BASHIR ABDINUR AHMED

SEMANTIC WEB SERVICE IMPLEMENTATION & INTEGRATION OF E-GOVERNMENT BASED ON LINKED DATA

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February, 2023

APPROVAL

We certify that we have read the thesis submitted by Bashir Abdinur Ahmed titled "**Semantic Web Service Implementation & Integration Of E-Government Based on Linked Data**" and that in our combined opinion it is fully adequate, in scope and quality, as a thesis for the degree of Engineering Master.

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DECLARATION

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, From the stage of planning until writing through implementation. I have fully cited and referenced all material and results that are not original to this work.

Bashir Abdinur Ahmed

02/02/2023

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DEDICATION

To my parents….

ABSTRACT

Semantic Web Service Implementation & Integration
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The use of the Internet has raised significantly, The Semantic Web and Linked Data aim to take the web of data to the next level of intelligent where humans and machines understand data. E-government represents among the information and communication technologies in the public sector that is more open, encourages participation of community. The majority of e-government rely on data integration and it is the most relevant sector where the open government data is a significant source of data will promote and deal with different information infrastructures, people, management models, and relationships between these entities. In this study, we provide a case study to develop Linked Data by emphasizing data governance in the United Kingdom data portal for central government, and more particularly those emphasizing semantic web service. Additionally, an e-government concrete ontology is provided. This work has also involved and building understanding and capability amongst officials from across government departments and agencies. By implementing these instances of linked datasets due to the UK central domain of e-government ontologies and adding semantic web services to e-government through linked data, this study constructs a high-quality integrated ontology that is easily understandable and effective in acquiring knowledge from various data sets using simple SPARQL queries. The necessary technology already exists to enable this (RDF, OWL, SPARQL, etc.). In the future, scholars and academic researchers will also participate in this work and contribute to the effort of the Semantic Web and Linked data community to benefit from its current achievements and future possibilities.

***Keywords*:** Semantic Web, Linked Data, E-government, Open Government Data, Ontology, Web services

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LIST OF ABBREVIATIONS

APIs	Application programming interfaces
CSS	Cascade Style Sheet
CSV	Comma Separator Values
FOAF	Friend of a Friend
GUI	Graphical User Interface
HTML	Hypertext Markup Language
HTTP	Hypertext Transfer Protocol
IaaS	Infrastructures- as -Service
ICT	Information and Communication Technology
IS	Information Systems
ISO	International Organization for Standardization
JDK	Java Development Kit
JS	Java Script
JSON	JavaScript Object Notation
JSON-LD	JavaScript Object Notation of Linked Data
LD	Linked Data
LOD	Linked Open Data
N3	Notation 3 or N-Triples
OGD	Open Government Data
OWL	Web Ontology Language
PaaS	Platform-as-a-Service
PHP	Hypertext Preprocessor
REST-API	Representational State Transfer API
RDF	Resource Description Framework
RDFS	Resource Description Framework Schema
RSS	Really Simple Syndication
SaaS	Software-as-a-Service
SPARQL	SPARQL Protocol, and RDF Query Language
SWS	Semantic Web Service
TTL	Terse RDF Triple Language (Turtle)
UK	United Kingdom
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
W3C	World Wide Web Consortium
WSDL	Web Services Description Language
WWW	World Wide Web
XAMPP	X(Cross)-Platform, Apache, MySQL, PHP and Perl
XML	Extensible Markup Language

CHAPTER I

INTRODUCTION

The Internet is difficult to designate in comparison; even the smart assistant systems, a vast industry with many times the sales of the Internet, is considerably more straightforward. A data web denotes a substantial amount of related data. The Internet, in particular, has seen significant changes in the production, storage, processing, transmission, integration, and use of information and communication technology. The Web is becoming more widely recognized as a global information environment comprising linked data and documents. Information is the phenomenon that spreads the fastest in this process, where the world has shrunk to a little town. The faster information is disseminated, the more information and communication technologies (ICT) are used. Knowledge-intensive applications are made simpler by semantic web technologies, which enable a Web-based machine-understandable data based on proper and clear representation of the design and denotation of the data (Kim, 2002).

Software architecture and engineering concerns have been relatively understudied in the present studies on implementing Semantic Web service technologies, which has a tendency to concentrate on information modeling, data retrieval, data extraction, and information integration benefits have all been thoroughly studied. However, the entire life cycle of Semantic Web data needs to be evaluated in terms of the costs and benefits of the application development, nevertheless, in order to promote the widespread use of Semantic Web technologies. This life cycle, in accordance with this definition, entails the initial stage of ontology construction, pursued by deciding how to utilize the data, generation of new data or improvement of current data, determination data archiving, dissemination of data, and public access (Attard et al., 2015b). The application may execute creation, refinement, archiving, and publication all during runtime; as a result, software engineering and software architecture concepts are also present in addition to data modeling concepts. To our knowledge, there is no experimental study of the difficulties associated with the implementation of developing, enhancing, archiving, and publishing data based on linked data. This is in contrast to the empirical examines of the difficulties associated with ontology development projects. Through an empirical analysis of Semantic Web applications, we can pinpoint the most often used shared components as well as the difficulties in putting these components into practice. These

elements come together to form a reference architecture for Semantic Web applications (Gruninger & Lee, 2002). According to the poll, using Semantic Web technologies poses difficulties that could have an impact on the entire application. Semantic Web technologies are just beginning to see the emergence of best practices and standard solutions. The absence of these has made it difficult to develop and deploy apps that make use of Semantic Web technologies in practical applications.

This framework divides the thesis work into three sections. It is explained how the information society and e-government are related to semantic web services and linked data. Additionally, an e-government conceptual framework is provided. In light of this, the first section of the work discusses the relationship between the information society and e-government, the difficulty of defining government portal and its characteristics, and its advantages, objectives, dimensions, and elements that affect it (Crichton et al., 2007). The issues that arise in their applications are looked at. Throughout history, societies have changed, and more people are now than ever. The public administration system has also had to alter due to the many needs. The public needs to reorganize its management in the current system's operation by pinpointing the issues encountered; the system will be more effective and practical with the shifting needs of society. It serves a rational purpose that can be understood. Electronic government, often known as e-Government, is a notion on the agenda and serves a role in industrialized and developing nations. It is not an active idea. Information and communication technology are essentially combined in the idea of electronic government.

1.1 BACKGROUND OF THE STUDY

The use of the Internet has increased significantly, making it one of the most popular platforms for exchanging information and providing people with a wide range of services pertaining to numerous different disciplines. In this day of advancing technologies, almost everything is now accessible online. Researchers are continuously struggling with information overload as a result of the scientific literature's explosive growth. Additionally, everyone should have access to the same websites and the chance to enjoy a comparable online experience (Lawrence et al., 1999). In other words, users should be able to request access to these resources from anywhere on the Internet, making them useable by

everyone. According Rouse (2006) asserted that E-government are rising its momentum across globally, but the current E-Government systems has been suffering from lack of interoperability, resource sharing, operation integration and concept of collaborative work in terms of specific knowledge or abilities in the field of information technology, just as it is in fields. As a result, the Web developed into a worldwide information hub with connected data in addition to linked documents. In the course of history, societies have changed, and there are more people now than ever before. The public administration system has also had to alter as a result of the many needs. In order for the current system to function, the public is under pressure to reform its administration.

By addressing the issues, the system will work better and better with the shifting demands of society. It serves a rational goal that is clear-cut. Electronic government, often known as e-Government, is performing a purpose and is on the agenda as a very popular notion in today's world and industrialized nations. It is a conservative idea. Information and communication technology integration is the core of the idea of e-government (Apostolou et al., 2005).

One of the information and communication technologies that benefit the public is e-government, which is more transparent, encourages citizen participation, is less expensive, and provides more services. Although it is a useful administrative framework, its definition encompasses more than just moving transactions from the physical world to a digital one. One e-Government, which is a restructuring model, is communicating electronically with citizens and institutions that can respond realizes practices that will ensure efficiency and transparency (McGuinness, 2010). On another aspect the state's internal processes, which citizens do not know and see at all, are efficient, effective, to become accountable, in short, the main objectives of the new public administration approach have made it capable of realization. So, e-Government to provide a service went beyond being a method and became a transformation in the state structure. It expresses a social structure in which it is becoming easier to produce and access information.

Open government data is an important source of information that is directed at a sizable audience. Unfortunately, this data is frequently sent in raw form, that is, without adhering to any rules, and is thus untapped. All segments of society use information revealed by

changes in the social field in the last quarter of the 20th-century information and communication technologies. As a result, the efficiency in the production of all kinds of goods and services has increased. In addition to the requirements of the people who make up the social structure changing, a change process transforms the current social structure into an information society (Theocharis & Tsihrintzis, 2012). A citizen waiting for more, quicker, and more effective service has now been identified. In a time of such profound change, with the chance presented by technological advancements, effective public service that is efficient, high-quality, and effective can help to increase citizen-state communication, strengthen the foundation of the state's legitimacy, and open a dialogue between citizens and the government. Integrating communication technology and automation with public administration is one option proposed to realize the ideal of the state and society. Its qualities include general applicability to business operations in institutions, facilitation of communication and coordination, enabling inter-institutional cooperation, time, resource, and information potential for significant benefits in its field, and technology in public institutions.

Tim Berners-Lee-Berners created the World Wide Web in 1990, and it has since undergone several generations. Tim initially backed language-based HTML pages for electronic publishing before relying on content management systems. The Internet brought participation, knowledge exchange, and information retrieval to life when there were recipients from everywhere, regardless of boundaries imposed by geography. Modern technologies and protocols for electronic publication have been employed since the introduction of the second generation of the web. Moreover, as a result, the use of the Internet started to shift in favor of beneficiary and system interaction. Using the Internet began to move towards interaction between the individual and the system through various technologies, such as wikis, RSS (Really Simple Syndication), social networking sites, etc... By achieving the web's understanding of the meaning and connotation of the words that are analyzed and recovered, third-generation web technologies are revolutionizing the world of information (Shinavier, 2010).

The development of the web led to an evolution in the information retrieval systems used with this new generation of the net. What is known as semantic search? How have search engines advanced this type of research? In this study, the researcher became acquainted

with linguistics, its characteristics, and what distinguishes it from traditional research. An application study of the use of one of the semantic search engines and one of the conventional search tools. This study covered the Story and Google search engines in November 2010. It also examined some of their research and retrospective characteristics (Kim, 2002).

The main importance of this work lies in the fact that it is one of the few e-government studies that address the topic of semantic search. This represents a modern revolution in information retrieval systems. The study aims to direct e-government attention toward third-generation Web technologies of linked data and invest this technical development in the exploration for and retrieve of government information via search engines via the Internet. This study aims to follow up on recent developments of semantic web services in the field of linked data.

The study follows the descriptive approach by conducting a semantic web service of the linked data. The researchers identified characteristics of information retrieval and display of results that differentiate Hakka from Google. The study follows the descriptive approach by conducting an analytical study of the search engine field. Using four different search terms and searching both Hakka and Google, the researchers determined the characteristics of information retrieval and created the display (Vitvar et al., 2006).

These characteristics differentiate Hakka from Google. A study on e-government has been published by the UN Department of Economic and Social Affairs since 2001.Over the past ten issues, the research has established itself as a premier e-government resource and a tool for political decision-making. There is currently no global report that evaluates the state of e-government progress in all countries. It is believed that each country has to decide which level and extent of e-government initiatives it pursues, including members of the United Nations, since they measure the performance of e-government against each other rather than on an absolute basis. It also acts as a resource and development tool for nations to share knowledge, pinpoint strengths and weaknesses in e-government, and tailor their policies and plans in response. It also in addition, the event aims to facilitate discussions between intergovernmental bodies, including the UN General Assembly and the Economic Council Social and high-level political forum, allowing for an in-depth discussion of e-government and the role that ICTs play in development (Abijaude et al., 2018).

1.2 STATEMENT OF THE PROBLEM

The majority of e-government merging on data centralization and automation. However, in concerning to develop it, time intensive as well as costly support are needed and software developers should gain knowledge about logic inference and interpretation. The requirements imposed on the e-government service by Semantic development tools include at least three elements (the integration service, crawler, and frequently the search service) for enhancing data. semantic Web services can work with both local and online datasets so managing and control depend on the source of the dataset. Also, the process of exchanging information e-government data in its current situation form acquires a lot of time, labor and effort. Web services have the advantage of allowing consumers to focus on the services they want to get rather than the data they require. However, the main shortcomings of web services tools are their incapability to provide automatic invention, synthesis, and collection, necessitating human work & intervention. The aforementioned issues with web services are resolved by integrating semantic web technology (Adadi et al., 2015).

The study continues by outlining how much work still has to be done in order to create workable techniques and patterns for the publication of government data because the world of Linked open data was nearly prepared for a big e-government portals to adopt these standards on a broad scale. The use of semantic web service standards for publishing e-government data is argued for in this thesis, along with some of the advantages. It discusses the reason reliable data publication is so crucial to the e-government data association as well as how semantic web service standards exclusively enable e-governments to share data significantly. There has been a lot of research and work done on anything from Uniform Resource Identifiers (URIs) to provenance and versioning to semantic web services. In each instance, creating straightforward, repeatable patterns has taken precedence over conducting research. implemented with these tools. This study has also elaborated, developed structure, and facility including officers from beyond government departments and agencies.

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1.3 OBJECTIVE OF THE STUDY

1.3.1 General Objective

The general objective of this project is to have a platform that ensures its clients semantic web services for e-government linked data.

1.3.2 Specific Objectives

1. To find out a platform that ensure reliable, effective and efficient e-government.
2. To prevent risks in semantic web services e–government linked data.
3. To transform tradition e-government data into linked open data.

1.4 RESEARCH QUETIONS

What aspects are relevant to consider when implementing semantic web services for e-government linked data. This question will be illuminated by studying the following sub-questions:

1. What are the main problems of integrating e-government data?
2. What are the challenging issues that implementation of e-government linked data using semantic web service?

1.5 SIGNIFICANCE OF THE STUDY

One of the most significant benefits a computer system can deliver is speed and accuracy, as well as a more user-friendly system for e-government that can save time and resources. The main aim of this study is to afford an integrated solution to security and availability concerns for semantic web services through an authorized e-government-linked data framework. As the current e-government data system is not entirely linked, the upcoming procedure will be able

to conduct whole responsibilities certainly in coordinating schemes, provide an accessible, adaptable, and effective working unit, and have central storing, backup, and robust testing abilities.

In this study, we provide a case study to develop linked data service by emphasizing data governance in the United Kingdom (UK) open data for central government, and more particularly those emphasizing semantic web service. Nevertheless, there is no connection between the pertinent information on each website, much less across websites maintained by different member states. The latter could give the person the opportunity to analyze which necessary supportive details are required in order to exercise the similar line of work or receive the identical facility movement in other countries. The person would then be able to select the nation where such an endeavor remains simpler.

According to Claudon (2014) defines Confidentiality, keeping information accessible only to those with permission is one of the pillars of information security. Privacy is the protection of personal information. Some internet problems affect the intimate details of users, so how do we manage these issues? The answer is that particular digital tools, like browsing aspects, anti-spyware tools, and anonymous tools, secure identity such as "private browsing and options for do not track." According to (Easttom, 2012), The most important rule is protecting the server that catalog the site's database. Each website's server catalogue serves as its core. Usually, the most important data is kept on this work station. This suggests that the best method to defend this engine against intruders is to make it a desired target.

1.6 ORGANIZATION OF THE STUDY

I. **Chapter One: Introduction-** The research plan is presented in this chapter as an introduction to the study. After describing the background of the study, it discusses the problem, its motivation, its objectives, its questions, its scope, its significance, and its organization.

II. **Chapter Two: Literature Review**- The main topic of this chapter is the prior research on the development of Linked Data, Semantic Web services, and other pertinent information.

III. **Chapter Three- Methodology-** this chapter clearly points out the methodology used in this research which is to develop a software solution. it explains the hardware and software requirements to develop the system, and possible solution for the research question, methods and concepts chosen.

IV. **Chapter Four: Analysis & Design**- in this chapter the researchers are going to demonstrate the logical design of the system that is to show the flow of the data within the system. which analyses the current system status including the manual system and the attached software and vulnerability of that system among security and accuracy of information, this chapter also discusses the solution given by this work to solve all possible problems in current system.

V. **Chapter Five: Implementation**- This chapter explains the testing environment, the testing process, the examples used throughout the test stage and some snapshots, and how the problem is resolved.

VI. **Chapter Six: Conclusion and Recommendation**- This chapter concludes the research by outlining the findings and then offers essential recommendations for further study on the subject for the field's future scholars.

CHAPTER II:

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter demonstrates how the planned research relates to existing knowledge, earlier studies, or current practice. This is accomplished by citing pertinent research from other academics who have studied the issue. One must first understand how computing has changed historically. Our Topic is the semantic web service for linked data. We will concentrate mainly on the technological developments that paved the way for cloud computing. We will also talk about how to operate the cloud computing infrastructure efficiently, including the procedure for semantic web service for linked data so that e-government can access the services.

There are four key sections in this chapter: The history of the Internet, technology, and how they impact online platforms are briefly covered in the first section. The importance of credentials and the function of information systems for e-government of semantic web and linked data process are discussed in the second section. The third section goes through the ideas and methods of cloud computing as well as the differences between desktop and web cloud system. This paper defines semantic web service for linked data in its concluding section. It explores the advantages of semantic web, analyzes the services and delivery methods that are available, and assesses the security threats that are involved.

2.2 INTERNET AND TECHNOLOGY

The Internet is among the best illustrations of the benefits of ongoing funding and commitment to information infrastructure research and development. The Internet allows people to interact and communicate using their computers no matter where they are in the world. It also acts as a platform for international broadcasting. Since the early days of packet switching research, the government, industry, and academia have collaborated to create and deploy this novel new technology. (Brown, 2022).

2.2.1 Internet Growth

It is challenging to describe the Internet. Even the voice phone system, a massive industry with profits significantly more significant than the Internet, is more accessible in contrast.

