By applying these new regulations of the Directive, Member States set clear rules for the re-use of data across EU and additionally the legal environment is harmonized and more stable than before. Furthermore, establishing simple mechanisms for resolving disputes related to the further use of public data would:

- Include the provision of public information for re-use to the public administration workflows
- Create simple tools in how to clear up and dispose of public information for re-use
- Share the best practices and decision-making tools between public administrations

The PSI (Public Sector Information) Directive focuses on the economic aspects of the re-use of information rather than on access to information by citizens. It encourages the Member States to make as much information available for re-use as possible. It addresses material held
by public sector bodies in the Member States, at national, regional and local levels, such as ministries, state agencies and municipalities, as well as organisations funded mostly by or under the control of public authorities (e.g. meteorological institutes).

Since its 2013 revision, content held by museums, libraries and archives also falls within the scope of application of the Directive. The Directive covers written texts, databases, audio files and film fragments; it does not apply to the educational, scientific and broadcasting sectors. Member States were obliged to transpose Directive 2013/37/EU by 18 July 2015 into their national law.

In addition, a VP of GFOSS, mentioned that “We have a fairly modern legal environment”. He continued describing that in 2016, a law was adopted on open source and open data and all businesses should be applied where there is personal data. Personal data is defined under the Directive as any information relating to an identified or identifiable natural person ("data subject"); an identifiable person is one who can be identified, directly or indirectly, in particular by reference to an identification number or to one or more factors specific to their physical, physiological, mental, economic, cultural or social identity.

The Directive sets out the legal framework for a European market that is based on the access and re-use of Public Sector Information. It aims at fostering the internal market in particular by enabling the conditions for development of cross-border services, based on the re-use of Public Sector Information. At the same time it targets transparency and a fair competition within the internal market.

The revision of the Directive was preceded by a consultation and an impact assessment which indicated the persistence of obstacles to wide re-use of data and the diverging practices with regards to the availability of data for re-use, the licensing conditions and the charges applied. An update of the legal framework proved therefore necessary. Its main elements are the following:

- A default rule of charging for re-use of documents based on the marginal costs of their reproduction and dissemination and subject to limited exceptions only;
- A general rule that all accessible documents are by default re-usable for any purpose, commercial or non-commercial, unless protected by third-party copyright and without prejudice to data protection legislation;
- Exclusive arrangements are generally prohibited. Exceptions can be accepted in a specific case of digitization agreements but those should be limited in time and safeguard the public domain character of the cultural items.
- Scope of the Directive is widened so as to cover content held by museums, libraries and archives but is only re-useable if the institutions allow its re-use.
- Public sector bodies must be transparent about the licensing conditions and charges they apply and about the factors taken into account when calculating charges.

Based on the results of the interview, this section argues that the Greek legal framework around open source software and open data is friendly to the creators and reuse of data because of the international framework that it follows, the CC licensing and the European PSI Directive.
There is no need for more laws, there are enough laws within the Greek legal system and they should be enforced and applied accordingly in order to protect the copyrights and facilitate the data and information sharing across the various interested parties. The Greek law is sufficient for boosting innovation however, the right incentives come from an overall cultural shift towards openness, integrity and transparency. By applying these new regulations of the Directive, Member States set clear rules for the re-use of data across the EU and additionally the legal environment is harmonized and more stable than before.

6. Examples of Greek Open Source Projects

The most notable open source projects in Greece right now is the DIAVGEIA platform or so called the “Transparency Portal” and the “smart city” of Heraklion in Crete. Regarding the “Transparency Portal”, government decisions which are made by public authorities and institutions, significantly affect the daily lives of ordinary citizens. Therefore, an important dimension of open government is making these government decisions open and easily accessible to the public. DIAVGEIA, introduced in 2010, has been built along three fundamental dimensions that concern:

- the completed collection and
- organization of required information from the whole of Public Administration and
- the availability on the Internet for the reliable briefing of citizens or enterprises with regards to their transactions and their interaction with the State.

In light of the harmful effects of lack of transparency between the Greek government and its citizens, the government decided to introduce the transparency program which opened the door for unprecedented transparency in the Greek public administration while introducing a new form of “social contract” between state and citizens. The effect of this initiative on the manner in which officials execute their executive power is silent but profound. This transparency program was able to curb corruption to some extent, while exposing corruption cases since interested parties and citizens alike have access to those questionable acts. This form of collective scrutiny is quite effective because it gives citizens the power to scrutinize these issues, instead of leaving it in the hands of the media who are more inclined to carry sensational stories thereby restricting coverage.

This e-government program aims to publish all decisions of civil services online at a central portal, the Greek Transparency Portal. It serves as a rich dataset with a large number of interconnected entities, taking part in all aspects of economic activity in Greece and covering all stages of public sector cash flow: from budgeting to contract formation and finally, to actual spending. The main objectives of the Program are:

- Safeguarding transparency of government actions
- Eliminating corruption by exposing it more easily when it takes place
- Observing legality and good administration
- Reinforcing citizens’ constitutional rights, such as the participation in the Information Society
• Enhancing and modernizing existing publication systems of administrative acts and decisions
• Making of all administrative acts available in formats that are easy to access, navigate and comprehend, regardless of the citizen’s knowledge level of the inner processes of the administration

DIAVGEIA is enforcing transparency over the government and public administrations, by requiring that all government institutions have to upload their decisions on the Diavgeia Web portal. The portal is managed by the Ministry of Administrative Reform and E-Governance. Diavgeia is now fully implemented by public authorities. The current rate of uploads in the Diavgeia portal is 16,000 decisions per working day, summing up to a total of approximately 27 million decisions up to now. The technological implementation model which is based on an agile strategy of “open content” and “open architecture” allows for the dissemination and re-use of Public Sector Information (PSI), providing the necessary tools for open and thorough access to it. Each document is digitally signed and assigned a unique Internet Uploading Number (IUN) certifying that the decision has been uploaded on DIAVGEIA. Following the latest legislative initiative (Law 4210/2013) of the Ministry of Administrative Reform and e-Governance, administrative acts and decisions are not valid unless published online. The “Transparency Portal” is considered an open government Best Practice and has been presented to many European and international conferences and other events receiving very positive feedback. In Greece it is considered as a prototype for the design of future e-Government interventions, both at the organizational and the technological level.

Nine years of operation of the portal have been completed and on this occasion, it is worth mentioning some important opportunities for the public administration and the private sector. Opportunities for achieving transparency and accountability and establishing citizen-state trust relationships and for the digital transformation of public administration.

The quality of data needs improvement as decisions are currently uploaded as PDF files and follow no structuring of their textual content. As a consequence, interested parties (the government, public authorities, ordinary citizens, non-government bodies, courts, the media, etc.) rely on keyword search over PDF files, in order to find decisions that might affect them in some way or verify that uploaded decisions have been taken according to the law. Also, despite the fact that these decisions are digitally signed, there is no integrity mechanism which ensures the immutability of all decisions over time.

The need to revolutionize the way that decisions of the Diavgeia program are made public, by following the footsteps of other successful efforts in Europe which publish legislative documents as open linked data was made clear by all interviewed experts. By applying Semantic Web techniques (human - machine readable format), the goal is to achieve a new state of affairs in which ordinary citizens have advanced search capabilities at their fingertips on the content of public sector decisions. In addition, by enabling the use of blockchain technology, decisions can remain immutable, introducing unprecedented levels of transparency to the DIAVGEIA program.
and ensuring the integrity of the published decisions as open linked data. A couple of suggestions made by the experts:

1. Modeling and encoding the content of decisions uploaded by the Greek public authorities to the DIAVGEIA website. Using this ontology, decisions can be encoded in RDF and be interlinked with other Greek government data (e.g., legislation in the system Nomotheia, General Accounting Office and others), empowering interested parties to pose rich queries over these data sources. The linking of Diavgeia with Nomotheia has the benefit of making sure that the references of public sector decisions refer to valid legislative documents (laws). Also interlinking DIAVGEIA with a dataset encoding the administrative geography of Greece has the benefit of categorizing decisions based on geographical territories. This will be achieved by integrating existing information systems (existing protocol and document management) and minimizing manual entries for decisions. This will save time for public officials and reduce mistakes and especially to achieve better quality information and less electronic bureaucracy.