The essential service in the phone system is clearly stated and easy to explain. Users can only do so much in indicates of system interaction. The Internet has entirely distinct. The procedure's users engage with it in a wide variety of ways over a wide range of time scales, and numerous intricate feedback loops exist. The work provides an excellent overview of the issues of simulating the Internet (Coffman & Odlyzo, 2001)

There are also significant issues in measuring the Internet. Relevant measures come in a variety of forms. We will focus on interchange as considered in unit size in this chapter, exactly as we did in the papers. It is capacity that is most important for the fiber-optic cables sector. Capacity measurement is, unfortunately, fraught with issues. A large portion of the fiber is kindle; as well as when it isn't, just an occasional wave-lengths are frequently lit. Lastly, a large portion of the available dimensions is used for rebuilding using SONET or other techniques. Furthermore, it is challenging to acquire precise amount capacities even at the levels of lines used to provide IP traffic because only some carriers provide comprehensive data.

Furthermore, because bandwidth is typically increased in significant stages, this type of capacity has a propensity to leap abruptly (such as going from OC3 to OC12, and then OC48, a phenomenon that contributes to the low utilization of data links [Odlyzko1]). As a result, capacity growth numbers are inconsistent. However, we do observe a startling regularity in traffic increase, which prompts us to suggest that a kind of "Moore's Law" is in effect. As we shall explain later, over time, we anticipate that capacity will increase a little bit more quickly than traffic. Other metrics, such the number of users, how they spend their time, how many and what kinds of business transactions they conduct, and so on, are crucial for a variety of objectives. Such information can be accessed in various places, and helpful references can be found at Cyberspace, MeekerMJ, and Nua (Coffman & Odlyzo, 2001)

2.2.2 Online Platforms

Both consumers and businesses depend on the Internet economy for their day-to-day operations. It is also growing in importance as a significant platform for the spread of artistic and cultural materials. The hub of this ecosystem is made up of online platforms. They serve as a crucial evolution and community progress engine locally and worldwide.

According to reports, between 2001 and 2011, the information and communication technology (ICT) sector—of which online platforms are a part—contributed 30% of GDP growth in the EU, compared to 55% in the USA. The Commission projects that the Digital Single Market will increase GDP by 1% to 2.1% over time (Oxera.com, 2015). In this context, the function of platforms in Europe's digital economy has attracted growing political and regulatory attention. The European Commission released its three-pillared approach to creating a single digital market for Europe in May 2015.

- better access for consumers and businesses to digital goods and services across Europe;
- creating the right conditions and a level playing field for digital networks and innovative services to flourish;
- Maximizing the growth potential of the digital economy.

Online platforms are remarkably diverse in function, industry, economic model, and scale. Platforms differ in size from modest websites with a small local audience to global businesses with billion-dollar annual income streams. They provide a variety of services, including online marketplaces (eBay, Booking.com, Asos, Allegro, and Amazon), video-sharing platforms (such as Dailymotion, Vimeo, and YouTube), music and video platforms (such as Deezer, Spotify, Netflix, and Canal Play), social networks (such as Facebook and Twitter), platforms for the sharing economy (such as Airbnb, Uber, BlaBlaCar, Ulule, and Crowdcube), as well as online gaming (such as Steam) (Oxera.com, 2015).

2.3 INFORMATION SYSTEM

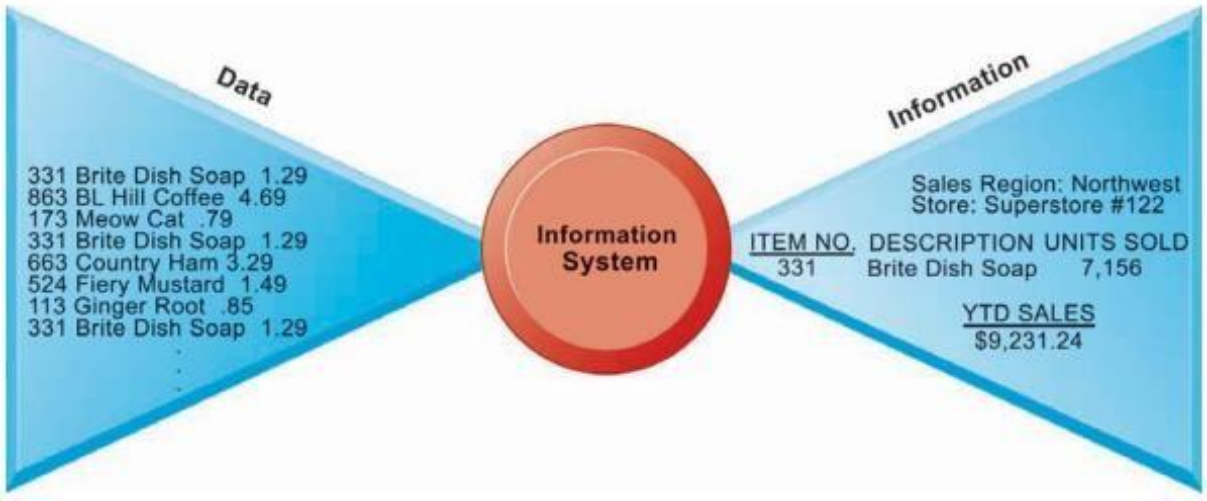
2.3.1 General Definition

"Any organized combination of people, computers, apps, communication networks, data resources, and processes that input, store, query, alter, and generate information in an organization" is what is meant by the phrase "information system" (IS) (O'Brien, and Marakas, 2007). Any business today needs information systems to maintain notations of whole efficient areas. Information systems enable people to connect by employing technology, rules and regulations, communication channels, and data storage. According to

Nowduri1 et. al (2012), it is a set of systematized components that collaborate to carry out activities for store, formulation, data storage, managed data, and validation as a way to transform data into useful information that will be consumed in an association to support estimation, formulation, controlling, administrative-decision, and corporate experiences.

Specifically, an information system is "a collection of interconnected elements that gather, process, maintain, and disseminate information within an organization to facilitate administrative decision-making, communication, and control." With the exclusion of aiding organizational policymaking, supervision, and manipulation ("Laudon, K., and Laudon, J., 2006"), it can similarly help managers and staff members evaluate and assess issues, create difficult ideas, and invent new things. It may also focus on how important people, places, and things are communicated within the business or to those outside of it. Information is not simply raw data; rather, it is material "formed into a type that is valuable and helpful to humans." The converse is also true: "Data are streams of raw facts describing events that exist in organizations before they have been turned into a format that everyone can understand."

Figure 2.1 Data and Information (Laudon, and Laudon, 2006)



A program known as an "information system" processes and produces information from data (facts). Information processing cycles are referred to as processes. There are four functions that make up the information processing step. input, process, output, and archiving (Khane, et al, 2011).

2.3.2 Information Systems role in an organization

The corporate institution in charge of providing information technology services is the information systems department. It oversees the hardware, software, data storage, and networks that make up the company's IT infrastructure. The department is headed by a "chief information officer" and is formed up of professionals like developers, computer scientist, strategy managers, and information system administrators.

2.3.3 E-Government Definition

E-government is one of the main information systems technologies in the public sector that is more open, encourages citizen participation, is less expensive, and provides more services. Although it can be described as a practical administrative framework, it refers to more than just moving transactions manually to a computer environment. One form of e-government, a restructuring model, uses electronic communication to reach out to institutions and citizens and executes procedures that guarantee efficiency and transparency (Jain & Kumar, 2018). In another way, the ability to realize the principal goals of the new public administration method has been made possible by the state's internal operations, which individuals do not know about and cannot see at all. Thus, e-Government is used to provide a service. The method evolved into a change in the state structure rather than just being a method.

Information was made available through information and communication technologies by all facets of society during the last quarter of the 20th century. It is used to depict a social structure in which it is easier to produce and access information. As a result, the production efficiency of commodities and services has grown. In addition to the requirements of the people who make up the social structure changing, a change process transforms the current social structure into an information society (Jarrar et al., 2011). A citizen waiting for more, quicker, and more effective service has now been identified. Knowledge-based public administration is one of the approaches to realizing the ideals of the state and society.

This approach involves the fusion of automation and communication technology. Its features include the potential for significant gains in its field, general applicability to business processes in institutions, communication, and coordination facilitation, enabling inter-institutional cooperation, time, resource, and information availability, and technology in public institutions. In a time of such profound change, with the potential provided by technology advancements, efficient, quality, and effective public service can increase citizen-state contact, enhance the foundation of the state's legitimacy, and promote a dialogue between citizens and the government (Michel et al., 2018).

These integration efforts all as in the world, it has found its equivalent in US, UK, and etc. under the name of e-Government. In practically every area where the government provides services, e-government applications are the standard. Methods have started to be used. While in certain locations, change happens quickly. It started later and moved slowly. In the area of health, e-government is similarly sluggish. One of the fields in development is it (Gupta et al., 2018).

2.3.4 Towards Semantic Web

Web 2.0, the subsequent stage of the technology, has given rise to numerous concepts. These include social media, electronic government, electronic schools, and massive open online courses (MOOC). Although initially resisting, every field—from states and politicians to the health industry and the education community—had to be repositioned to fit this new reality in the following years. The "Social Network Age" of the Internet is currently underway, but the semantic web will soon take its place (Kim, 2002).

The Semantic Web, currently thought of as the Internet's future, is an equation with numerous unanswered questions, just as social networks were at the start of the 2000s. It is impossible to predict when the internet business will adopt this new network architecture, in which artificial intelligence is employed more frequently, and which projects will reach their breaking point. But it is recognized that we are making headway toward this network (Xiao et al., 2007). The Internet enables people to ponder new questions every day. We can see how much more the systems we have now can be developed as we pose these questions. Google, a search engine that we all use, serves as this. Google returns 479,00 results when we type in "what is excellent for stomachache."

One of the important points that we should pay attention to in the example of Google is the following. Just as Web 2.0, of which social media is an important part, made social transformations through the internet, a similar scenario awaits us in Web 3.0. "Understanding is change," said an Indian philosopher. His motto is seen as a situation that will be encountered frequently in the future of the internet (Albarghothi, 2018).

The interpreted data will reveal the meaningful systems. Meaningful systems, on the other hand, will fuel the changes in society's view of sociological and economic events. Therefore, he will also manage the systems that will be established that manage the data in the future. While states, one of the actors with the most data, are developing systems such as e-government and m-government, they may have to concentrate on the idea of "Semantic State" in this period. While the slogan of the internet of the future will be private internet, the motto of the semantic state may have to be "private state" (Davies, 2005).

By checking the weather conditions in the place where the Semantic State citizen lives, it will be able to warn its citizens in advance about the possible changes in the health status of the person. Citizens looking for jobs and employers looking for employees will be able to instantly follow up on heat maps and provide specific guidance to citizens with an information message. In this period, when there will be hundreds of similar applications, the transparency and questionability brought by web 2.0 for governments and companies will emerge much more strongly. At the same time, privacy and security issues have become big problems. Hackers can no longer hack Facebook accounts but cannot hack the relationship between health cards and spending habits (Shinavier, 2010).

A chart of painkiller usage by citizens of a country is for sale on the deep Internet. Much like the pain we are going through with the transition to Web 2.0, Web 3.0 will not appear before humanity as a thornless rose garden. However, the apparent facts are: Both brands and institutions that cannot keep up with semantic development are in grave danger. Some will survive this crisis. Some people do not. Looking to the future of the Internet today, our future, and designing scenarios on the "Semantic Web" is essential to becoming one of the Internet's ultimate powerhouses (Crichton et al., 2007).

2.3.5 Differentiating Semantic Web and the Linked Data

The fundamental necessity for semantic web applications is to usage RDF for metadata. This can be inferred from RDF's essential part in the "Semantic layer" of architect web standards. Furthermore, we should use a group of proper vocabularies to obtain our system domain and use SPARQL as our data-enquiry language. All applications are investigated to encounter these conditions, excluding for those that use systematic retrieve to RDF information for competence objectives. The Semantic Web, regard as the phase of next-generation evolutionary step of the World Wide Web, It is a vision of the World Wide Web of linked data. In the Semantic Web, whole data on the Web is arranged and machine-understandable. That allows devices to understand relations among properties and opens up the possibility for humans to discover new areas of knowledge-graph (Ding et al., 2011). The modern predecessor of the Semantic Web is the Google Knowledge Panel. It summarizes information from numerous providers into a compressed and clear information container. Linked Data doesn't just put data on the internet. It's about creating connections this grant access to people and devices to explore the data web (Dojchinovski & Vitvar, 2018).

By specifying some of them, we can discover data associated to linked data. Corresponding the hypertext link, the data web is built from documents on the Web, contrasting hypertext on the link, where links are relational anchor-tag in hypertext documents written in HTML, and Uri’s in data link among random objects written in Resource Description Format (RDF). A URI identifies each entity or model. But with HTML and RDF, the similar prospects concern to the growing linked data:

1. Allow users to look up those names using an HTTP URI.
2. If someone looks up her URI, use standards (RDF*, SPARQL) to provide helpful information.
3. Add links to another URIs so additional can be exposed.

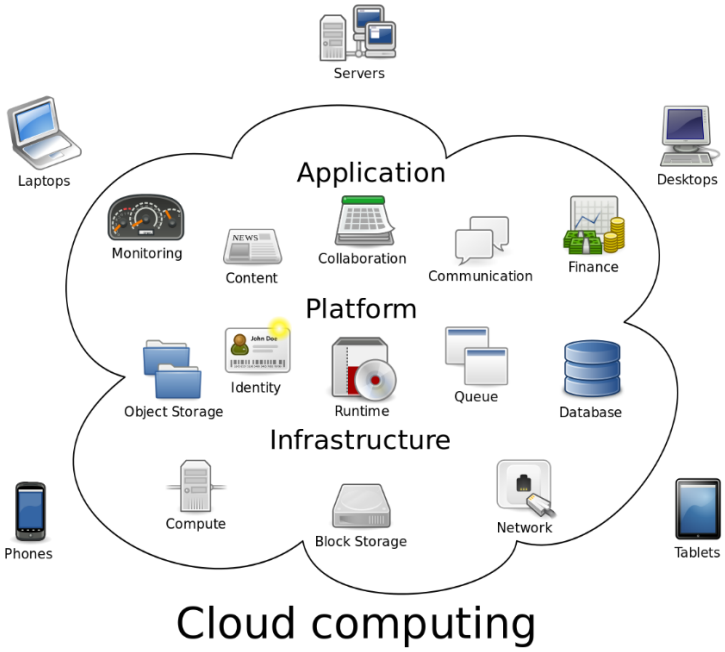
Linked Data Principle defines how to publish RDF data and acknowledges RDF datasets to be linked into format data mesh. project Linking Open Data (http://linkeddata.org) offers the basics of the linked data available today (Chae et al., 2016).

2.4 CLOUD COMPUTING

2.4.1 Cloud Computing Definition

The term cloud has historically been used as a similar for the Internet. This convention initially stemmed from the representation of the cloud as a regular outline in his network diagrams, which carried data through his backbone (expressed as cloud) of the endpoint on another cross of the web. It was used to represent forwarding. (Doelitzscher, Reich & Sulistio, 2010) This concept dates back to 1961. At this time, Professor John McCarthy proposed that system time-sharing technology could be prime to an upcoming where certain system via computing power and utility types could sell business models. has gained many considerable popularity in the late 1960s. However, in the 2000s, the concept was revived. During this revival period, the term cloud computing appeared in technology circles. (Rittinghouse & Ransome, 2010). The cloud knows no borders, making the world a much smaller place. Although the Internet is worldwide in space, only launched methods of communication are respected. They can now reach other people from anywhere, wherever they are. The globalization of computing resources is perhaps the most significant contribution the cloud has ever made. As such, the cloud is theme to various complicated geo-political concerns.

Figure 2.2 Cloud computing Components



Hayes (2008) suggested that when application derived from local PCs to remote cloud servers, users and developers alike move with it. Greek myths express of people pulled from the surface of the earth and anchored in the night sky as constellations. Approximately like is occurring in the computer ecosystem today. Data and applications are carried from corporate desktops to servers connected in the workstation cloud. Computing is shifting again as functions are moved outwards to remote data centers reachable via the Internet. Cloud computing provides various services on virtual machines mapped to a large pool of physical machines residing in the server. Cloud computing only derives into concentration when we consider about what IT has frequently desired—a method to rise ability or improve other competences on the fly to the recent environment without advancing in new infrastructure, to train new staff, or adding new ones to license software. We have a lot of computing power and storage capacity that resides in the disseminated situation of the web. Cloud computing combines the potentials of these properties and makes these resources accessible as a distinct unit that can be modified to sustain present user desires. (Kareem et al., 2013). Cloud computing is an on-demand service paradigm for IT delivery that is frequently built on virtualization and distributed computing technologies, according to the European Network and Information Security Agency (ENISA). After a comprehensive assessment of current cloud computing explanations and the figuring patterns from which cloud computing derives relations and perceptions, described in this study. We will adopt Amazon's description of cloud computing. With pay-as-you-go pricing, a cloud service platform delivers computing power, database storage, apps, and other IT resources on demand over the Internet.

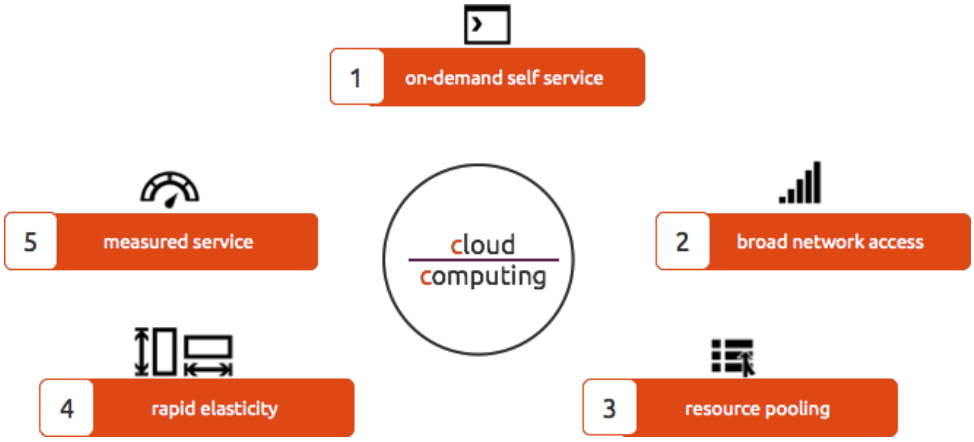
2.4.2 Cloud Computing Characteristics

Skilled are various detracting traits of a cloud calculating surroundings. Duty contributions are frequently created usable to distinguish purchasers and narrow trades that visualize the benefit as valuable cause their capital spending is underrated. This decreases hurdles to the entrance in the forum because the foundation used to supply these contributions is possessed by one cloud internet access provider and need not be obtained by apiece consumer. Cause consumers are not firm on a particular instrument (they need only the strength to approach Cyberspace) and cause the computer network admits locale freedom, the practice of the cloud allows duty sources' consumers to approach cloud-authorized

orders, although place they can exist or what ploy they pick to use (Rittinghouse & Ransome, 2010). The essential traits are:

- On-Demand Smorgasbord: admits for certainly supply calculating money as wanted.
- Broad Network Approach: an approach to cloud money is over the web utilizing specification systems determined through tinny or dense customers in a miscellaneous form, for instance, smartphones, movable phones, and desktop computer calculations.
- Ability Combining: the dealers' money is fit to be combined to do diversified customers utilizing a multi-resident model, accompanying various materials and, in essence, money in an active habit. The combining and appointing of possessions are accomplished to establish the changeful needs of customers or purchasers. The model of money contains; computing proficiencies, depository, and thought.
- Brisk Stretchiness: admits for fast wherewithal supply, keen measuring out, and measuring in of powers. The proficiency usable for supply to the customer appears extensive, and it may be bought as required.
- Calculated Aid: admits listening, control, and newsgathering of habit. It still admits for transparency middle from two points the householder and the customer.

Figure 2.3 Cloud Computing Essential Characteristics



Musee (2015) established that These traits are aforementioned: large-scale chance of estimating and depository wherewithal, uniformity, use of virtualization electronics, flexible estimating, and pay-as-you-go prototype. Depressed or no up-front IT foundation charges, the terrestrial allocation of clouds, and depressed overhead budgets for IT and presidency crew.

These traits form cloud calculating appealing to trade institutions and administration instrumentalities. The following substitute portion looks at the various electronics that hold in check cloud calculating.

2.4.3 Cloud Service Models

Skilled are three low-duty models for contribution cloud calculating duties. These models are Softwares-as-a-Services (SaaS), Platforms-as-a-Services (PaaS), and Infrastructures-as-Services (IaaS).

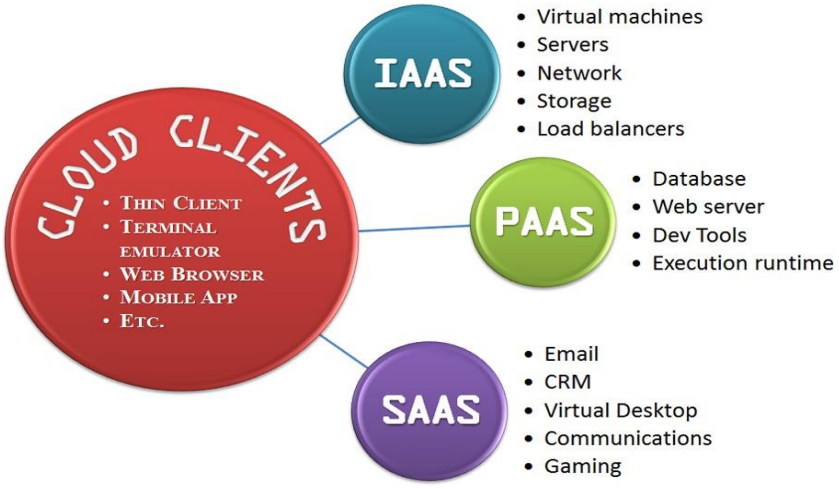
Softwares as a Services (SaaS). This involves given into the services search out custom the source's uses gossip about cloud foundation. The uses are approachable from miscellaneous customer instruments through either a thin customer connect, to a degree, a netting portal 19 (like netting-located electronic mail), or a program connects. The services do not accomplish or utilize the fundamental cloud foundation containing network, servers, operational examples, depository, or even individual request capacities, accompanying the likely irregularity of restricted consumer-distinguishing use arrangement backgrounds. (Musee, 2015). SaaS is a kind of cloud estimating that transfers use through an internet /web viewing software pertaining to 1000 consumers utilizing a multi-user construction. The attention for SaaS is completely consumer as opposed to trained duties (named beneath). For the consumer, skilled are no up-front grant costs in servers or spreadsheet licensing. For the internet access provider, accompanying just individual crop to uphold, costs are comparatively reduced, distinguished from the costs acquired accompanying a common entertaining model. (Rittinghouse & Ransome, 2010). In accordance with (Hayes, 2008) delimited as SaaS is further usually secondhand for energy reserve preparation and human property uses.

Another instance is Google Apps, which specifies connected to the internet approach by way of a netting gateway to ultimate prevalent commission and trade uses secondhand contemporary, concurrently with an activity consistency the operating system and consumer dossier stocked on Google servers. Ten of something in the past, nobody takes care of have foreseen the unexpected rise of SaaS uses in the way that these.

Platforms as a Services (PaaS): Consistently referred to plainly as netting aids in the cloud, PaaS has approximately had a connection with SaaS but gives a manifesto from what or which place to work alternatively and use to cooperate. These offer request prioritize application program interfaces (APIs) that authorize planners to exploit a range of capabilities over the WWW, alternatively giving lush uses. This difference in the cloud is estimating transfers are happening surroundings developers, scientists, and spreadsheet engineering as a duty. An approximate prototype is executed below that builders make requests created to brought to consumers in by way of a WWW gateway. (Rittinghouse & Ransome, 2010). In accordance with Rodent (2015) established that the proficiency supported the services utilizing compute not survive or influence the latent cloud foundation containing network, servers, functioning originals, or depository, but influence over the redistributed requests and conceivably arrangement backgrounds in surroundings.

Infrastructures as a Services (IaaS). This skill given into the services searches out supplying prepare, depository, networks, and different fundamental estimating possessions place the services is intelligent to redistribute and run a dictatorial operating system that can involve operating originals and uses. The services do not survive or control the latent cloud foundation but have control over operating examples, depository and redistributed requests, and perhaps restricted control of select socializing for professional or personal gain elements (like, host firewalls) (Musee, 2015).

Figure 2.4 Cloud Computing Service Models



2.4.4 Benefits of Using a Cloud Model

An advantageous reaction of utilizing this model is that calculating competency increases efficiency because clients do not should organize their requests for top occasions when dealing with stacks are excellent. Enactment of the cloud estimating prototype still existed allowed by way of the better chance of raised speedy frequency range. Accompanying better enablement, though, skills are added issues individuals must examine, exceptionally allowable ones (Kareem and others., 2013). Additional advantage that creates cloud duties extra trustworthy is that extensibility can change enthusiastically established changeful consumer demands. Cause the internet access provider controls the unavoidable foundation, and protection frequently is immensely enhanced. On account of dossier consolidation, skilled is a raised devoted effort to something safeguarding client possessions uphold for one internet access provider. To guarantee clients that their dossier is cautious, cloud providers are fast to purchase hard-working freedom sticks. This is broadly visualized as advantageous but has too nurtured concerns about a consumer's deficit of control over a delicate dossier. The approach to the directory is regularly recorded, but achieving the audit logs may be troublesome or even preposterous for the client (Zamani and others., 2011). Cause consumers mainly do not own the foundation secondhand in cloud calculating surroundings, and they can abstain from capital spending and waste possessions as aid by just repaying for the reason they use. Many cloud calculating contributions have selected the serviceableness estimating and advertising model specified above, while possible choice bills are on a consent base. By giving calculating capacity between diversified consumers, exercise rates are mainly considerably enhanced cause cloud calculating servers are not situated inactive for lack valuable. This unique determinant can humble foundation costs considerably and advance the speed of uses happening (Rittinghouse & Ransome, 2010).

2.4.5 Assessing the Security Issues of Cloud Computing

In current presences, cloud computing has a combination of the rapid-increasing fields in the information system business. Savings of scale, geographical disposal, open-source software, and the capability to reduce costs through automated plans make cloud calculating an attractive activity option. However, many of the benefits of cloud computing come with

allowable and reputational risks. US and EU regulatory necessities governing data stocked by cloud providers highlight a few risks associated with cloud computing (Sotto, Treacy, & McLellan, 2010). Arrangements considering cloud-based duties should learn the risks involved, define good use cases and necessary balancing controls, and allow their use for supervisory or confidential information. Cloud-calculating surroundings have IT risks similar to any outwardly delivered services. Few unique attributes demand risk assessment in data purity, recovery, privacy, and judging legal issues in e-finding, regulatory compliance, and verifying (Heiser & Nicolett, 2008). Gartner defines *cloud* estimating as "a style of computing where laboriously scalable IT-enabled wherewithal is delivered 'as an aid' to external customers utilizing Internet sciences." From a security and risk perspective, it is the smallest transparent externally culled service transfer method, storing and converting your data externally in diversified unspecified sites, often sourced from additional unnamed providers and holding data from various clients. A service provider has far more flexibility by preventing specifics about allure location, staff, electronics, processes, or subcontractors. Increasingly, service is being presented by a chain of providers, each invisible contribution processing or storage aids on behalf of an internet access provider that might not be directly ruling any of the technology, and each can approach unencrypted data in an allure facility invisibly. This form makes it easier to maintain costs down and scale to meet changing client demands, but it also makes it harder to determine the risks to businesses utilizing such services (Heiser & Nicolet, 2008), Understanding the risks that guide cloud computing is particularly troublesome. CIOs, chief information protection officers, compliance and solitude officers, and line-of-trade leaders should be complicated in risk assessments of new cloud-based aids. If a company revere using external help, it should:

- Evaluate protection, privacy, and agreement risks.
- Identify use cases inappropriate for this duty delivery order based on risk level and current management.
- Recognize use cases that represent an acceptable level of risk for aid delivery patterns.
- Select and implement alternative controls before the entire operation.

An essential challenge in deriving systems to the internet is the necessity to gain several words and managing ecosystems. Various cloud systems depend on relational databases for back-end processes, so little code is implemented in database or added query languages.

The application design grant permission to be applied in JavaScript entrenched in HTML files on the client side. Middle from two points, the data-source, and the customer, is a server system composed in a scripting language (PHP, Hot beverage made from beans of a tree, Python, etc.). Information replaced between different tiers may be encoded in a few variations of XML. New models of detached computing appear to be canceling the "liberation" motion of the 1980s, which gave individual consumers control over their programs and data. Still, this shift has not necessarily abandoned corporate IT areas in possession. Does not necessarily return capacity to the owner (Hayes, 2008).

2.5 OPEN GOVERNMENT DATA (OGD)

The Electronic Government framework works to achieve compatibility at the stage of information technologies, processes, and services to support e-Government at the national, regional, and municipal levels.

However, the UK PSC's organization of service activity data does not allow for connections between related service activities. For instance, while A is a requirement for B, there is no connection among two service accomplishments A and B. Furthermore, there is no connection among service accomplishments A and its English transformation. This is because there is no conceptual connection among related service accomplishments. Hence, there is a requirement to convert this instance of Open Government Data (OGD) to linked data service (Ding et al., 2011).

OGD initiatives have only lately been implemented. Therefore, classification techniques to study them still need to be improved. However, there are more and more valuable recommendations being made by diverse stakeholders. The e-governance concentration association of the World Wide Web Consortium (W3C) recommends three measures for public governments. To publish and distribute their data: Data should be published in three stages: first, as raw data in files in well-known, non-proprietary formats like Comma Separated Value (CSV) and Extensible Markup Language (XML); second, as web catalogs; and third, as machine-readable data (Attard et al., 2015a).

2.5.1 Linked Open Data (LOD)

Future OGD initiatives appear to rely heavily on linked open data. Linked data defined as "data published on the web in such a way that it is machine-readable, has a clear definition, is linked to other external datasets, and can, in turn, be linked to from other datasets". The concept and tools of the Semantic Web are the foundation of the Linked Data initiative. However, unlike the fully realized semantic web vision, it primarily focuses on publishing designed data in RDF format using URIs as opposed to concentrating on the ontological level or inferencing (Färber, 2018). By the way data from diverse and decentralized source may be linked together through reserved links, it promises to usher in the "Web of Data."

2.5.2 Web Service Distributed from the Cloud

As science moves around from the established principal prototype to the modern cloud prototype, services of contributions progress approximately every day. Our resolute in this branch search out deliver little elementary experience to place the area is now from the perception of the electronics and present we think for place it will affiliate with organization the not-long period of time. In accordance with (Rittinghouse & Ransome, 2010) Web duty contributions often have various ordinary characteristics, to a degree a reduced barrier to entrance, place services are presented particularly for consumers and narrow trade individuals. Usually, a small amount or no resources investment for foundation is essential from the consumer. Although large scalable is familiar with contributions, it is not forever needed. Several cloud merchants have still to reach immense interoperability cause their operator create mainly ensures not demand. Multi-tenancy allows rate and talent giving beyond the (frequently boundless) consumer root. Lastly, maneuver and district self-sufficiency admit consumers to approach plans although where or what scheme they use. In accordance with the available remark Wikipedia, Infrastructures-as-a-Services is the transmittal of calculating arrangement (usually a policy containerization surroundings) services. IaaS influences meaningful knowledge, duties, and dossier midpoint funds to give IT as a aid to clients. Different usual out-sourcing, that demands widespread outstanding intensity, bargainings ad infinitum, and complex, lengthy contract jeeps, IaaS is concentrated about a help transmittal prototype that supplies a pre-defined, patterned foundation augmented definitely for the consumer’s systems.

2.5.3 Benefits Semantic Web Services for E-government Data

In accordance with (Davies, 2005), the benefits of semantic web services duties for e-governance data are:

- Scalability/flexibility/updatability: Refers to the ability of a web-located repository system to scale outside significant performance degradation.
- Dependability/Resilience (Fault Resistance):A Theb-based repository order can handle abnormal situations and support disaster recovery duties.
- Where applicable, plan and information truthfulness: Refers to the capability of a web-service warehouse application to confirm that stocked information is clean after handle, Duplicates of information, addings, deletions, and modifications of information are correct and correct.
- Performance: This refers to the web-located repository system's reversal time for the upload or log in.
- System and data chance: It means that you can use it anytime.
- Approachability: It means 24/7 access to find and fetch information.
- Reachability: A system's talent to keep different kinds of information.
- Magnificence: The capability of the application to merge with another web-located application, doubt desired.
- Safety refers to the system's capability to prevent hateful security threats from hackers, insane, and other security dangers.

CHAPTER III:

METHODOLOGY

3.1 INTRODUCTION

This chapter purposes to find appropriate system designs and methods that e-governments, and organizations use to process linked data. A suite of system methods and modeling techniques are substantiated to develop a semantic netting service prototype. Following in position or time interacting with bureaucracy and seeing how fast and easy it was, most users cherished implementing such an order. Moreover, why that specific area is preferred from the feasible possibilities, as well as everything connected with this extent, to give the scholar a thorough understanding of the subjected-area secondhand and how it works. Meet your trade needs. Finally, this chapter decides on the development methods requirements. Because when evolving software, several belongings are necessary to create the information system, containing hardware and software necessities.

3.2 SYSTEM DESCRIPTION

E-Governance is the mainly appropriate area where the Semantic Web will benefit. E-Governance deal with distinctive information systems, people, management structures, services, and relationships among these units. Government infrastructures are tense to operate culture with various organizations and authorities. Accordingly, fundamental contract on the value of concepts and procedures is required in advance of ontological configuration occur. Governments have several different data sources.

- Unstructured data residing in rules, procedures and concepts, policies, and so on.
- Data relating to facts and figures treated as operational ideas. As Gupta (2004) pointed out, data is raw facts and figures, information is processed data, and knowledge is 'suitable information.'
- Structured data: Every piece of data is originated from information that can be kept in a systematic warehouse and help for administrative-decisions.

Here exists efforts to bring certain order to the management of information and understanding the meaning through several systems of e-governance.

E-governance is exceptional because of the vast challenges of achieving interoperability. It is considering the various semantic differences. Laws, regulations, civil society, organizational procedures, superlative applies, and several languages that must be considered in the outside and beyond different regions. Building unified e-governance applications requires for information accumulation and operational integrates (Adadi et al., 2015).

It's an excellent stage advancement, and everybody concerned would be grateful for the capacity of information that has been rendered accessible and web portals, which (different of UK e-governance systems) was established quickly by a local group built on open-source application at small budget. This is the primary stage on a long journey (Janev et al., 2018). Some of the aspects of the UK Governance's methodology to make data as free-use is the improvement of linking service. It hasn't really been explained, in our opinion, what that means or why we should adopt this strategy. From this point we have noticed that software engineers appear to believe: Linking data is an alternative for transforming entire data into RDF format and setting in single large triple store, correspondent to assembling another large dataset of e-governance data and hence disposed to precisely the similar, familiar and assumed issues that e-governance has producing massive datasets (Jain & Kumar, 2018).

Linked data expects everybody to follow to the similar schemas and vocabularies, that involves enormous work in standardization and endings up with rather than the appropriate ones. The UK e-governance would only release the entire country's information as linking data going forward. Academics who know nothing regarding the website or the actual world functions have persuaded the UK government to use connected data. Many corporations who stand to gain significantly by offering services to government agencies that are compelled to reveal their data in this manner have successfully persuaded the UK e-governance to use linked data. These are all untrue. Since they are certain it is the ideal method for publishing data in a very diversified and distributed environment gradually and sustainably, the UK e-governance actually dedicated to publishing data as linked data (Sheridan & Tennison, n.d.).

Since linked data is merely a concept describing how to distribute information on the cloud while using the website, and the website is the greatest technology we are aware of for progressively and persistently publishing data in a very huge and spread system, (Michel et al., 2018).