2. The work currently done for the version 2 of the platform, involves cutting edge technologies like distributed ledgers for storing and sharing of data. By organizing and aggregating decisions into blockchain structures, it is possible to verify the correctness or each document and detect possible foul play by a participant in the process.

3. DIAVGEIA gives an API to pull data, however it should be made more open in order to cover more areas and give access to more data sets. Moreover, there are opportunities for new personalized services. Depending on the target group, DIAVGEIA provides an information tool to professionals interested in doing business in Greece, as information on contracts and commissions, budget commitments is posted. Additional front ends can be created for businesses that engage with the public sector and are interested in the pre-production of specific products and services. These new services can also be implemented by the private sector through the open API (Open Access Program Data Interface).

Regarding smart cities, the term has been used to describe cities that are environmentally sustainable, those with a concentration of knowledge workers, and places with smoothly functioning infrastructure and entrepreneurial economies. Over time, the idea of creating digitally connected cities moved to the forefront.

Today those concepts are converging. Smart cities are being redefined as places where different actors employ technology and data to make better decisions and achieve a better quality of life. City agencies can use data to respond to fluid situations and to plan more accurately for the future. Better-informed companies and individuals can make decisions that translate into more efficient use of resources for the city overall.

Three layers work together to make a smart city a reality. First is the technology base, the building blocks that have to be in place before a city can deploy applications at any kind of scale. The technology base includes high-speed communication networks, a critical mass of smartphones, open data portals, and sensors. Second are the specific applications and tools
themselves. The third and most crucial layer is user adoption and experience. Before a city can become smart, it has to be connected. The underlying digital infrastructure has to be in place, including a network of data-collecting sensors and devices, comprehensive broadband and wireless networks, and platforms on which data can be stored and shared.

A city with strong communication networks can quickly and securely transmit the data collected by smartphones and other sensors. Cities around the world are prioritizing faster fixed and mobile broadband speeds and decreased latency, which are needed to support ever-growing data usage by residents as well as the development of higher-bandwidth applications. At the same time, less bandwidth-intensive smart city applications can benefit from the rollout of low-power wide-area networks (LPWAN), which allow broad deployment of sensors with much lower operating costs. Free Wi-Fi throughout a city is especially useful for visitors but also helps residents who do not have access to unlimited mobile data. Open data platforms are the last crucial ingredient of the technology base. Smart technologies run on data—and cities, with their immense scale and complexity, generate endless streams of it. They create huge volumes of data on traffic flow, public transit systems, energy demand, crime incidents, waste disposal, noise, weather patterns, outbreaks of infectious disease, and countless other aspects of daily life. Yet this data only becomes useful once it is made available to actors who can build smart applications out of it. Open data platforms do exactly that. They come in multiple forms, from centralized open data portals to specialized real-time travel information platforms. They allow for safe storage and adequate access to the different data sources that power a smart city, and they can provide the raw material for ongoing innovation.

Turning raw data into alert, action, and insight requires the right tools. This is where technology providers and app developers come in. They continue to create a wide array of specific applications touching on every aspect of urban life. In some cases, data feeds into analytics systems that can remotely adjust, move, or control objects and complex systems, with no human involvement required. In others, the key is creating easy-to-use interfaces so that individual users and city employees can access information and act on it.

Encouraging Participation is one of the key challenges for Heraklion to encourage the citizen, the businessman and the players of the city to participate in the life of the city. The Municipality already has a Municipal Committee of Consultations as well as thematic committees such as the Smart City Committee, the Tourism Committee, etc. which encourage participatory planning at the institutional level. At the same time, the Municipality encourages the participation of citizens through the Volunteer Networks that already have a strong presence in city life, as well as the encouragement of independent interventions of groups of citizens. Social cohesion in a smart city means:

- Covering the needs of the "smart city" for the largest possible part of the city's inhabitants (balanced investments - changes, balancing inequalities in accessibility, etc.). Emphasis on people with limited mobility and accessibility to services (elderly, children, people with disabilities, etc.)
The upgrading of public and social structures is aimed at serving all residents regardless of economic order, spatial and social origin, place of residence and accessibility to services. The aim is to upgrade the quality of life with horizontal application to the citizens.

Participation in shaping the development path of the city involves all citizens (development of consultation, participation, etc.).

Innovations / new areas of research include and relate the social dimension of the desired outcomes to a wide range of social groups and societies.

Rational resource allocation: A smart city uses information as a basic principle of planning, organizing and servicing the functions it is required to perform. Comparing, compiling, and analyzing information with reference to space can highlight the patterns of occurrence and change of phenomena over time, facilitate the identification of shortcomings and weaknesses, and thus direct the rational commitment of resources (human and financial) (Heraklion Digital transformation 2017).

A key element of Heraklion’s policy is the choice of open standards in the storage and distribution of information, as well as the use of Open Free Software. The “digital content” of the Municipality is open, meaning the data it has is free for use by all citizens. This enables the city to use this data to improve local entrepreneurship, participation and quality of life. Heraklion follows the example of all the world’s leading cities for investing in open digital infrastructures.

Based on the results of the interview, this section argues that the most notable open source project in Greece right now is the DIAVGEIA platform or so called the «Transparency Portal». Government decisions which are made by public authorities and institutions, significantly affect the daily lives of ordinary citizens. Therefore, an important dimension of open government is making these government decisions open and easily accessible to the public. The direct accountability brought upon the administration by the radical transparency that the Transparency program introduces, leaves considerably less room for corruption, and exposes it much more easily when it takes place since any citizen and every interested party enjoy the widest possible access to questionable acts. This e-government program aims to publish all decisions of civil services online at a central portal, the Greek Transparency Portal.

Another notable open source project in Greece is the smartcity approach to the municipality of Heraklion, in Crete. Based on open source software, open hardware, open data and through open governance, citizens enjoy a higher quality of life than before, enabled through the use of technology. For the citizens to be able to fully participate in such initiatives and help them grow, some basic knowledge on high level about technology is required. Thus the following question explores the information technology literacy in Greece and its impact on Open Source Communities.

6 source: https://smartcity.heraklion.gr/en/pillar/governance/
The modern inclinations and challenges are dynamically impacted by media and information, thus it can be used as an important tool to encourage users to collaborate through innovation. The lives of people have been significantly revolutionized ever since the development of Web 2.0 and Web 3.0. It has enabled easy flow of information throughout the world by enabling individuals to communicate globally. This revolution has underlined a new mindset, i.e. forming communities and collaborating by making people change the way they live their lives. It is easy to produce and share content with the help of easily accessible internet in the west. In this manner, active users participate and exchange information by accessing digital community. The educational setting has been greatly reshaped because of these advanced technologies as well. The way people perceive and get influenced by the online content depends greatly on their level of digital literacy.

The Greek educational system should incorporate the aspect of digital literacy, as contended by numerous experts. In this manner, the experts believed, use of computers, information available online, and newly introduced technologies will be better understood by the younger generation. For this purpose, the digital literacy concept should be well comprehended by the educators so they can help students understand it. According to a few experts, understanding and critiquing media requires the students to be properly equipped, they should not be used in an instrumental or functional way or as a mean to deliver information. The inability to think in a productive manner due to poor education quality is the fundamental problem, they stated. The future generations may face unexpected consequences due to this educational inability because they will probably be lacking in the area of critically evaluating and questioning the information they come across on the internet.