If we're a website creator, we previously recognize that the greatest web services are RESTful-APIs. So, there is no dispute can come over. That means:

- Using (HTTP) URI in order to classify properties: specifying everything with URI to be more precise than activities on these objects (which are performed to use the set of standards HTTP requests).
- recognizing the difference among properties and their schemas: the resource may be represented differently by the same URI, such as HTML or XML, or JSON.
- Returning expressive responses: having the ability to handle represents in a way that is evident from the mime type will allow you to return identity responses.
- mechanism as the links of system states: having the ability to find more resources by using (text-based) hyperlinks that refers to the system state.

Linked data is all refers to follow these standards in order to publish data. It involves utilizing URIs to classifying objects, adding identity expressive metadata to the ending of such URIs, and connecting those things to other things using structured hyperlinks. The absence of any huge relation is one of the advantages of this strategy. Nobody sat down and meticulously planned the web, mapping out each page's precise relationships to one another in preparation. It developed and grew, and it still develops and grows now. It expands as a result of people and organizations publishing information for their own purposes, linking to those publications, and doing so because clients and servers may communicate with one another in accordance with some essential criteria. (Vitvar et al., 2006).

3.2.1 Criteria Used to Semantic Web Services

Semantic Web services clarify with self-descriptive service systems by providing an interoperability, machine-understandable web of data based-on proper and clear explanations of the model and meaning of data. Current study on the use of Semantic Web service has focused on data modeling and relatively neglected issues of software architecture and engineering. Advantages such as data retrieval and data extraction with simplified information integrates are well studied. Though, to promote the widespread implementation of Semantic Web services, the entire lifecycle of web service must be evaluated in relations of application development effort and return on investment (Theocharis & Tsihrintzis, 2012).

This lifecycle comprises the primary stages of linked data implementation, then preparation how the data will be used, creating new model or improving existing model, permanently storing the model, and finally, the data. Make it public and access it externally. Creation, reconciliation, archiving, and publishing can all be done by the application at runtime and involve software development and architecture aspects in addition to data modeling aspects. Web service implementation challenges have been analyzed based-on experimental data from web service development systems, but to the best of our experience, related to the implementation of data creation, refinement, archiving, and publishing based on linked data service. No experimental study of the problem exists (Marjit et al., 2009).

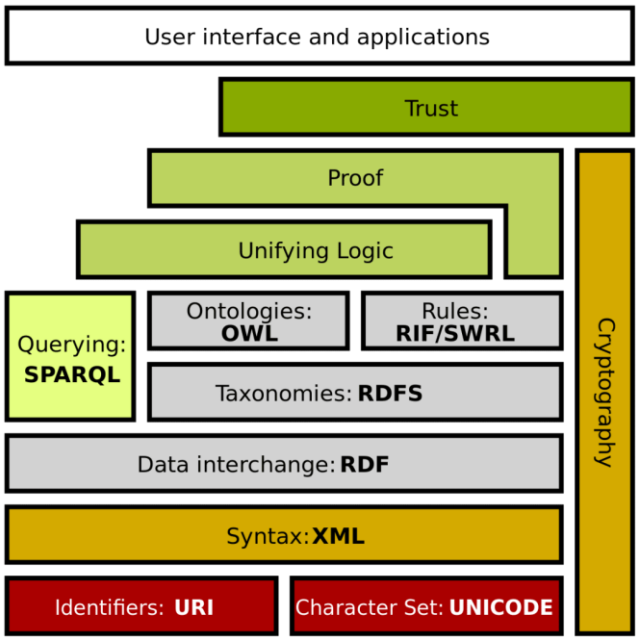
We conducted an empirical study of Semantic Web Applications to help classify the most commonly assigned elements and the issues of developing those models. At the same, these model form proposal architecture for linked data services. This research demonstrations that developing linked data service poses issues that can assume the overall system. These Model approaches and best experiences for linked data services are emerging today. Their absence is an problem to develop and organizing web service that leverage linked data in current-world practice situations (Davies, 2005).

3.3 SEMANTIC WEB ENVIRONMENT TOOLS

The WWW and the Semantic Web are one and the same. It is a Web extension that transforms current Web publications into data by supplementing them with fresh data and metadata. This expansion of Web content to data will make it possible for humans to process the Web manually as well as automatically. Semantic Web works well after creating a great value website using markup code and some plugins or scripting methods. This term describes to the use of specific procedures, tools, and technologies, referred as three-tier, client/server, and semantic web technologies, for web page and website development (Empire State of the South University, 2008). The term semantic web comes from the meaning that data linking to application are based on Information systems, specifically the part called the World Wide Web Consortium (W3C). A poorly designed technical environment prevents proper procedures. A technical background is required for development, testing, and production (Zhou et al., n.d.).

In e-Government approaches, models not only lower the risk of misunderstanding but also lower the cost of modifying the system to accommodate changes in requirements.

Figure 3.1 Semantic Web Environment Tools



3.3.1 Semantic Web and Linked Data Principles

Linked data is the foundation of the Semantic Web. It describes the Semantic Web as "an extension of the current Web that gives information a clear meaning and allows computers and humans to work better together." Data is designed in a way that allows machines to create relationships among different sources. These relations are called linked data. Establishing best-feature, shareable, modeled metadata can make the library resources and studies discoverable and relatable to other relevant data sources. There are several open-source technology tools to get in progress with Semantic Web. Some are: - Linked data. World Wide Web Consortium (2015), Brief introduction from W3C. Contains a synopsis of the Linked Data and illustrations of connected data sources. Linking Data: Further development of the semantic web into a worldwide dataset. Steve Chris and Lobvis Visor (2010). Indicates a theoretical and methodological summary to Linked Data.

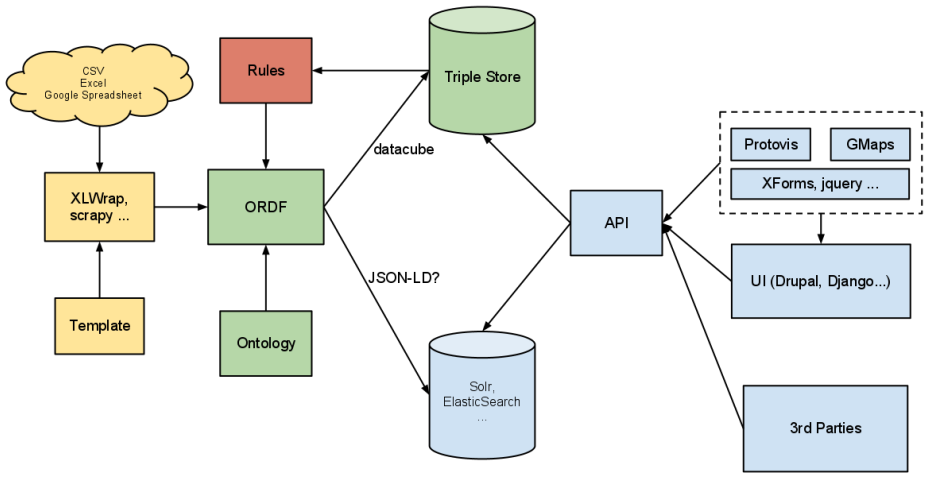
Tim Berners-Lee suggests four common procedures for developing linked data for the Semantic Web to make it possible for both humans and robots to access data from several servers and to more readily understand its semantics. As a result, the Semantic Web evolves from being a collection of connected documents to one that is made up of linked data. It in turn enables the development of a densely connected network of meaning that can be processed by machines.

1. As the name of the object, that uses the URI. This comprises identifying relations among objects. Using actual URIs in the data is essential for linking the data to other datasets.
2. Use Web URIs to allow users to search for these terms. Take care the URI is from a well-known and moderated vocabularies with a functional public that provides and manipulates these standards.
3. Use a standard, such as a controlled vocabulary, to provide helpful data when somebody searches for the URI.
4. Add links to another URIs to help individuals and computers determine more.

3.3.2 Architecture of the Linked Data

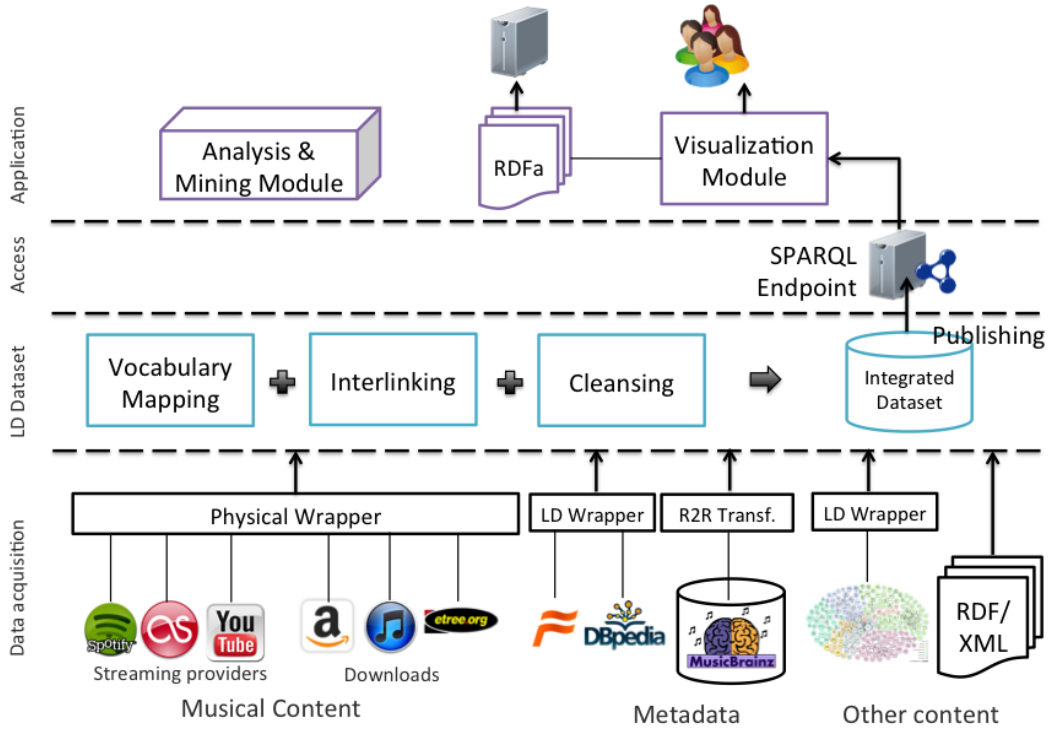
"Architectural design is the structure and blueprint of how a system's 'networked environment' works, what hardware and software are used on each computer that circulates on the network." (Sommerville, 2016).

Figure 3.2 Linked Data Platform Architecture



Architecture for Linked Data has developed. The primary capability continues to be the collection of data from spreadsheets and other structured sources, such as SPARQL endpoints, and the subsequent visualization of that data within a Drupal-based user interface. The technology and architecture we employ to achieve this goal have changed as a result of the lessons we've learned along the road, and we're currently planning and putting them into place. At the same time, the server controls the system logical, information retrieve logical, and storing data (Davies, 2005). This is a representative choice, requiring reduced over-head and more straightforward protection.

Figure 3.3 Example of the three-tier architecture of Linked Data



The "presentation tier" in the three-tier architecture is the primary tier and covers in the application interface. The second tier is the "application tier," and cover the company process logic that allows data to be shared and distributed across applications. It is developed in program language like PHP and RDF. The final tier is the "data tier," which covers the datasets and "data access" layer, for example, SPARQL. The three components of every Linked Data application are the semantic web, related URIs, and Web service application. First, getting Linking Data from data sources is the responsibility of the related URIs.

Wrappings can be transformed to convert data into related URI when the obtained information is not in the RDF format. Mashups are commonly used to describe systems that exclusively consume related data. Second, it is up to the Linked Data consumer to modify the data they have already ingested in order to create new Linked Data. Lastly, the user interface gives users a mechanism to communicate with the program. Although not always, this will be an application interface. The system can contain these interfaces supportive, such as, visualization of the schema and web service APIs for interaction with the application.

3.3.2.1 Advantages of Client-Server Architectures

The main benefit of the client-server architecture is that it promotes semantic interoperability. If one server becomes slow, he can easily install another, using many servers to run the program's functional logic or the database system. This allows to boost or reduce server capacity and processing power quickly. A second advantage is an ability to support many different servers and clients. This means that devices with other information systems can be immediately related. The final benefit is:

Given lightweight client/server architecture (with a limited portion of program logic) using Internet standards, explicitly separate system logical, data access logical, and process logical and build them separately, It makes sense. It contains. This means that the system's front end can be transformed without changing the program logical and vice versa. From these motifs, I decided on this architecture.

3.4 SYSTEM DEVELOPMENT ENVIRONMENT

A development environment collects methods and techniques for implementing, testing, and debugging a system or software. The development environment is a significant concern, and it is a matter which needs a decision by choosing among the many available environmental alternatives for the client and using the one that best suits the needs. So, the application will be a complete program developed in OWL and RDF as the front-end approach and SPARQL server as back-end tool.

3.4.1 Front-End Selections

Front-end web development uses HTML, CSS, RDF, and JS in a website or web application so that end-user can directly display, read and interact with it. The front-end is also allows for developing the visual representations that the user sees and interacts with within the application. Her goal when designing a website is to ensure that when a user opens her website, they get information in an easy-to-read and well-formed format.

- **Hypertext Markup Language (HTML)** is the primary markup language for designing webpages and any visual representations that can be presented in web-browsers. HTML is the backbone of all website development processes, without which no website would exist. A markup language designates that normal data can be transformed into tables, pictures, links, graph, and other visual formats. Hypertext refers that data link, called hyperlinks, are entrenched within the text. When the user clicks on the hyperlinked word or phrase, it takes her to another web page. The principle of the web-browsers is to view HTML files and assemble them into readable, audible or interactable webpages. The web-browser not just present HTML documents but also uses them to interpret the page's content. We can also introduce text-scripts and HTML links displayed in JavaScript language that creates effects the behavior and interactivity of the HTML webpages.

- **Cascading Style Sheet (CSS)** is the stylesheet language referred to describe the appearance and designing of documents in markup languages. Its commonly used for formatting webpages and interfaces written in HTML and XHTML. CSS is an actual web specification, and almost every website uses CSS for stylesheet to designate their appearance. CSS controls the presentation aspects of a website and gives it a unique look. It sits on main of other format presentations and manages style sheets generated based on various prospectives like screen sizes and device resolutions. CSS is primarily designed to separate the document content, including layout, colors, and fonts, from the document presentation. This separation improves the accessibility of content, provides greater scalability and flexible in specifying appearance features, allows various webpages to share designing, and reduces the complexity and replication of interaction in presentational format.

- **JavaScript (JS)** is a one of the core technologies in scripting language for computers. It is frequently utilized webpages to just let web-browser scripting interact with users, manage

web-browser settings, interact synchronously, and change the content of displayed documents. Moreover, it is utilized in mobile and computer software development, server-side scripting, and coding. A scripting language with syntax highlighting and many useful features, JavaScript is built on prototypes. C has an influence on its syntax. Although JavaScript borrows several terminology and identifying rules from Java, the semantics of the two different languages are extremely dissimilar.

- Web Ontology Language (OWL) is a Semantic Web language of knowledge representation languages for building ontology. Ontologies are proper ways of describing catalogs and clusters networks that fundamentally define the knowledge structure of many domains.

A noun describes a class of objects, and a verb describes the relationship between objects. Correspondingly, ontology models are much uses as they aim to convey data on the web drawn from disparate data sources. As contrast to that, class hierarchies have a tendency to be relatively fixed, much less diverse, and trust on more structured data sources. Company database. The OWL language is considered by proper semantics made on a World-Wide-Web Consortium standardization for belongings known as Resource Description Framework. These tools are of excellent for institution, government, and business industry.

3.4.2 Back End Selection

Back-end tools for development are responsible for server-side systematic logical process and integrate the work of front-end development. SPARQL is used as the backend used to design the database.

- SPARQL, SPARQL Protocol, and RDF Query Language are semantic query Languages. Its RDF query language can be used to express queries for datasets to process and manage data stored in the RDF format. It was standardized by the W3C's RDF Data Access Working Group (DAWG) and is concerned about one of the critical tools of the Semantic Web service and linked data. SPARQL has several characteristics that distinguish it from other DBMSs, as described below. In SPARQL query can contain of triple-store, aggregations, graph-patterns, and optional parameters. Several programming language implementations exist. Some tools, such as ViziQuer, can connect SPARQL queries to his SPARQL endpoint and build them semi-automatically.

Additionally, there are technologies for translating SPARQL query into different query languages , such as SQL and MySQL:

- SPARQL is a dataset management system used on the semantic web.
- SPARQL allows querying Linked Data and RDF. SPARQL software is open source.
- SPARQL database servers are fast, reliable, and easy to use.
- SPARQL Server works on client/server or embedded systems.
- A large amount of provided SPARQL software is available.

SPARQL is also used by many large and well-known websites such as Wikipedia, Dbpedia, Amazon, Google (for search maps), and Government Open Data portals.

3.5 KEY TERMS OF SEMANTIC WEB

3.5.1 Linked Open Data (LOD)

Linked Data is a structured scheme standards for publishing machine-understandable related data on the Web, Where Open Data refers to free accessible publish and manage. Based on the RDF standards of the Semantic Web, Linked Open Data describes a concept of worldwide available and related information on the internet. LOD is frequently referred to as a virtual data cloud where anyone with access can add to any data without affecting the actual data source and view any data they are authorized to see. This creates an open environment for data creation, connection, and internet-scale consumption. Wikidata and DBpedia are two examples of sizable linked open data sets.

3.5.2 Resource Description Framework (RDF)

The Worldwide Web Consortium created a set of semantic web standards (W3C). These guidelines establish a framework for making straightforward claims about resources so that computers may understand relationships. Subject-predicate-object reports, or triples, are used in a linked data environment to represent the connections between entities.

3.5.3 Schema Structure

A schema uses formal language to describe a database system. It refers to how data organization in a database is constructed—a groups of components for structured dataset such as MARCXML, MODS, AACR, EAD and RDFS.