Therefore, the concept of using new technologies and interpretation of online content should be introduced in the educational policies. The commodity logic manipulates and uses online information, for this purpose it should be determined how the issues emerging from this are addressed by the educational policies.

According to all the experts, life-long learning is necessary. The purpose of educational systems should be to provide life-long learning experience rather than focusing on providing education that only lasts for as long as the student remains in the school. However, the concept of life-long learning is rarely practiced in the educational systems, and instead they encourage students to accomplish the goals set by respective institutions. Success does not depend on memorizing procedures and facts. The complex concepts should be conceptually comprehended by individuals in order to use them in a creative manner for the generation of new thoughts, philosophies, products and knowledge. It is important that students focus on evaluating what they read in a critical manner, clearly express their ideas, and possess an understanding of the mathematical and scientific thinking. Their focus should not be on learning de-contextualized and fragmented facts rather they should focus on learning usable and integrated knowledge. The issue to life-long learning must not be left at the discretion of the educational institutes, the students need to take responsibility for it as well. Citizens who have acquired media and information literacy skills may:
- Enjoy safe access and browsing in the new media environment, recognizing the benefits of information and interaction and protecting, at the same time, their personal data.
- Foster a strong critical attitude and deep knowledge on how media and multimedia content platforms function
- Learn how to look for the truth behind the news and how to respect copyright.
- Realize the crucial role of audiovisual and digital archives in the preservation of cultural heritage. Through open access to archives, young people especially, learn about the past and how to (re)use the material for their own creative projects.
- Become themselves producers and consumers simultaneously, hence “prosumers”, as an element for their own cultural self-expression as well as for enhancement of the public discourse.

GFOSS has a framework agreement with the Ministry of Education, within this agreement GFOSS has designed the “edulabs” initiative (for students) and representing Greece in the “Scientix” project (for teachers) of EU.

Edulabs have been installed in 144 Schools in all major cities in Greece. Each Lab is equipped with Raspberry Pi’s, Robotics Kits and a 3D Printer and Scanner, all labs run a special open source distribution that contains all open source educational software and educational materials used in Greek Schools and is available in GitHub. This software has been collected by a community of about 330 teachers that actively participate in open education projects of GFOSS, all this information is collected in open repositories at edu.ellak.gr.

Scientix project promotes and supports a Europe-wide collaboration among STEM (science, technology, engineering and mathematicss) teachers, education researchers, policymakers and other STEM education professionals. In its first stage (2009-2012), the project built an online portal to collect and present European STEM education projects and their results, and organised several teacher workshops. The goal of the second phase of the Scientix project (2013 – 2015) was to expand this community to the national level. Through a network of National Contact Points (NCPs), Scientix reached out to national teacher communities, and contributed to the development of national strategies for wider uptake of inquiry-based and other innovative approaches to science and math education.

This activity is continued in the third stage of Scientix (2016-2019), which is funded by the Horizon 2020 program of the European Union for research and innovation. Scientix was originally born at the initiative of the European Commission and has, since its inception, been coordinated by European Schoolnet, a Brussels-based consortium of thirty ministries of education, which is a driving factor for innovation in teaching and learning and fosters pan-European collaboration of schools and teachers.

HELLUG’s main mission is to educate users with the Linux operating system and capitalizing in helping school’s share the knowledge about open source software. Additionally, by installing Linux OS in public school’s hardware, they contribute in re-using old, non-functioning computers and thus enabling students to learn. In addition, “Epoptis” software is revolutionizing
access and use to old hardware as it is enabling a classroom of computers to be administered from a single computer (the professor's computer), for free.

Based on the results of the interview, this section argues that the emergence of Web 2.0 and 3.0 has revolutionized many aspects of people’s lives. One of its most basic characteristics is how communication is now enabled globally, allowing information to flow easily from one part of the world to the other. This underlines a new mentality, changing the way people govern their lives, form communities and collaborate. In the knowledge economy, memorization of facts and procedures is not enough for success. They need to learn integrated and usable knowledge, rather than the sets of fragmented and de-contextualized facts. Projects such as “Edulabs” and “Scientifix” boost teachers and students ability to foster a strong critical attitude and deep knowledge on how media and multimedia content platforms function and how to best use these tools. The following question will explore the obstacles facing the Greek Open Source Community.

8. Obstacles facing the Greek Open Source Community

Most of the respondents raised the issue of the de-politicization of public administration, recognizing the fact that the past governments, since coming to power, have used the public sector as a vehicle for the hiring of family members, friends, and close associates. As it turns out, this is a multi-faceted issue and there is not just one “solution” to address it. The shared opinion of all of the respondents in addressing the issue is by changing our mindset and by introducing open source software solutions within the Greek public administration bodies.

The latter leadership bodies have proved to be as unscrupulous and opportunistic as the leaders of the political parties that run Greece since the re-establishment of parliamentary democracy in 1974. Making false promises, outright lies, and using intimidation methods against opponents of the government have been the defining features of the Modern Greek administration.

The effective supervision and controlling of public-sector entities is hard for individual ministries because central administration’s tools to monitor, coordinate and share-information are quite poor. To enable effective implementation, it is important to manage, oversee, and coordinate effectively, which is not the case with the central administration. In addition, the central administration lacks management of policy measures in the long-term, which includes structural reforms for the sustenance of economic growth. The ineffectiveness of other reforms is due to this underlying issue. There is no space for cooperation in ministries and ministry-based silo vision of governance due to central administration’s culture and procedures of prevailing nature. Fulfilling the formal competencies is the primary focus of the administrative culture. The fragmentation and compartmentalization of the administrative work is done within ministries. The coordination issues handicap ministries as they are unable to prioritize their competences. The formal structures rarely support coordination; if it does happen on a rare occasion, and it is usually based on personal knowledge or initiative.
The efficiency and effectiveness of governance is hindered by legal formalism, which is a huge issue reflected in these areas. In this manner, the central administration’s costs are raised due to undermined productivity. Furthermore, the central government’s effectiveness with regards to its services for public and organizations is also undermined.

If civil law is used as a basis for legal system, then it can partly result in legal formalism, which conventionally highlights the need to cover all issues through a structure of laws and regulations that are comprehensive and detailed. However, according to the majority of experts, Greece lacks this corrective action which has been taken in other European nations who had a tradition of similar nature. Securing legal text’s clarity, updating codes in which such a legal system is structured, and cleaning-up law through consolidation and removal of redundant texts is the main focus this corrective action.

In legal formalism, the administration work is framed by extensively using internal administrative processes. This is done so that fundamental policy work is not paid as much attention to as these processes. There are various European countries that face this issue, however it is relatively stronger in case of Greece, to the extent that civil servants career and HR policies are covered by internal administrative processes. An inflexible and highly detailed system has been generated as a result of this. This consequently compromises the personnel mobility among ministries. The state’s competencies are highlighted by another example.

Taking an important decision related to administration or policy at any government level is almost impossible. For instance, rationalizing and adapting the ministries structure is virtually impossible for incoming ministries, unless they put in great struggle. Securing integrity of administration and protecting it against interferences of political nature was the primary purpose of establishing some of these administrative and legal processes. However, central administration has experienced a framework that lacks efficiency and cooperation, and most significantly, varied outcomes regarding integrity of public service. The way in which government functions, and visions and expectations of people related to it are partly related to what legal formalism is about. It is widely believed that the culture of Greece incorporates this vision, however the opposite is suggested by the developments that took place recently, as they did not correspond to the desires and expectations of the community.

In the culture of legal formalism, administration work is slowed down, policy substance of civil service work is not considered, administrative processes are honored, policy actions without legal text are discouraged, and the civil servants do not receive any incentives for the initiatives they take.