3.5.4 Uniform Resource Identifier (URI)

An organized, distinctive phrase used to recognize objects is a URI or uniform resource identifier. A URN, or uniform resource name, is one sort of URI and is a recognized, standardized label for a specific item. The second kind of URI is a URL, which gives a resource's internet address. Typically, machine-interpretable URIs take the form of URLs. Although not all URIs must refer to a webpage humans can read, specific URLs can direct objects of end-users to additional data about these resource parameters. The URI http://purl.org/dc/dcmitype/StillImage illustrates a URI for a still-image (photo, maps, etc.) from the Dublin Core kind vocabularies. Another example uses https://viaf.org/viaf/50566653 as the URI for American novelist Mark Twain.

3.5.5 Triples

RDF triples are subject-predicate-object declarations that designate the connections among objects in a semantic web standard. Triples are also referred to as Semantic Triples. They act as the building structures of related data. On the Semantic Web, each triple's components are frequently expressed as URIs. For example, Jane Doe's book "Some Book," which bears the title is identified as being written by Jane Doe using the triple maybe something.

3.5.6 Semantic Web

Semantic Web is an idea for a World Wide Web Consortium of interlinked data across webpages, applications and files and is seen as the new phase of web development. All web-based Data is designed and organized as machine-readable on the Semantic Web. Computers can now infer links between resources, expanding how people might discover new fields of knowledge. The Google Knowledge Graph, which compiles information from various datasets into a condensed and clear information, is one modern example of a Semantic Web forerunner.

3.5.7 Turtle

RDF lessen The Resource Description Framework (RDF) paradigm uses a syntax and format called Triple Language (sometimes referred to as Turtle) to store and express data. As opposed to using words to express values, data in Turtle style is presented in triple form. For instance, data on a library could be displayed in Turtle or domain model. While machines might be able to store this Data, only humans can understand it because of the format.

3.6 SYSTEM REQUIREMENT SPECIFICATION

In software development, some hardware and software requirements should be available when developing semantic web services for e-government-linked data. Although these requirements depend on the system's complexity, even the least complex one also has some requirements for developing that particular software.

3.6.1 Hardware Requirements

Every system is composed of units that are put together to work as one to achieve a common goal. The hardware device requirements for the implementation of the system are:

Client Machine:

Processor	: Single Core (1.4 GHz) of CPU
Monitor	: SVG Color Monitor
Memory	: At least 1GB of RAM

Server Machine:

Processor	: Core 2 Duo of CPU
Monitor	: SVG Color Monitor
Memory	: At least 2GB of RAM
Free space	: 10 GB and more

3.6.2 Software Requirements

The system will also require software to develop the plan:

- Operating system - Windows 7 is the one of the popular operating systems as it is secure, provides many features, and more responsive than other windows.
- Database - SPARQL is used as a dataset as it is simple to maintain and retrieve datasets by effortless syntax that is simple to read and write.
- Development environments and Programming language - The entire website's code is written in HTML, and CSS and JavaScript are utilized for styles and behavior, and RDF and OWL for server-side programming.

The following software must be installed on the computer system to implement the new system effectively.

Client Machine:

Operating System	: Windows 7 and Higher
Dependencies	: JavaScript
Browser	: Microsoft Edge/Explorer, Google Chrome or Firefox

Server Machine:

Database	: SPARQL
Dependencies	: Java Development Kit (JDK)
Ontology Model	: Protégé 5.5.0 Editor
Web Server	: Apache-jena (Fuseki server)

CHAPTER IV:

SYSTEM ANALYSIS AND DESIGN

4.1 SYSTEM ANALYSIS

System analysis concerns the analyze of system domain to fully comprehend the issue being raised. The primary goals of the activities are to gain a thorough understanding of the current system, including its advantages and disadvantages as well as the justifications for restructuring, replacing, or automating it. It is the procedure of gathering and analyzing data, determining the issues, and breaking down a system into its constituent parts such as risk planning, cost approximation typically organized by the project analyst. The proposed system aims to develop a plan for improved facilities. The proposed method can overcome all the limitations of the existing system to reduce the time involved in e-government web service.

4.1.1 Existing system

Although the existing system of the e-government considering the lack of interoperability, the new system will be projected to benefit semantics. However, e-governance extend leverages the capabilities interconnecting participation of society, there is a crucial necessity considering the lack of interoperability to use of integrated network infrastructure in public service and delivering government services stored in these distinct systems to citizens. Semantic Web technologies offers the basics for exchanging expertise and information to coordinate business processes. The manual method of data processing reveals several problems, which include:

- Records to be kept are often too large, diversified, and complex to be processed manually.
- Manual collection of information requires a lot of workforce, time, transportation, and strength.
- The record maintenance and operations required on a day-to-day basis are extensive.
- Needs manual calculations
- Information can be lost when records are stolen, misplaced, or vandalized
- Consumers' large volume of paperwork
- Inaccuracies often ensue from human error in manual record keeping.

The problems that the e-government system faces can be solved by using semantic web service of linked data. The existing system has no capacity integration for interlinking government information. The design needs to be online and automated to avoid all these limitations and make the work more accurate.

4.1.2 Proposed system

The new proposed system aims to implement a e-government for linked data services. The solution minimizes manual labor while providing enough security. The current method has a number of drawbacks and numerous operational challenges. The suggested approach makes an effort to get rid of or significantly lessen these challenges. The proposed deliver public services, increase transparency, and provide integrated network infrastructure for government.
The existing e-government observes are fraught with several integral insufficiencies and short comings. Often, a substantial disparity happens in the system with fewer production.
During our requirements gathering, we discovered a number of issues with the manual system (current system). The following issues were some of these:

- Paper and pencil procedure: The old method is entirely manual-based. The operations involving the e-government data are not systematic.
- Reliability of Information: The old systematic, especially manual processes, facilitates the ability for information to be improperly maintained (mishandled).
- Redundant data: It's simple to find information or details about a specific individual in various places. Errors and unreliable and repeated datasets in many data sources are blamed for unorganized information processing.
- Decision-making: Whereas the existing system's effectiveness is weak, decision-making is generally prolonged.

The new system is straightforward in semantic web service and linked data. The system needs meager standards and will adopt in practically formats. It provides following aspects:

- Minimize manual data access.
- Least time required for the several processes.
- Better effectiveness and improved service.
- User-friendly and interaction.

CHAPTER V:

IMPLEMENTATION AND EVALUATION

5.1 INTRODUCTION

In this thesis, we sought to use of semantic web service in order to implement the linked data of e-government. We used the UK government as a case study and developed a new ontology and linked data service model based on the central government's open data portal. The necessary technology already exists to enable this (RDF, OWL, SPARQL, etc.) The Web service and Linked Data need to go among their existing achievement reports, which are mostly regulated to e-government settings and certain societies and offer services that enhance people's daily lives to the broader public. Increasing the volume of semantic web services on the linked data and creating the essential technologies are required to achieve this. we present different steps of implementation and integration this innovative model by taking in account the different main units and subunits of this government.

5.2 Brief Description United Kingdom (UK) government

The United Kingdom Government, usually known as the British Government or just the British Government, is the main executive division of the United Kingdom of Great Britain and Northern Ireland. Its full name His Majesty Government, or HM Government, and It’s the official name of the entity. The Prime Minister, who will lead the government and appoint all other ministries. Since 2010, the Conservatives have controlled the government of the nation, and each subsequent prime minister has been a member of its leadership team. The cabinet, which is the highest governing body, includes the prime minister and his senior ministers. The UK's seat of government is similar to any other governments in the global. The UK Open Government Data platform provides facilities to whole UK citizens, residents, visitors, organizations, and the private sector. The UK Government has a National e-Government goal of reaching whole governance facilities available to the public and ensuring the effectiveness, consistency, and credibility of these facilities at reasonable values that meet the people's essential requests. The UK governance has taken many projects to lead the UK towards information systems launching numerous industries in the UK to adopt and use e-government. The success of e-government in the UK depends on government support and public

acceptance. Adopting e-government in the UK presents many challenges, including administrative issues, technical challenges, infrastructure issues, absence of trustworthiness and security issues. Apart from these, there are social challenges such as the low IT skills, poor usability of government website, lack of linked data, and nonexistence of machine-readable data. The challenge of applying e-governance portal is how UK can implement its government portal more linked data to provide both human and machines understandable data, helpful, and access to the data service they desire.

5.2.1 UK Government Linked Data Ontology

The framework for semantic-based services used by the UK's central government. It consists of the UK public body, the Cabinet, the Government Organization, the Post, The Civil Service, and the Committee. The ontologies were developed using the protégé tool. An e-government service domain is a framework for semantic integration's initial input. Several information sources and domain experts were engaged in establishing the domain's procedure. Then, a domain ontology is created to record the pertinent ideas, actions, jobs, rules, etc.

The ontology model is a group of clusters used by the e-governance and represented in their framework. Establishing central government ontology design principles, creating an ontology concentrating on categories related by the formed standards indicated in schemas, and appending classes and properties are the processes taken to connect the connected data of the UK government. By using correspondent Classes and sub-Class-Of to construct an sub-classes relations and correspondent Properties and sub-Property-Of to construct an sub-properties relations, it is possible to map the central government ontology that has been implemented in place of linked data for organizations respectively.

Exploiting attributes, data interlinking is necessary to see Also or same As with creating and using higher ontologies for actual data connections. Discovering data with the similar category or entity is addressed by central government ontology mapping, and a procedure for recognizing the similar propreties is necessary for linking data relationship. Data from each institute must be connected together since interlinking data is crucial for utilizing linked data. Securing and sustaining linked data is particularly crucial because some data

can only be accessed throughout SPARQL endpoint package, or the existing data package may not support them, making read data linking services impossible to establish. By removing institutional boundaries and improving data interlinking, central government ontologies for establishing related data are created of multiple domains and familiar sets. They will be able to cut down on the time and money needed before implemention, such as ontology modeling and external relation for other institutes to build linking data.

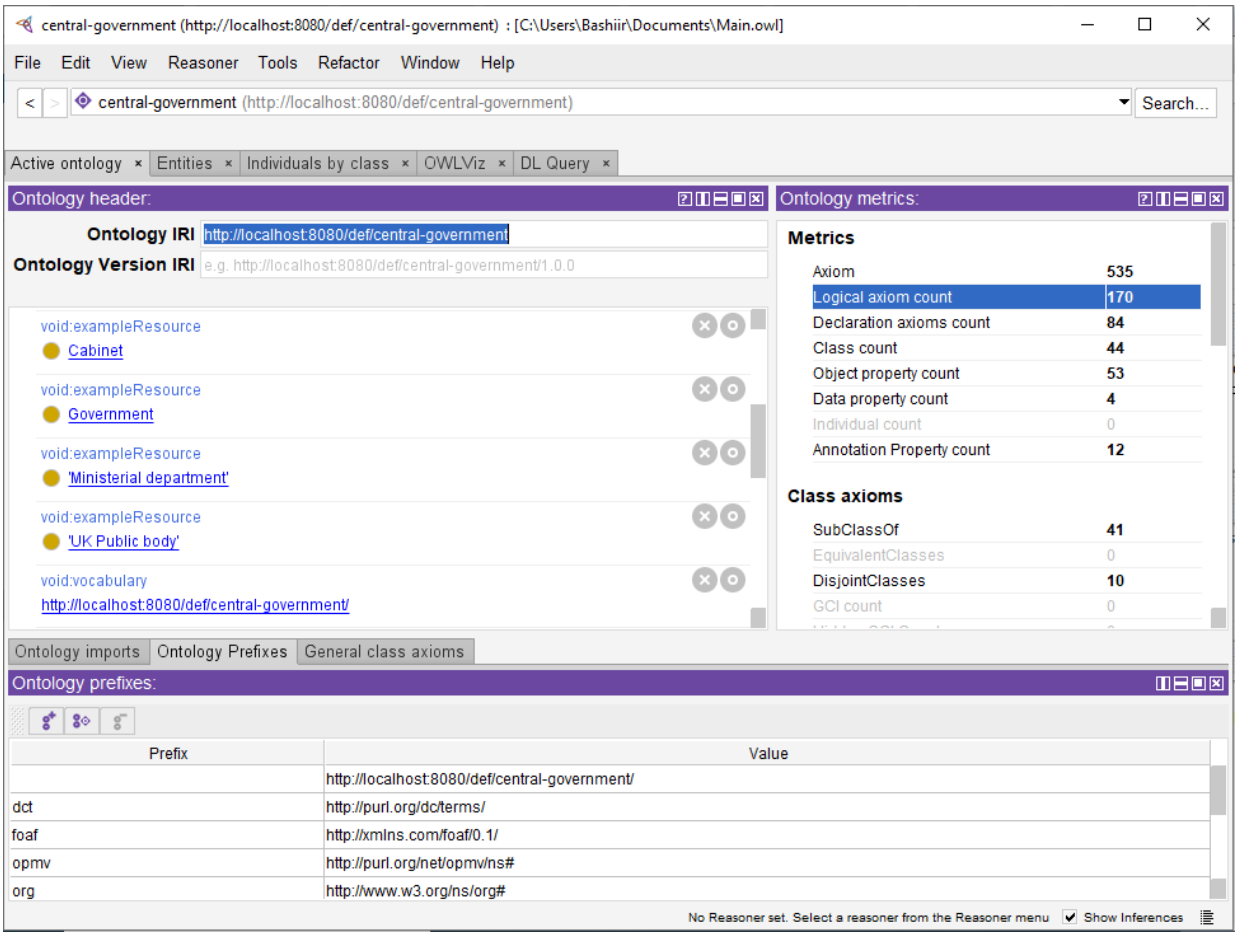
Figure 5.1 Central model Ontology of UK Government

Figure 5.1 displays the main model of ontology in domains that we have implemented for the UK government using OWL languages. The procedure we have developed to construct these areas contains these stages: Firstly stage, Ontology Extraction stage, which separates the notations from data sources.

Secondly stage, Ontology Design and Integration stage, which outlines the essential schemas

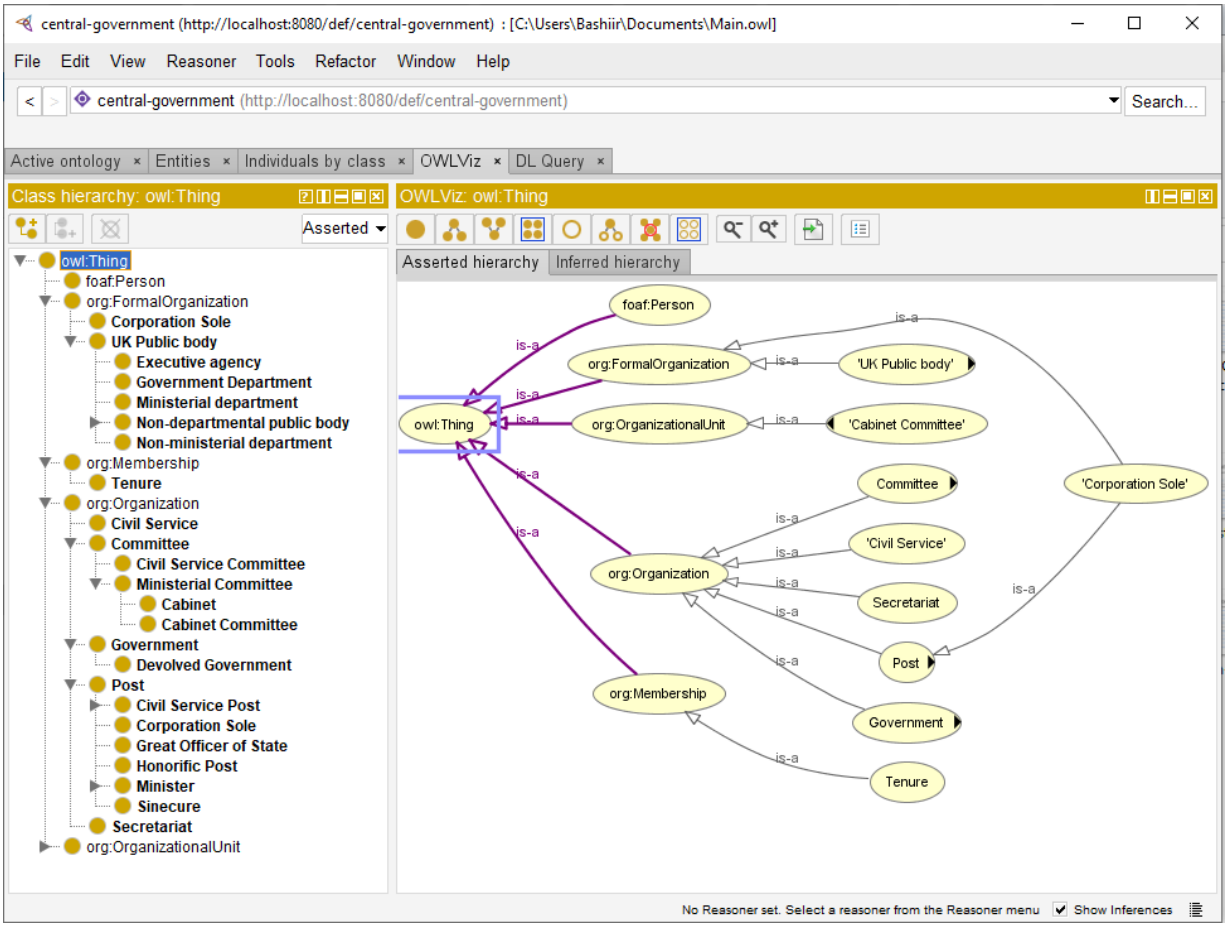
to construct an integrated domain ontologies declared in central government structure with the Linked Data obtained from the open data portal of UK government. Thirdly stage, the Ontology Validation stage, which confirms the notation domains in knowledge sets. Lastly stage, the Ontology Implementation stage, which indicates the model with ontology language.

Figure 5.2 The Main Page of Protégé Editor with Ontology metrics



The active ontology of the UK central government's many branches was presented using the program Protégé Editor 5.5. Also, the experts can change or add classes to the tree during this phase. using OWL, the semantic web's common language, to create the domains ontology. The primary concepts from the design phase serve as the input for this stage.

Figure 5.3 The Ontology List Classes Entities



5.2.2 Class, and property for integrating domain ontology

There are at least six primary classes in the domain ontology. Each class has sub-classes, including The Cabinet, The Government Organization, The Post, The Civil Service, The Committee, and The UK Public Body. There are more than 280 vocabularies in the ontology connected to components through semantic ontological relationships. Synonyms for semantic relationships are used when referring to the protégé, described as "the same individual as" the property, for example. Figures 5.3 and 5.4 illustrate the classes in model and the properties in the integrated domains notation, respectively.

The graph model of the classes and object properties is shown in Figure 5.5.

Figure 5.4 Cabinet Committee Class Annotation and Description

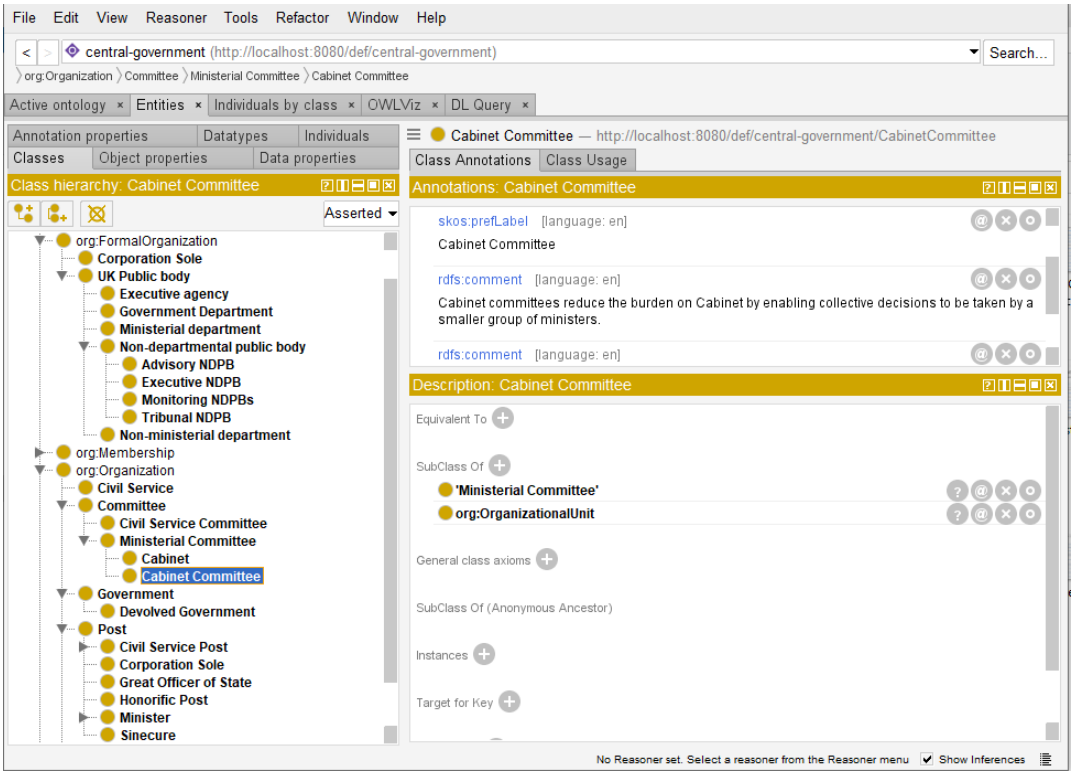


Figure 5.5 Object Properties and Its Annotation

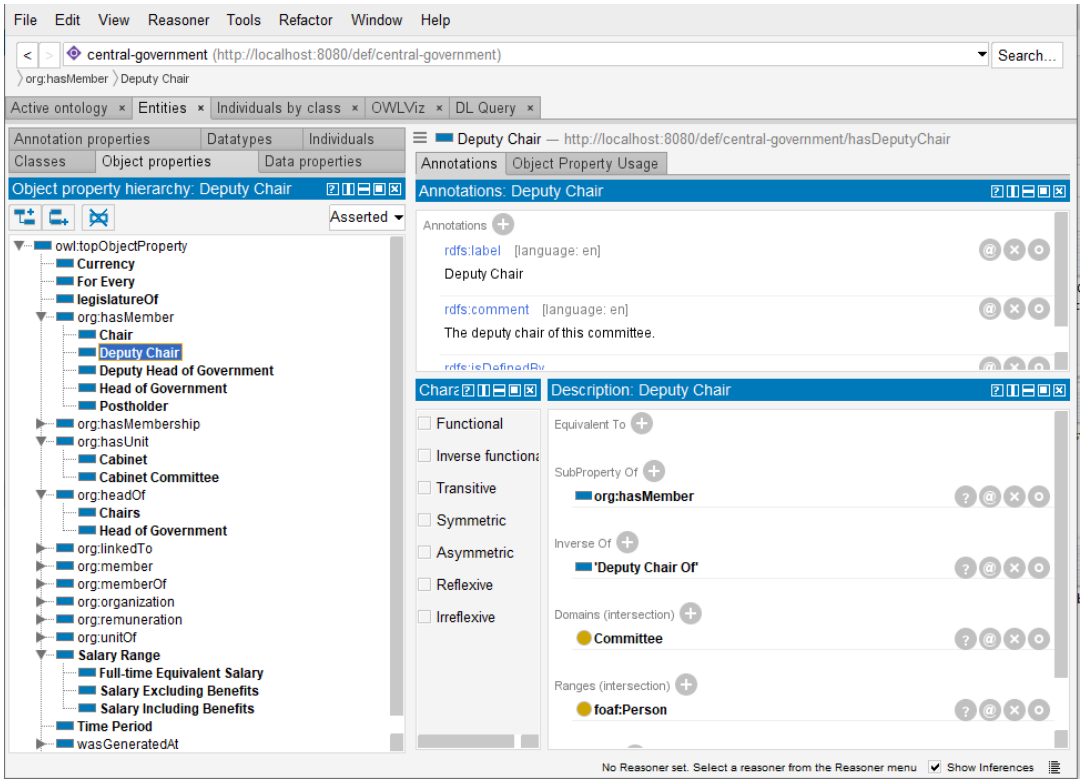


Figure 5.6 Central Government Graph Visualization using OntoGraf

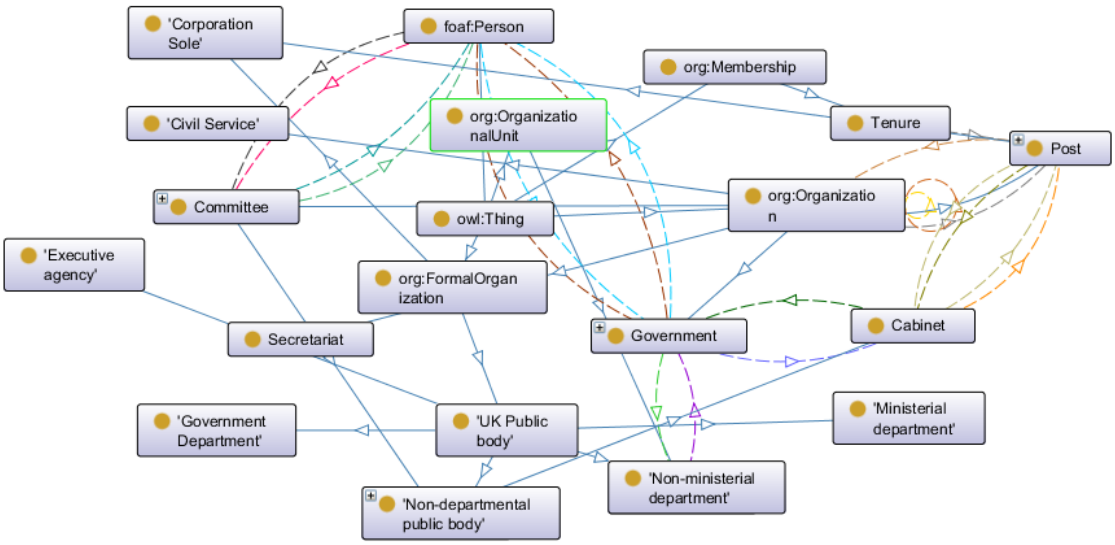


Figure 5.6 shows the central government of visualization for the model by using OntoGraf. OntoGraf is proposed and built-in by using the owl protégé editor. The structure of your ontology can be automatically organized using a variety of layouts. Subclass, individual, domain/range object attributes, and equivalence are just a few of the relationships offered.

Figure 5.7 Central Government Graph Visualization using OWLViz

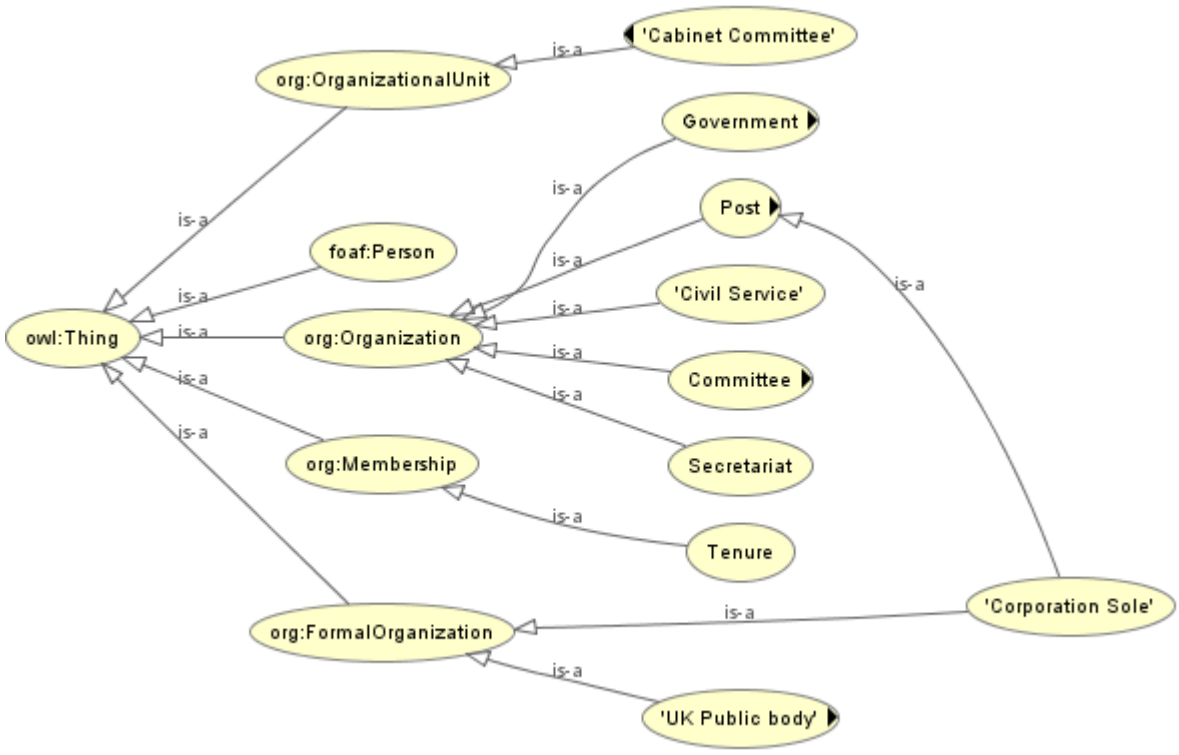
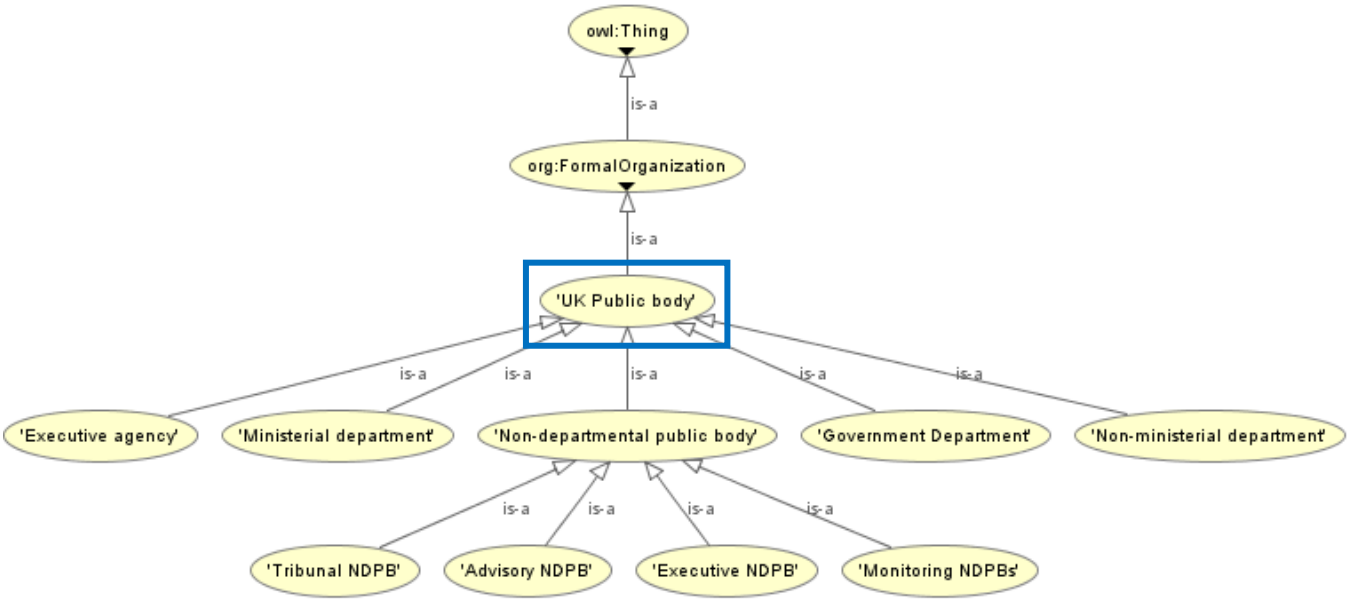


Figure 5.8 shows the central government of hierarchical for the ontology by using OWLViz.

OWLViz is graphical representation and installed-plugin to using the owl-protégé editor; it provides class hierarchies in OWL Model to be views and relational navigation, allows relationship of the asserted class hierarchies and the inferred class hierarchies. In order to implement the projected model, the procedure has been completed throughout a wide-ranging inspection for resource of constituent evaluation.

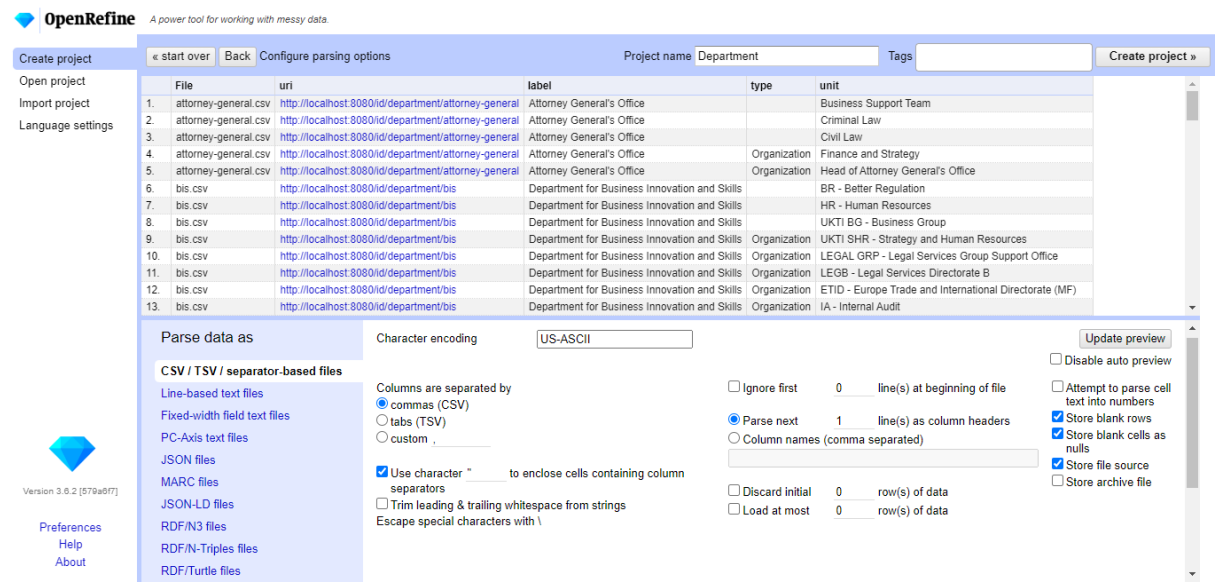
Figure 5.8 UK Public body Hieratical in Domain Ontology



5.2.3 Clean Data with OpenRefine

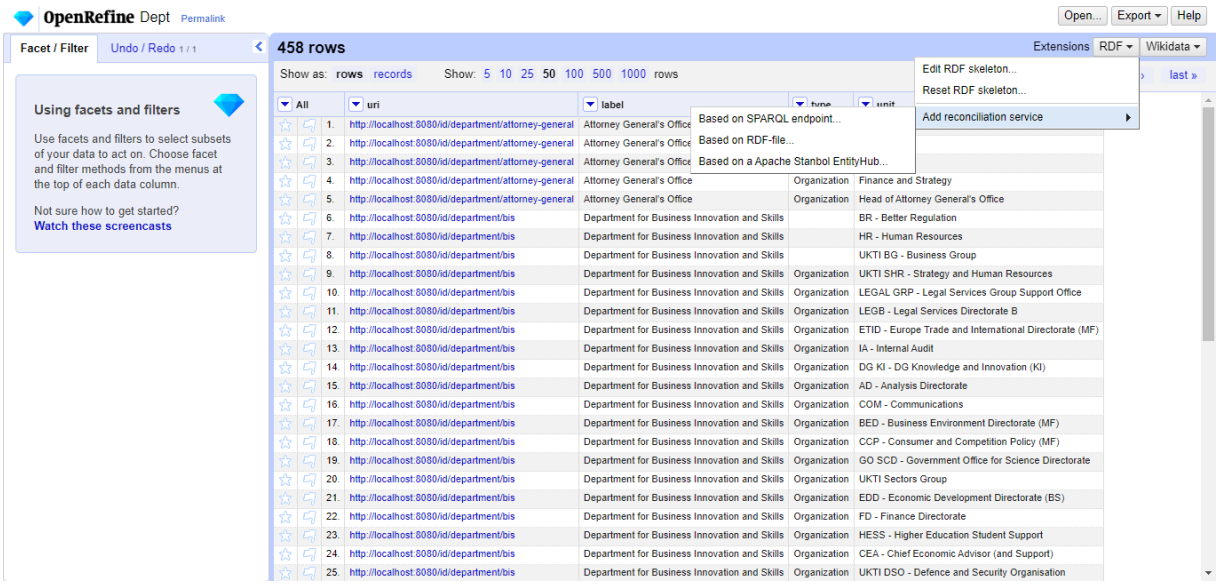
Open Refine is A very effective tool for data exploration or data classification. By converting the CSV data into the necessary graph structure, we were able to build entities without having to repeatedly write the base URI. Given that Open Refine includes an excellent selection of filter and perspectives tools, this is quite helpful if you want to investigate the distribution of values in a numerical column, transform columns of data, or filter between ranges. Then Export RDF as RDF/XML or Turtle contingent on linked data. In this study using this RDF Extension for OpenRefine-3.6.2 version. The steps below will explain how to use OpenRefine to transform this data into tabular format.