The administrative management and other policy decisions should be based on factual evidence and data. However, Greece’s public governance severely lacks in this area. There is an inadequacy of processes thorough which data can be collected, collated, and analyzed. The duties such as, information extraction from data and record keeping are often ignored by the administration. Financial data should not be used to create limits for data management. In
addition, data management should be handled as an ad-hoc project. Reliable data production is significantly emphasized by Greece and the Troika MOU (memorandum of understanding) that took place in May 2010. Nonetheless, only the expenditure and revenue data is usually considered by these requirements. Data management on a broader scale would have been supported if the need for capable and competent administration was mentioned by Troika Memorandum of Understanding. The justification of efficient and effective policy decisions require a strong evidence base on behalf of reform strategies, however there is an absence of precise data and inadequacy of data collection schemes which consequently hinders the justification and support of the policy decisions. Evidence is an essential factor for significant reforms that have the potential to fortify societies by significantly enhancing the economic performance. Legal formalism’s most negative impact is due to its policy making approaches that lack evidence, which results in disconnection of public administration from the society and economy.

Based on the results of the interview, this section argues that the central administration lacks the management, oversight and coordination structures to support effective implementation and long-term management of policy measures, including structural reforms to support sustained economic growth. The underline issue is legal formalism which prohibits innovation because of the use of internal administrative processes to frame the work of the administration, so that more attention is paid to these processes than to underlying policy work. That makes it very difficult for structural reforms and overall innovative actions to take place, anything that does not follow the as-is process is considered illegal thus not implementable. The following question is the last part of the questionnaire and it explores the future of Open Source Communities.

9. The future of Greek open source communities

Open source has been changing the world for more than 25 years. Ever since Linux's inception in 1991, the open technology movement it set in motion has been very successful and its influence — which goes beyond the world of software and business — is likely to continue for decades to come. Open software and systems are where many advanced, cutting-edge technologies are now being developed such as Cloud, AI, blockchain, and quantum computing. As in the past, open source will help democratize these new technologies and create groups dedicated to advancing them.

In addition, all of the respondents highlighted the important role education plays into shaping the future because the citizens and leaders of tomorrow are the youth of today. Therefore, there is a need to transform our approach to education to fulfill the needs of every individual during the era of abundant technological innovation.

Moreover, in order to offer education its rightful support during this era, the principles of open source, open hardware, open design and open governance have to become embedded into our culture, as well as into public sector agencies. This means there should be a mindset shift on how we perceive technology and how we utilize it through open source tools in our
everyday life. At the same time, opening and utilizing data from the public sector agencies would benefit the society on all its aspects, from individual to business to education, thus enhancing any future results, conclusions and discoveries. That's why in today's complex environment “open” increasingly means interoperability across platforms — for frameworks, for apps, for data — even those belonging to competing entities. It's also why it's critical that the groups that manage these projects are committed to open governance. Without open governance, users realize there is a greater risk of vendor lock-in, or even potentially, project abandonment (Bouras, C.et. al., 2013).

**FOSS, based itself on skill developing, learning and experimentation, has a great potential as a training toolset.** The skill setting value of FOSS has been acknowledged long ago by employers that are willing to recruit developers with an open source “exposure” background. Such a training value comes at significantly low cost either to individuals or public organisations and therefore it can be capitalized to increase digital literacy and professional IT skills for both staff and citizens. Governments and public administrations are urged to develop programs and initiatives on FOSS training for staff and citizens through their capacities and infrastructures. The European Union should also fund and actively support FOSS training as means to address its deficit (compared to US) in ICT skills and digital literacy. These actions can have several benefits on various levels: increasing the level of e-inclusion and digital literacy, increasing the level of professional ICT skills in public organisations, supporting and expanding a base of new open source developers, enhancing trust and awareness on FOSS through expert training and certification for staff/citizens, fostering innovation on new internet-based models for software delivery.

Apart from providing itself a training tool for ICT skills, FOSS can offer low cost, stimulating learning environments through educational platforms and applications. On certain occasions FOSS penetration is faster and higher within the IT infrastructure of educational units and departments compared to other public sector sections. Greek government and public administrations are urged to introduce or further integrate FOSS-based learning tools and environments in their educational systems and infrastructures. Through a policy for promoting FOSS-based learning, schools, educational units and administrative authorities will be able to:

- Reduce the cost of buying educational software
- Develop or customize their own learning platforms independently without having to solely rely on proprietary software vendors
- Provide open and customizable tools and platforms for ICT training and skill developing
- Provide a basis for an early awareness or adoption of open standards and open source software.

It is important to use the technology as a personal cognitive and social tool by developing new models that use technology to support individual and social learning activities. Multidisciplinary collaboration between technology developers and educational designers need to find ways to apply virtual spaces, simulations, and game-technology or mobile applications to learning. Many European countries have made efforts to use information and communication technology (ICT) in education. For example, the Finnish strategy says: “In developing the use of information and communication technologies in education, the objective is to shift the focus from
hardware to pedagogic renewal and help increasing numbers of pupils to learn increasingly demanding information structures and problem-solving skills. In education, the emphasis lies on high-quality contact education, communality, interaction, open and flexible expression, and the use of distributed expertise through networks.” (Information Strategy for Education and Research 2000-2004, Ministry of Education in Finland). The core message of this strategy is that the rapidly changing society necessitates new forms of participation. Modern working environments involving intensive collaboration, expertise sharing, and social knowledge construction are permanent, and therefore contribute to setting new norms for educational standards. By combining the ideas of collaborative learning and networked technology, these approaches aim at turning classrooms of students into communities of learners and learning situations into challenging and interesting projects with authentic problems. Such inquiry activities provide a valuable context for learners to acquire, clarify, and apply an understanding of concepts in different domains. Based on research and practical experience, the following principles are the best arguments according to the experts for implementing ICT in learning:

- ICT can increase authenticity and interest.
- ICT can build virtual communities among different schools, collaborating with teams, and teachers.
- ICT can help to share perspectives among students with different expertise; proving peer support and “benchmarking practices” in different fields.
- ICT facilitates the use of technology-supported inquiry approaches and problem-based models for increasing learning-to-learn skills.
- ICT provides innovative ways (for example, mobile tools) of integrating “just-in-time” support and interaction in different learning contexts.

Equally important, is the use of open or free tools by the public bodies of Greece. Although there have been efforts towards that direction, those efforts did not flourish because of the rigidity and the fear of the political impact and the distress of the officials to change their habits. Overcoming this obstacle requires a political decision to make a change. Such innovative political decision would be for example the use of Libre Office suite instead of the MS Office suite. It is clear that learning to use that suite requires the education of the employees and thus, introducing open tools into the educational system is the key.

Open technology will also have a profound impact on the next chapter of cloud. With companies increasingly integrating public and private cloud capabilities with existing on-premises business systems, it is more important than ever to give developers and businesses the ability to easily move between frameworks and use the best tool for the task at hand.

Nearly half of the smart city applications have a positive impact on more than one aspect of the quality of life. Mobility applications are primarily designed to reduce commute times, for instance, but tools such as intelligent traffic signals and congestion pricing also contribute to decreasing CO2 emissions and reducing road fatalities. Some, like car sharing, could save residents money by enabling them to forgo vehicle ownership. In healthcare, telemedicine can have multiple kinds of impact: it saves patients travel and waiting time; it may also save them
money; and it can improve health outcomes by increasing access to medical care in underserved communities. Data-driven building inspections can improve the efficiency of city operations while mitigating many risks, including fire safety hazards and exposure to lead.

Awareness of these co-benefits can help officials demonstrate the full positive impact of smart city applications on different constituencies—and articulating the benefits for residents is central to securing their buy-in and participation. Public adoption and behavior change determine whether applications such as home energy consumption tracking create real impact, and for residents, their own savings may be the selling point.

Officials also need to be aware that some applications may have a positive impact on one dimension but negative impact elsewhere. E-hailing, for instance, can save lives since it provides a safer alternative than driving for people who are impaired. But depending on usage patterns, it could increase average commute times by adding vehicles to the roads and worsening congestion.

**Based on the results of the interview, this section argues that digital citizen services can help reduce this unproductive time in government services. Cities can create easy-to-use online portals allowing people to apply for driver’s licenses, register their vehicles, and interact with agencies without the in-person hassle. This is especially helpful in cities with many layers of bureaucracy and red tape.**

The aforementioned interview data, provided enough information to shed light on the research questions of this thesis. This is done in the next Section.
5. Analysis: Answering the Research Questions

This section builds on the results of the empirical research presented in the preceding paragraphs to shed light on the following research questions this thesis has initially posed:

- How important is the role of open source / open licensing for software and hardware in a collaborative environment?
- What is the contribution of open source communities and how they boost innovation in societal and business environment?
- What are the opportunities and challenges for Greece to implement big data openness, governance and growth?
- Is big data openness and emerging technologies like blockchain in favor of open source community projects?
- How do the open source communities perceive the blockchain?

1) How important is the role of open source / open licensing for software and hardware in a collaborative environment?

Open source is a type of licensing agreement that allows users to freely modify a work, use articulated work in new ways, integrate the work into a larger project or derive a new work based on the original. By removing barriers between innovators, open source promotes a free exchange of ideas within a community to drive creative, scientific and technological advancement. Although, it is most commonly used in the software industry, professionals utilize open source licenses in many industries and applications: biotech, electronics, robotics and teaching to name a few. By placing an open source license on an original work, a person or organization agrees to:

- Make the entirety of the program's code available to the public
- Allow anyone to modify, enhance or re-engineer a program's code
- Allow the creation of derivative works
- Allow the program to be utilized for any purpose the user wishes

An open source licensing agreement stands in contrast to "proprietary licensing". When a user first starts a piece of proprietary software (e.g. Microsoft Office) the user typically agrees that they will not alter or modify the source code and will only use the software in the ways prescribed by the manufacturer. The back-end code of proprietary software is kept secret from the public, and anyone attempting to re-engineer or copy the code is subject to legal action by the software’s owner.

Why open source?

The idea of open source stems from the technology community. From the earliest days of computers, programmers and engineers developed new technologies through collaboration. For instance, a programmer in Greece develops a new application, then another programmer in Singapore studies the application and discovers ways to improve it. The knowledge is shared, and the entire community benefits from the collective innovation. (Fogel 2005, pp 38)
Hellenic Linux User Group or Hellug (Hel.L.U.G.) is the main Linux User Group in Greece. It is a non-profit organization founded by people who are interested, use or are positive towards Linux. Hellug's target is the union, communication, the promotion of the Linux operating system and the networking of people involved in such activities. The not-for-profit HELLUG was founded in 1998 and served as the first official Greek Club promoting open source development and in the same time facilitating community and educational initiatives.

*The Open Source Cycle*

It is a common belief among most people that a product is given away for free if it is developed as an open source product. The developers can sell their open source applications to people, regardless of the fact that most of such products are free of cost. However, copyrighting or patenting the derivative work is not permitted as per the license. Thus, it is possible that derivative works, performing similar functions, are developed by others for free.

The derivatives of the original work are propagated by the open source license. The users are required to follow the license if they agree to its terms. The open source of all versions of a software in perpetuity is guaranteed only if one of its part is made open source. Most of the organizations are inclined towards keeping open source foundation and building services on top of it, rather than directly selling the open source applications. The software dependent businesses are improved with help of a solid base as provided by open source technology. (L. Zhao, S. Fan, J. Yan, 2016)

*The Internet is Open Source*

Open source technologies provide basis for the internet’s core functions. Web servers' operation is regulated by the Linux operating system, while transference of data among worldwide server infrastructure and personal devices is negotiated with the help of a web server called Apache Web Server. There are infinite applications on the internet that are publicly accessible. The open source community can even access the proprietary innovations opened up by Google, Facebook, and other large internet companies. The streamlining of the whole internet is made possible through technology dissemination which consequently enhances user experience.

Innovation through collaboration is greatly encouraged by open source licensing. It would not have been possible to develop the technologies we have today without innovation through collaboration. In addition, the patent law would have restricted the public access to these technologies. The fast development of technology, in the last few decades, can be attributed to the open source movement.
2) What is the contribution of open source communities and how they boost innovation in societal and business environment?

The contribution of open source communities has many dimensions as it covers different fields ranging from business to society. Business-wise, open source communities have produced new business models open source software and hardware are bundled along with consultancy services or new innovative products. As far as the public administration is concerned, while the government should be the leading provider of data, individuals or teams can use that data in order to produce platforms, products and services that streamline the public administration process putting the citizen in the center of it. Platforms such as DIAVGEIA or the open data portal of Heraklion, contribute to manage more efficiently and effectively the citizen-state and business-state relationship by giving more information and more access to the interested parties. As the government should be the main provider of data, citizens and businesses should be free to access and reuse that data.

Open source software has a very promising future. More vendors are beginning to contribute to the open source software campaign. Even the non-traditional software companies are beginning to emulate exclusive software companies as they continue to introduce different open standards while boosting open source software. Open software is gradually venturing into AI/Blockchain/IoT domain. This is why open source organizations such as the Apache Foundation have taken it upon themselves to introduce new projects into the open source industry leading to the establishment of innovative open source communities such as openai.com. FOSS prides itself on its skill development, experimentation and learning, which is part of what, makes it such a great training toolset. (HICSS 2017)

Both open innovation and open source software are very essential in today’s industries. Communities come together to create different values, thereby boosting technology and innovation. However, though the parties involved are responsible for generating these values, in most cases, companies whose business models depend on these models end up commercializing it. This is why the business model representations used for most of these open systems are more concerned about the commercial aspects of companies, without any regard for value distribution and creation by the communities. This can affect the level of potential representation for alternative value of those individuals and communities who are not interested in direct monetary compensation. (Weber 2014, pp 29-33)

Regardless of what one chooses to call it technology has created a lot of opportunities for business innovations in recent decades. Open source software is one of such technologies. This connection has mostly been about the manner in which open source supports innovation while enabling business models. There’s been a lot of talk about business models amongst the academic community and the industry in recent times. New business models (NBMs) are becoming more relevant not just for the society, but for research purposes too. Their sharing, collaboration and sustainability puts them ahead of others, which is why their audience keeps increasing and why they’re becoming an emerging topic in economic research. These new models encourage value co-creation amongst diverse communities which creates a new view of what it
takes to do business today. The collaborative nature of most users of open source projects has already ushered in new innovations that compete with a lot of professional businesses. Open communities also create opportunities for these businesses. Companies have started creating value from open source projects to benefit from them through different business models. Though communities are gradually becoming more innovative, they hardly enjoy any monetary value from these innovations, apart from the alternative rewards available to them. Especially when you consider the fact that a lot of companies are linking up with those communities involved in the creation and innovation of open values. (47th HICSS 2017)

3) What are the opportunities and challenges for Greece to implement big data openness, governance and growth?

Challenges: fight bureaucracy/legal formalism

The central administration lacks the management, oversight and coordination structures to support effective implementation and long-term management of policy measures, including structural reforms to support sustained economic growth. The interviews revealed that the underline issue is legal formalism which prohibits innovation because of the use of internal administrative processes to frame the work of the administration, so that more attention is paid to these processes than to underlying policy work. That makes it very difficult for structural reforms and overall innovative actions to take place, anything that does not follow the as-is process is considered illegal thus not implementable.