Figure 5. 9 Open refine cleaning messy data parsing options



These figure 5.9 and 5.10 details how to maintain an open data portal (UK government data) supported by open refine, including the number of resources each portal department, agencies and the regional government or organization each portal definitions for web resources. Vocabularies, standardized in their structure and delivery according to Linked Data

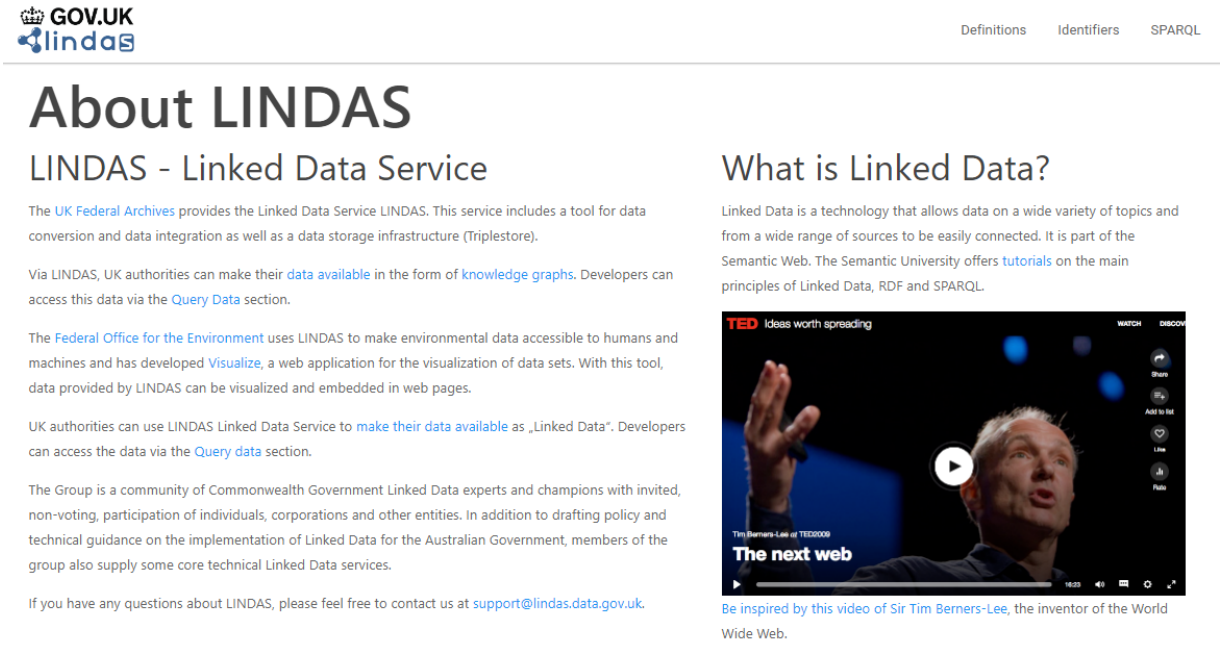
Figure 5.10 Open refine export data as RDF Format



5.3 Snapshots of the System

The following snapshots demonstrate the core pages of application with their important characteristic or capability that a new system must achieve. The first page that welcomes you when you visit our system is the star page as shown. This is used to aid navigation to other pages through the provided menu.

Figure 5.11 This is the welcome Page of the system



The general structure is described schematically below (see Fig. 5.12). In center government ontology, there are several triple stores to allow testing, integration and production of RDF data used to store interlinked descriptions of entities. Data conversion can be a process the central government ontology is implemented available in the different format. We can re-use such queries and combine them with other data.

Figure 5. 12 UK Central Government Ontology

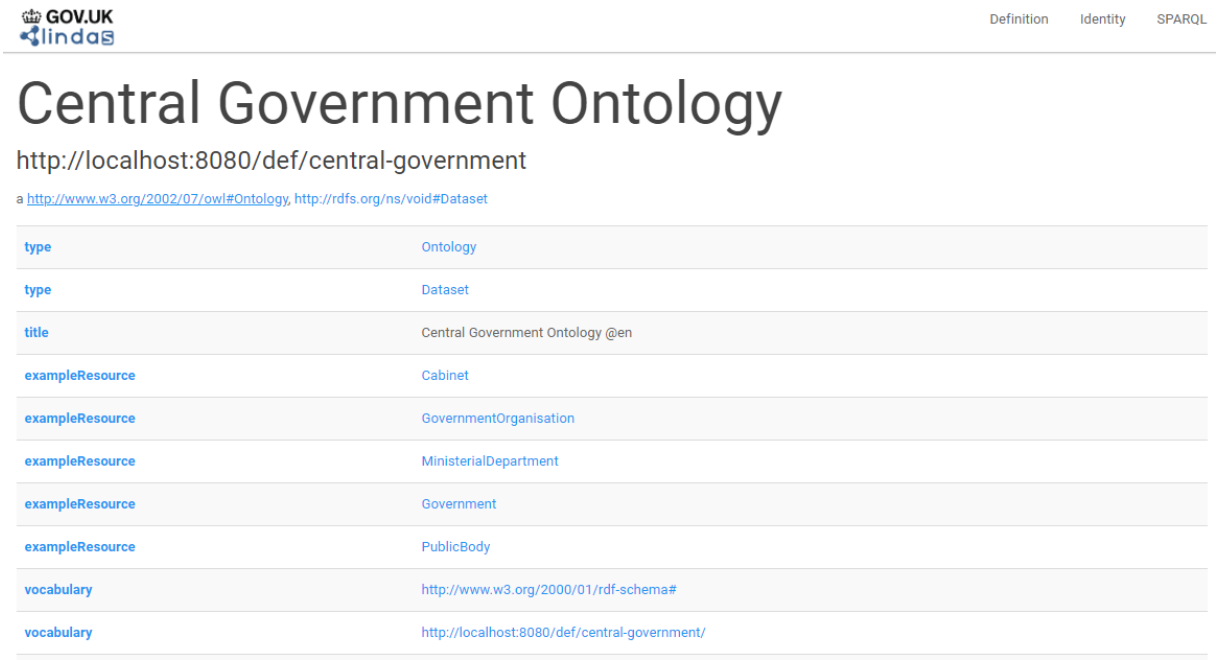
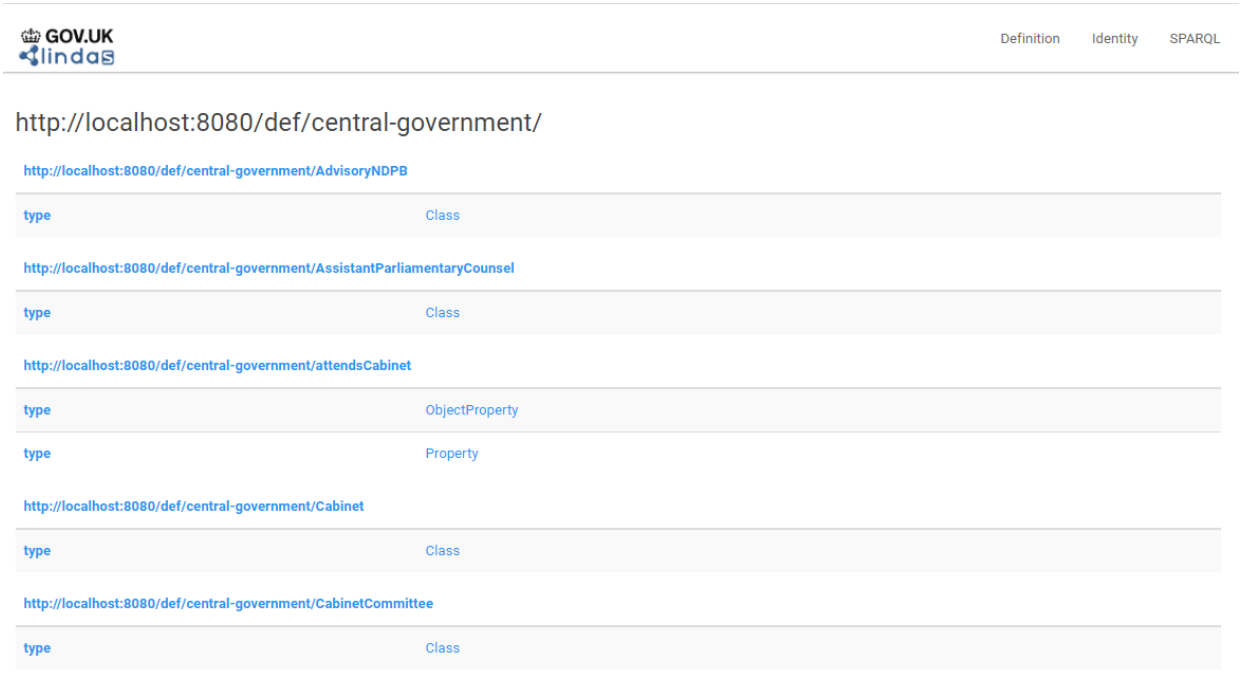


Figure 5. 13 Central Government Definitions



The Cabinet Office is the one of the main sections of UK Governance responsible the prime minister and Cabinet for maintaining cooperative governance, serving to confirm the efficient progress, administration and operation of strategy.

Figure 5. 14 Cabinet Definitions

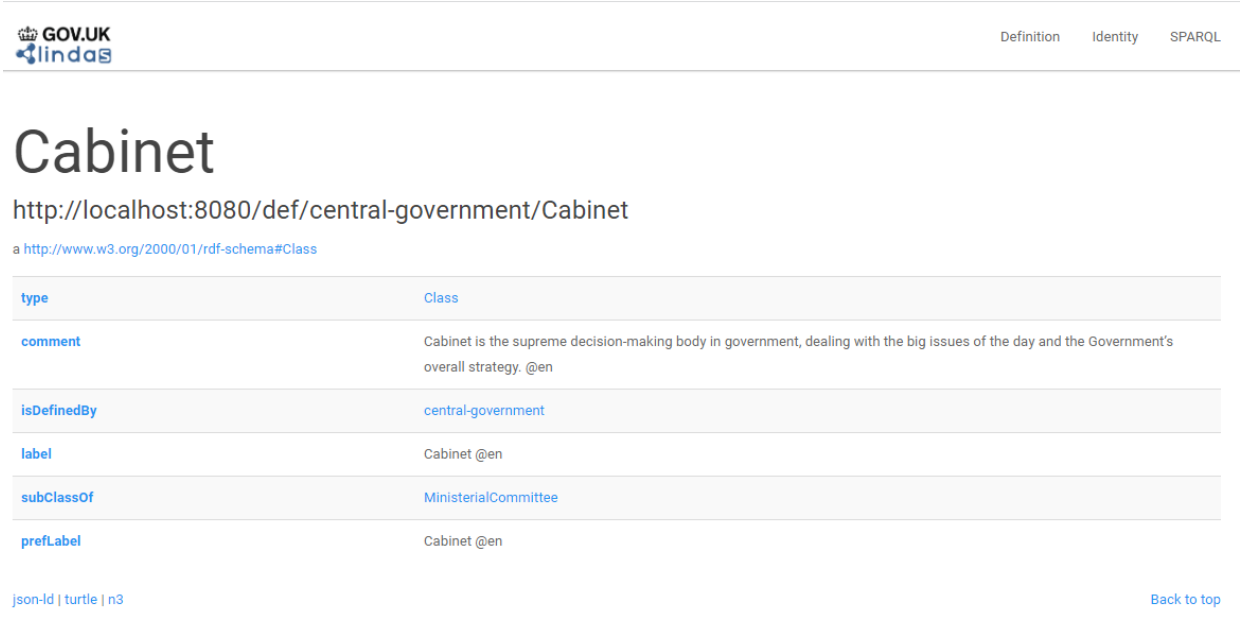
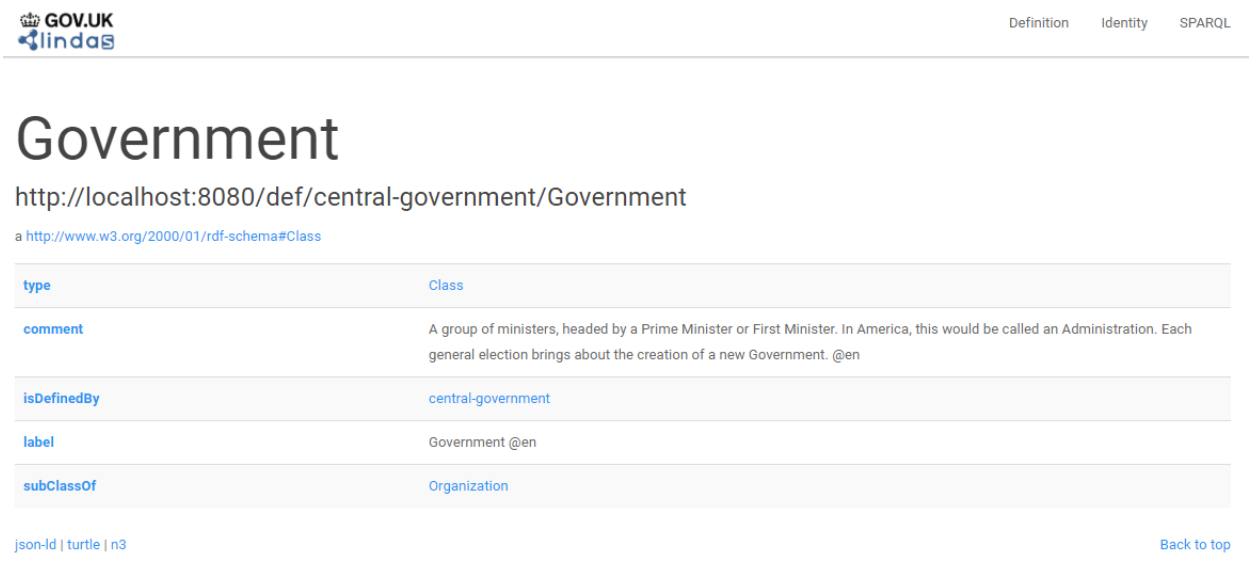


Figure 5. 15 Government Organization Definitions



UK public bodies are legally recognized organizations that are at least partially supported by the public to provide government or public services, but they are not ministerial departments. Groups from the executive branch of government that participate in national governance but are not departments of the government.