Opportunities: new platforms like Diavgeia, diadikasies, heraklion, (supporting organizations as FOSS producers, reusability of data), licensing norms

The most notable open source project in Greece right now is the DIAVGEIA platform or so called the «Transparency Portal». Government decisions which are made by public authorities and institutions, significantly affect the daily lives of ordinary citizens. Therefore, an important dimension of open government is making these government decisions open and easily accessible to the public. The direct accountability brought upon the administration by the radical transparency that the Transparency program introduces, leaves considerably less room for corruption, and exposes it much more easily when it takes place since any citizen and every interested party enjoy the widest possible access to questionable acts. This e-government program aims to publish all decisions of civil services online at a central portal, the Greek Transparency Portal.

As discussed previously, a smart city is a compilation of open source software and open hardware (such as IoT devices) used seamlessly in order to produce data about the city life. This kind of data is open to anyone interested in it and it is used in order to find innovative fixes to persistent problems, such as the administration of public authorities, transactions between citizens and state, environmental protection and others. Heraklion municipality in Crete is a role
model for EU for successfully becoming a smart city. More Greek cities should follow the steps and implement the plan of Heraklion, in order to improve the quality of life of their citizens.

The experts argued that Hackathon events contribute to sharing knowledge and boosting innovation within municipalities. Through brainstorming and a safe competition, great emphasis is placed on the introduction of disrupting technologies (e.g. AI, blockchain, VR, augmented reality, open APIs) in local government as well as the promotion of open data as it can be used by new developers and startup companies to create innovative applications.

The Greek legal framework around open source software and open data is friendly to the creators and reuse of data because of the international framework that it follows, the CC licensing and the European PSI Directive. According to the experts, there is no need for more laws, there are enough laws within the Greek legal system and they should be enforced and applied accordingly in order to protect the copyrights and facilitate data and information sharing across the various interested parties. The Greek law is sufficient for boosting innovation however, the right incentives come from an overall cultural shift towards openness, integrity and transparency. By applying these new regulations of the Directive, Member States set clear rules for the re-use of data across EU and additionally the legal environment is harmonized and more stable than before.

In order to best reuse the data, three key implementations have to be taken into consideration:

*Developing data portals*

One of the main reasons why national Open Data Portals exist, is to enable users to go to one centralized portal where all (meta) data of all local and/or regional portals can be found. The first step in this process is to create and administer a national Open Data Portal. Open Data portals are an essential part of the national and European data infrastructure. They connect data holders with data users, who in turn create services that citizens benefit from and rely on. They perform a wide range of functions – as platforms for publication, discovery, open government and engagement, and policy compliance/monitoring – which portal owners have to balance. One of the requirements to make sure data can be re-used, is related to guaranteeing that metadata available on the portal is up-to-date.

*Data driven decision making*

Not only are more governments starting to acknowledge the need to open more data and are changing their approach accordingly, we also see a positive trend in Open Data being used in decision-making. In 2016, 57% (16 countries) of national Open Data Portal representatives were aware of Open Data being used in decision-making. By 2017, this number increased by 11pp. to 68% translating into 19 countries. Notably, in Latvia policies are systematically made by using various data from state institutions including Open Data. An example is insolvency data which can be used to plan policies or support operations, in both the public and private sector. (europeanopendataportal.eu)
Licensing norms

The third sub-indicator contributing to the Presence of Open Data policies indicator is the use of licensing norms needed to determine the terms and conditions for the re-use of Open Data. Licenses are essential when re-using Open Data to avoid potential copyright and other legal issues. This could happen when either the license limits the use of the data or when no licence has been provided at all. Following the transposition of the original PSI Directive 2003/98/EC, many arrangements and procedures have been put in place to transpose the PSI Directive into national legislation. This has led to many different types of licenses. In order to align practices across the EU and make them more transparent and predictable for potential re-users, the European Commission had been asked by many Member States to issue specific guidelines on which licence to use. Also in Europe the Creative Commons licence has become a ‘de facto’ standard for publishing PSI in Europe. Some governments that recommend a different licence have redrafted their own licence to be compatible with the CC-BY licence. Besides better compatibility, the CC licence also provides machine-readable versions of the licences that software systems and search engines can understand. This means that public sector bodies can simply download the CC license or refer to the license via a link. The attribution requirement allows for PSI to be re-used under the condition that the re-user acknowledges the original source of the documents and or data (i.e. public sector body) by including a suitable attribution statement, preferably with a link. (B. Lowry, D. Wilson)

4) Is big data openness and emerging technologies like blockchain in favor of open source community projects?

Technology is becoming more advanced with every passing day. Due to this, companies need to focus on how they can effectively achieve exponential returns with the help of transformational technologies. There are numerous highly advanced innovations that are supported by open source software, such as quantum computing, blockchain, cloud and Artificial Intelligence. The system of open source applications has been introduced for a while now. Computers are predated by technological information’s free exchange, which has consequently encouraged technological advancements in manufacturing as well as computing. For the last few decades, numerous organizations have been using open source code which is quick to harness and provide valuable business outcomes.

A Competitive Advantage through Collaboration

The commitment to open source implies a sharp business strategy rather than wide-eyed sacrifice. Open source is consumed by the Fortune 500 countries at some point in the life of their business. Industries have become increasingly successful by using open source whether we consider gaming, crypto-currency or space program.

It is impossible for the businesses to deny the open source appeal. The organizations can easily move between systems with the help of interoperability and portability offered by open source. It is a common opinion among developers that code should be contributed by all the
developers throughout the world to any open-source project. Open source can help the business grow, innovate and remain competitive. (Ghosh 2005, pp 89-106)

Open source innovation requires some effort in order for it to provide a flourishing future. It is not possible to guaranty or predict the future success of this technology, as stated by a Board Member at Open Technologies Alliance (GFOSS). This technology can be promoted and safeguarded through a number of ways: There are a few ways to encourage and protect open source innovation, contribute as much as we take, deepen our commitment to open governance, and openly collaborate with other organizations.

**Contributing as much as we take**

The golden rule of open source is to put back in as much as you take. In open source communities, practices of open source can be encouraged and participation of employees can be celebrated if a company offers incentives. In the meantime, it should be ensured that the developers are able to access open source easily. For this purpose, the organizations should make sure that the barriers to entry are low. (B. Nothisein, F. Hawlitischek 2017)

This investment offers a few instant returns. The businesses are able to enhance their open source experience if they contribute as much as they take. Moreover, companies can gain competitive advantage if they create crowd-sourced public goods because this will enable their employees to gain experience and knowledge. (IEEE 4th International Conference on Future Internet of Things and Cloud 2016)

**Deepening our Commitment in Open Governance**

A code is openly developed by collaborators in a system that is built by following the process of open governance. In this process, GitHub and various other tools are used to build this system and there are numerous vendors that are responsible for controlling the project. The question of biasness cannot arise in this situation because collective technical community sets direction for developing code. (Storey, V. and Song, I. 2019)

The source code developed through open governance is generally more solid. This is because risk mitigation is made possible because of open governance, as a single governance model is not applicable in every situation. Every product and interaction can mirror transparency if developers commit to transparent practices. It is evident that in the past, most expansive markets and largest eco-systems have been attracted by open governance and inclusiveness of the open technology communities. A developer can predict project's future only if he contributes time to it, as indicated by the executive director of GFOSS.

**Collaborating Openly**

The key to encourage and promote open source is through open collaboration. It should be noted that the benefits provided by the open source projects are not limited to those particular projects. When a business partakes in an open source community, it can benefit in numerous ways. When changes are introduced to ways in which codes are developed by infusing principles and practices of open source into their system, the resulting technologies keep on improving and
becoming more innovative. The entire ecosystem will benefit from portability and interoperability across platforms, whether it is offered by your organization or some other business. (C. Lin, C. Liao, 2017)

The benefits provided by open source are infinite. In this context, a Member of HELLUG (Hellenic Linux Users Group), states, “the companies should justify why a project should be closed rather than emphasizing on why it should be opened”.

Ensuring an Open Future
There are several steps that need to be taken in order to promote and defend open source technology, despite its numerous benefits. The application of open source, contribution to it, and investment in its communities improves open source technology and makes it stronger. The achievements of open source cannot be taken for granted. For the successful continuation of open source technology, it must be ensured that the businesses are taking substantial steps to promote and encourage it. (C. Loebbecke, 2015)

5) How are the open source communities perceiving the blockchain

Open source is a collaborative software development and distribution model that allows people with common interests to gather and produce something that no individual can create on their own. It allows the creation of value that is bigger than the sum of its parts.

DAOs (Decentralized Autonomous Organizations) are business vehicles that operate through the combination of smart contracts and blockchain technologies. DAOs are not traditional legal entities but they might be partnerships with votes attached to tokens, which are financial products – a form of exchanging value in a trusted environment. Combined with emerging technologies, they have transformative potential.

DAOs are a re-imagined form of business vehicle, somewhere between a collective investment structure, a partnership, a venture capital fund, and a crowdsourcing platform. They facilitate economic cooperation on a global scale, allowing anyone with an internet connection to become an owner and manager of a business, and share in its risks and rewards. Instead of articles of association and shareholders agreements, DAOs operate according to bylaws expressed in a web of interlocking software code. The components of this code are commonly called “smart contracts”. A smart contract is an agreement that can digitally self-execute some of its terms. Through self-execution, smart contracts can reduce the amount of human intervention that is required for the performance of an agreement.

In the emerging Third Web, there will not be a convergence of ownership on just one or two organizations. Web 3.0 is intended to take back the internet for everyone. This movement away from putting all of your trust into one entity is for the betterment of humanity. Allowing just a
few companies in Silicon Valley to run the entire internet is the equivalent of having a Digital Dictatorship.

Web 3.0 has the power to enhance industries such as digital currency, communication, and social media, and break those industries from the singular strongholds that have bottlenecked the various, cool features of the internet all for themselves. Decentralized Autonomous Organizations will be at the forefront of the movement back to how the web should be. DAOs are especially prominent in blockchain tech where some blockchain companies are taking back the internet not for themselves, but for the betterment of everyone, everywhere.

DAOs are not companies: they have no registered offices, directors or employees, and they are not recognized as their own legal “person”. A DAO is created by smart contracts, deployed on a blockchain that is capable of executing them. From that point on, human involvement is limited, as a DAO’s operation, management and control is automated under the smart contracts, and decisions are made by collective votes. In some jurisdictions, a DAO is effectively a partnership. In others, it is a collective investment. In either case a court may not treat a DAO as having its own, separate, legal identity. That means, despite the smart contracts, courts may impose liability directly on the DAO’s participants or developers. “Companies” originally evolved to provide investors with limited liability. “Autonomy” from central management may come at a high price. Tokens are acquired by injecting funds into a DAO. These tokens can then be used to vote on proposals for how that DAO should allocate its resources. These proposals are submitted to the DAO by token holders, accompanied by a smart contract that will self-execute if the proposal is accepted by the required number of token holders. A DAO token represents an investment in a DAO, and also entitles the token holder to share in the DAO’s profits. In this respect, DAO tokens look a bit like shares or units. However, token holders can control the minutiae of how the DAO operates, with each decision requiring token holder approval, more like a partnership. Securities laws are designed to adapt to innovative investment structures, and in most developed jurisdictions, DAO tokens will trigger securities regulations and laws governing misleading conduct — perhaps with surprising consequences for those involved.

DAOs purely manage funds, and cannot by themselves create goods or deliver services. To generate revenue, DAOs rely on engaging various service providers to perform tasks. However, the combination and integration of DAOs with artificial intelligence and the Internet of Things may change this.
6. Conclusions / Recommendations

This section builds on the results of the empirical research presented in the preceding paragraphs. It is the final installment of this thesis and it contains the following recommendations/conclusions on the adoption of FOSS at the national and regional level:

- Creating IT strategies that includes FOSS adoption plans
- Providing medium and small sized organizations with the necessary support and guidance
- Backing public organisations to become FOSS producers
- Defining the necessary support and monitoring mechanisms needed for reusability and openness across public administrations
- Compliance with the interoperability frameworks in place in public tenders
- Organizing FOSS awareness and training to keep staff involved
- FOSS integration as a means of boosting e-inclusion and ICT skills
- FOSS integration in the educational system at both regional and national levels
- Creating a FOSS assessment policy
- Integrations of FOSS as a regional development tool. Policy makers are beginning to adopt smart cities concept and funding pilot programs and initiatives

Looking at its dominant features and the number of emerging technologies as well as the new software delivery models like Software-as-a-Service, it is hardly a surprise that open source is projected to further penetrate the market in the coming years. Hence the need to ensure that open source policies are well-adapted to the evolving software environment. This is why the EU, national governments and public administrations must find ways to meet the challenges of this new environment by ensuring that FOSS becomes a major enabler of every internet-based software service. Doing this could help:

- Expose the benefits of having FOSS on the software terrain,
- Introduce cost effective, innovative software solutions for all the public administrations, across Europe.
- Encourage the use of FOSS-based solutions across public administrations.

Creating IT strategies that includes FOSS adoption plans

Public administrations and governments should come up with integrated plans to facilitate the adoption of FOSS across their infrastructures according to the needs of the different organisations and the resources available. In designing a wider strategy for the adoption and sustainability of FOSS, there should be clearly set objectives and estimated risks, estimated costs and anticipated benefits. The plan for FOSS adoptions should also be adjustable for the IT architecture, organizational profile and scale of the public organization for which it is intended. The solutions proffered must be reviewed to ensure that they go with the technical and human resources available, existing applications and software systems, targeted end-users as well as the overall needs of the organization. (C. Bouras, A. Filopoulos, V. Kokkinos, S. Michalopoulos, D. Papadopoulos, and G. Tseliou. 2013).
The features and requirements of medium and small businesses are significantly different from that of large organisations or institutions and national agencies that handle thousands of stakeholders or end-users. The integrations of FOSS solutions within a broader IT framework should:

- Make the migration towards open source applications and systems smoother,
- Make the adopted FOSS solutions more effective
- Create an effective planning method that can help public administrations maximize the benefits of open source for a long time.

Providing medium and small sized organizations with the necessary support and guidance

National agencies, regional administrative centers and central agencies are urged to provide those medium and small sized organizations considering FOSS adoption and migrations projects with the necessary support and guidance. This support should not be restricted to funding alone but should include specification of requirements and standards, documentation and knowledge resources, guidelines, stakeholder motivation and consensus building. Joint collaborations and initiatives can also be encouraged under an umbrella agency to attract potential adopters and encourage the transfer of best practices amongst small scale organizations. Higher political guidance and support can contribute by:

- Encouraging and boosting FOSS adoption for medium and small public organisations without enough technical resources or staff,
- The valorization of reusable FOSS solutions and components amongst small scale organisations,
- Boosting homogenous integration of different open source software across every division of the public sector.

The GFOSS has successfully implemented the “umbrella” agency model. The GFOSS has become a platform for Free Software, Open Data, Open Standards, Open Hardware and Open Content in Greece. Most of the Research Centers and Universities in Greece participate in GFOSS, and the top developers in Greece play a major role in the way the policies are implemented.

GFOSS is one of the founding members of FAB LAB ATHENS, a member of Node of the Open Data Institute, Open Government Partnership (OGP) Network and lots of other significant openness communities.

The upcoming recommendations are related to public institutions:

Backing public organisations to become FOSS producers

The European Interoperability Framework has stated clearly that European Public Administrations should come up with component-based service models, and re-use and share software solutions as many times as they can. In light of the above recommendation, there is
need to provide support for public administrations, not only at policy levels, but the support should cover legal guidance, practical guidelines, resources and funding to help them become FOSS providers and producers. If public administrations became FOSS producers, they could:

- Become more independent and efficient in their capacity as producers of their own in-house software solutions,
- Share, re-use and develop software solutions and components with other peer public institutions,
- Contribute to the quality and supply of consistent open source solutions.

**Defining the necessary support and monitoring mechanisms needed for reusability and openness across public administrations**

The national interoperability strategies should comply with basic European Interoperability Framework principles on reusability, adaptability, openness, technological neutrality and transparency. The development of common interoperability policies and the undertaking of joint initiatives based on their requirements and needs will help public administrators to:

- Implement their standardization software needs,
- Identify the necessary implementations for platforms and open standards,
- Identify the open source solutions that are capable of implementing such standards.

Member states are not bound by the reusability requirements and interoperability recommendations contained in the European Interoperability Framework (since they’ve not been adopted under their national legislative Acts), which is why their implementation is not considered mandatory. Legal frameworks for full compliance as well as uniform implementation for member states can be found under relevant legislation like the Directive 2003/98/EC (Directive 2003/98/EC, 2003) for re-use across the public sector.

In the last couple of years, there have been great examples of support centres and monitoring instruments for reusability and openness in Europe like JOINUP, which was used as support centre and repository for sharing and re-using open source solutions. Such EU support and monitoring centers should form an integral part of the implementation policies of the EU on reusability and openness.

There should be similar mechanisms at the regional or national levels to define and present the reusability and open standard requirements for all stakeholders and to ensure their proper implementation across every area of the public sector. In addition to monitoring the implementation of these requirements, regional and national authorities should also provide support resources and knowledge basis for making available options, technologies and standards clear and accessible for every stakeholder

**Compliance with the interoperability frameworks in place in public tenders**

Public administrations must learn to include interoperability and open standard requirements in their tenders in a justified and clear manner. For example, a public organization
should be able to make rules requiring that the protocols or file formats, interfaces and standards implemented by the solution supplied should be in line with the requirements of the open standard. Here are some simple open standard properties:

- Suppliers and other equivalent technologies can deliver standards,
- Standards are documented and developed from transparent and open procedures,
- There are no rules restricting standards re-use,
- Procurement criteria should include compliance with the National Interoperability Frameworks where applicable,
- There must be a set policy for the inclusion of interoperability requirements for public tenders in public administrations because it provides the basis for:
  - Reducing vendor lock-ins and risk data,
  - Opening the field to encourage more software solution specialists,
  - Considering open source solutions equally,
  - Extending the increase of interoperability and use of open standards in public administrations,
  - Facilitating the implementation of the necessary National Interoperability Frameworks.

The following recommendations are related to training and education:

**Organizing FOSS awareness and training to keep staff involved**

Most open source migration projects fail because the staff and users are not given the opportunity to participate. The best way to ensure that end-users participate actively, share their experiences and continue to use the applications and systems introduced is by encouraging a number of staff, or even an entire department or organization to participate in integrating FOSS solutions. This is why public administrations must learn to come up with reasonable initiatives and actions for training their staff and raising awareness about open source applications and systems as an essential requirements for effective open source policies. The plan could include an effective long and midterm policy to be implemented by public administrations and agencies so as to:

- Reduce the risk of failure in large FOSS migration projects,
- Achieve complete integration of the adopted FOSS solutions for IT infrastructures and internal processes,
- Make adopted FOSS solutions more effective,
- Boost open source awareness and trust amongst staff,
- Help the staff to boost their ICT skills.

**FOSS integration as a means of boosting e-inclusion and ICT skills**

FOSS is all about learning, experimentation and skill development, which is why it has such a great potential for training. Employers have long acknowledged FOSS’s skill setting value.
These employers are the ones that will rather recruit developers with open source background and exposure. The cost of this training is quite affordable both for individuals and public organization, which is why it should be maximized to increase professional IT skills and digital literacy amongst staff and citizens alike. Both public administrations and the government should come up with FOSS training initiatives and programs for their citizens and staff by taking advantage of the existing infrastructures and capacities. The EU can also fund and support FOSS training in a bid to address its digital literacy and ICT skills deficiency. There are several potential benefits to these actions. They include:

- Increasing digital literacy and e-inclusion,
- Increasing professional ICT skills amongst staff in public organisations,
- Supporting a new crop of open source developers,
- Boosting FOSS awareness and trust through citizen/staff certification and expert training,
- Encouraging innovation of new internet-based software delivery modes.

**FOSS integration in the educational system at both regional and national levels**

Apart from its role as an ICT training tool, FOSS can also provide an affordable and stimulating learning environment with the help of educational apps and platforms. FOSS penetration is actually higher and faster in the IT structures of the educational sector in certain situations, than in other sections of the public sector. Public administrations and governments alike are encouraged to integrate FOSS-based learning into their educational system. Promoting a FOSS-based learning environment, educational units, administrative authority and schools will lead to:

- Reduction in the cost of educational software,
- Customization of their own independent learning platforms without having to rely on vendors of proprietary software,
- The introduction of customizable and open platforms and tools for ICT skill development and training,
- An avenue for early adoption or awareness of open source open standards software.

**Recommendation 9: Creating a FOSS assessment policy**

Public administrations and governments should introduce full assessment policies that put long-term benefits and costs into consideration for those adopted open source solutions. The adoption and integration of FOSS applications and systems in the IT infrastructure of an organization is quite a long procedure that requires constant monitoring and evaluation in terms of cost effectiveness, user satisfaction and improvement in different fields of operation (e.g. performance and productivity, vendor independence, IT system security enhancement). The best way to address all the identified weaknesses and risks and ensure long-term impact of those benefits on the organisation, is to evaluate the FOSS project using predefined criteria like (total cost savings, technological reliability and maturity) and procuring internal feedbacks and external expert opinions where possible. Defining a clear FOSS assessment policy whose criteria includes
clear evaluations that reflect the specific requirements and needs will help public administrations and governments:

- Make informed decisions on how to pick the best solutions on the basis of best-value-for-money,
- Ensure the technological reliability and maturity of adopted open source solutions,
- Fine-tune and enhance their software and IT procurement policies,
- Leverage the complete FOSS potential.

**Integrations of FOSS as a regional development tool. Policy makers are beginning to adopt smart cities concept and funding pilot programs and initiatives**

Public administrations and regional authorities planning to integrate FOSS into their infrastructures to encourage regional development and growth have a lot of potentials. The government of the Heraklion, Crete region has a nice success story on the positive impact of FOSS at the regional level. The Heraklion Municipality have been able to implement wide adoption of FOSS solutions in their IT structures and public services in the last couple of years, with open source penetrating most of their applications and systems. Through the adoption of open source applications and platforms to suit local needs with the help of extensive customization and localization, Heraklion was able to engage more citizens in e-government services, while enjoying high control over software. The Municipality’s ICT director stated that FOSS serves as a tool for “sustainable and technologically independent development” in Heraklion.

From the above success story, it is obvious that a well-planned, large scale IT infrastructure and public service migration to open source, if well-combined with the right motivation for citizens, staff and businesses (like economic incentives, platform localization, training) can make a difference in regional development. This is why, regional authorities and local governments must learn to view open source as a nice enabling factor that is capable of opening opportunities and utilizing local strengths as part of a wider ICT strategy for regional growth and development. This could help regional authorities and local governments:

- Enhance e-inclusion rates while opening new opportunities for their local businesses,
- Boost trust on the reliability and effectiveness of FOSS for their citizens and staff,
- Become independent of proprietary technologies and vendors by exercising more local control over their software solutions,
- Take advantage of their knowledge and background through the transfer of knowledge FOSS-based solutions and support to regions experiencing similar problem-solving priorities.
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