Figure 5. 16 UK Public Body Definitions

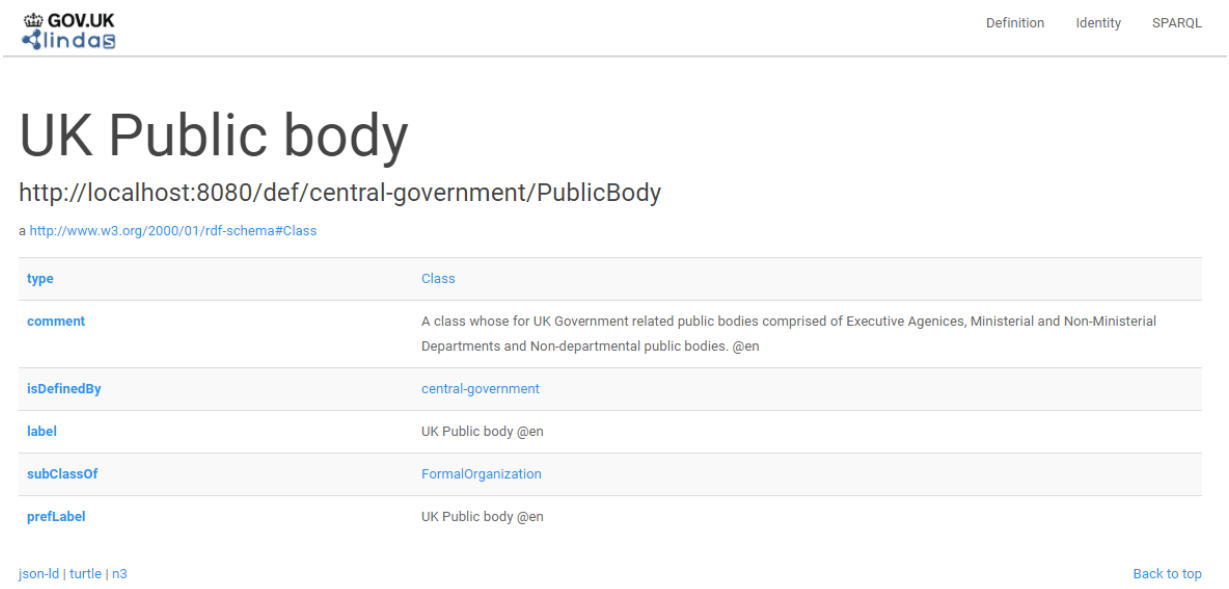
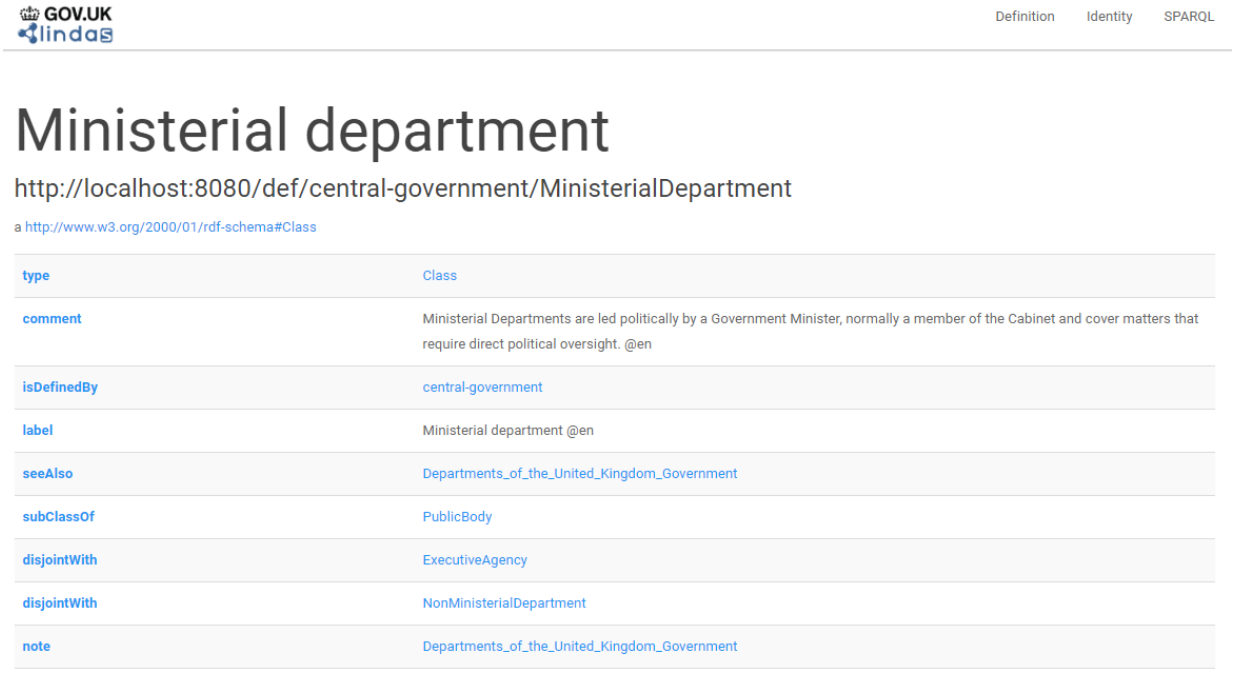


Figure 5. 17 Ministerial Department Definitions



Executive agency is also the main section of UK governance departments that is considered as administratively and its budgets distinct, to perform certain portion of the administrative operations in United Kingdom government, Scottish Government, Welsh Government or Northern Ireland Administrative.

Figure 5. 18 Executive Agency Definitions

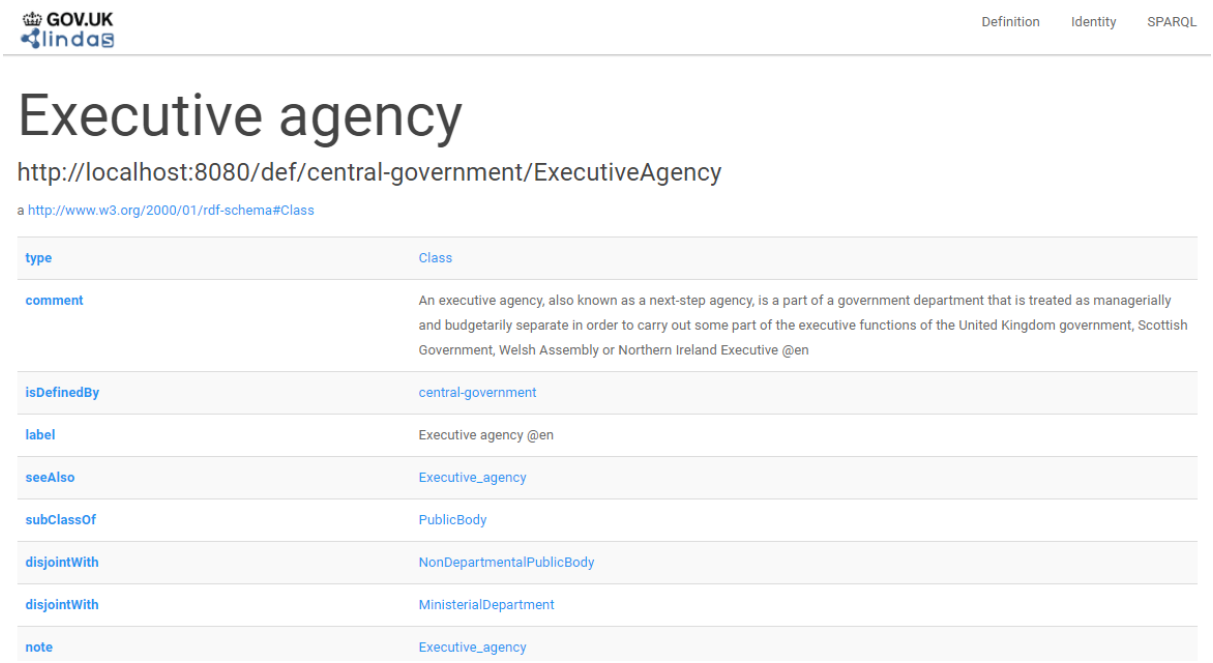


Figure 5. 19 Post Organization Definitions

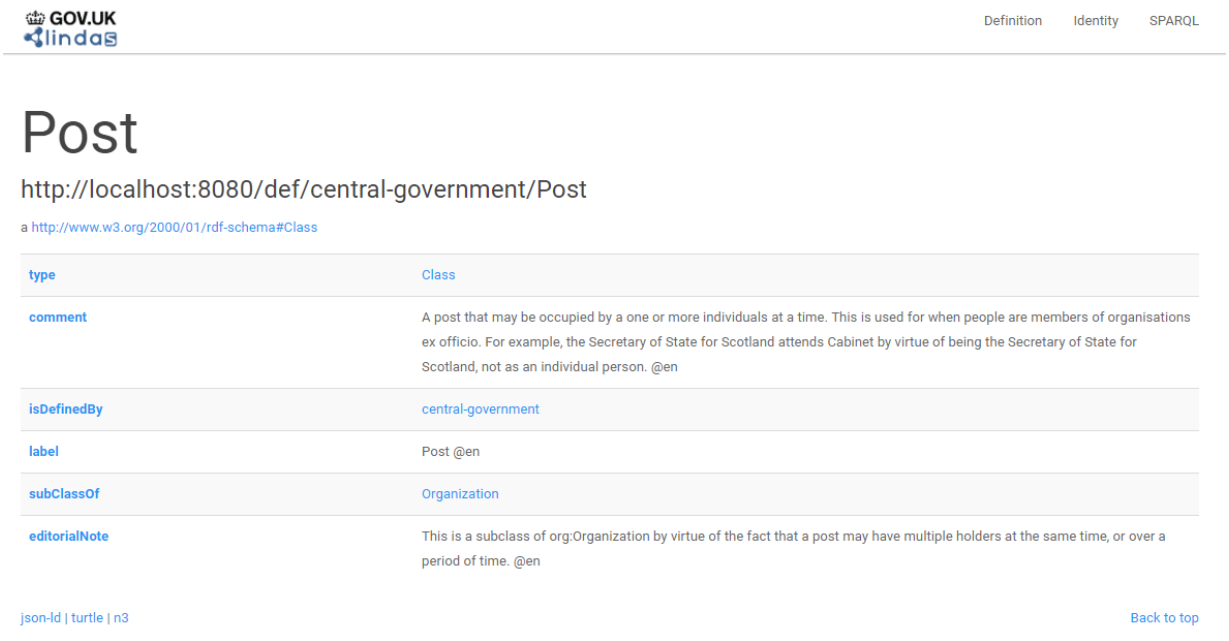
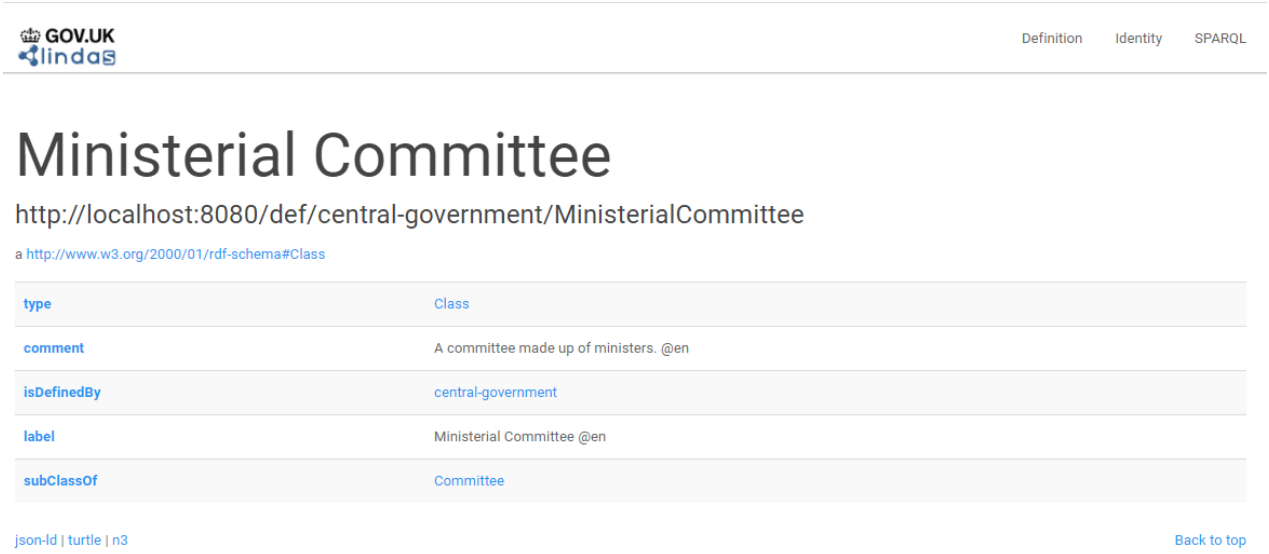
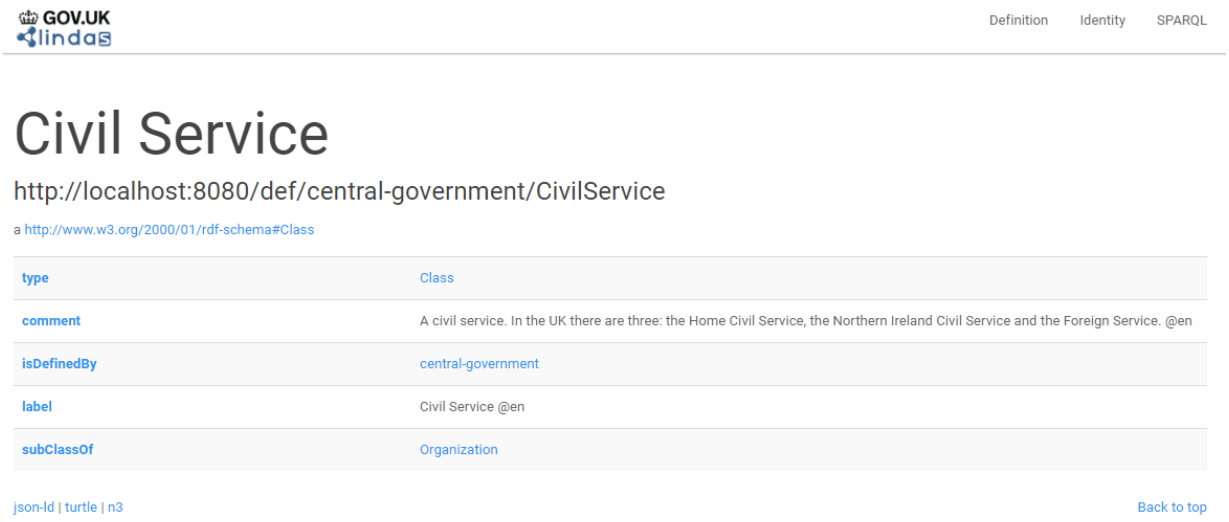


Figure 5. 20 Ministerial Committee Definitions



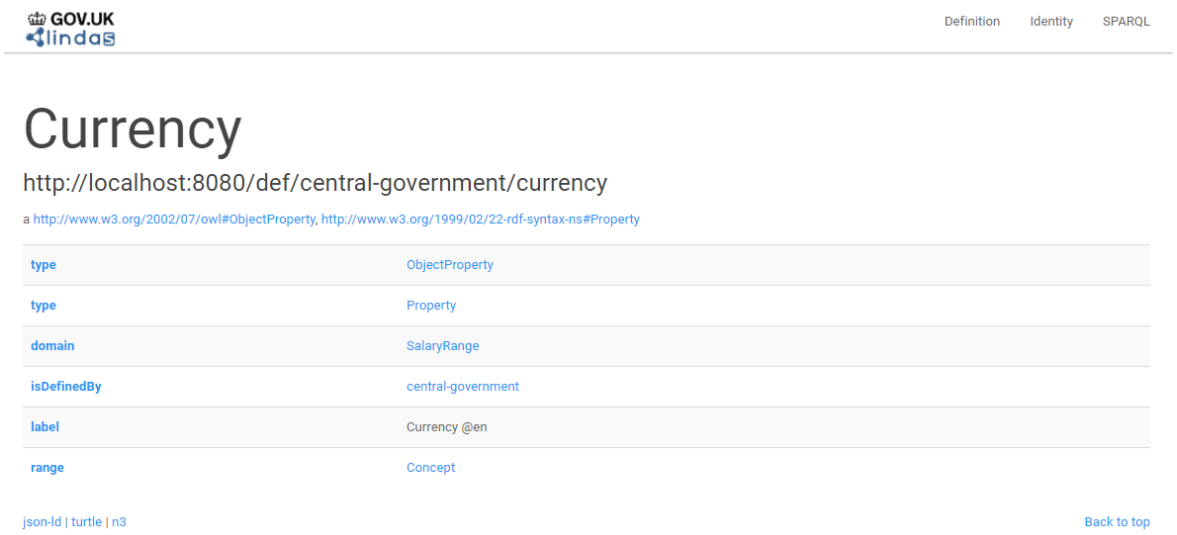
The Civil Service, can be referred as the Home of Civil Service, is also the endless organization or secretariat of Head workers that helps of ministers selected by the Prime Minister However, civil retainers are subject to various customary and legal obligations that prevent them from being utilized for political purposes.

Figure 5. 21 Civil Service Definitions



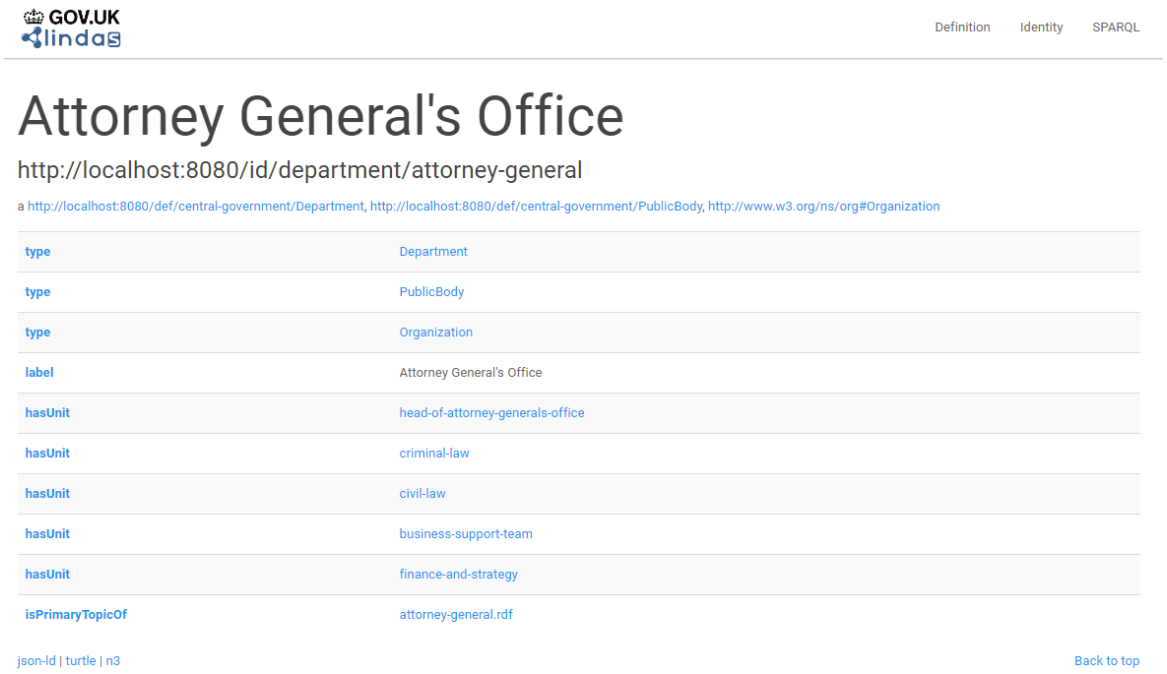
A "currency standard project" is now being carried out by Currency. The first phase of work's findings will be made public as a part of the Methodology Working paper series. The project's second phase, which is now under way, is concentrated on how to synthesize the microdata.

Figure 5. 22 Central Government Currency Object



In addition to collaborating with the Ministry of Justice and the Home Office to create criminal justice policy, the Attorney General Office (AGO) is the section that offers legal counsel and support to the Law Officers, who in turn advise the government on legal matters.

Figure 5. 23 Attorney General Office Identifiers



The ONS Secure Research Service is the focal point of OFSTED's data linkage plans, which have received most of its attention. It has successfully motivated several employees to apply for research grants and submit project proposals to use linked data in this setting.

Figure 5. 24 Department of Education Identifiers

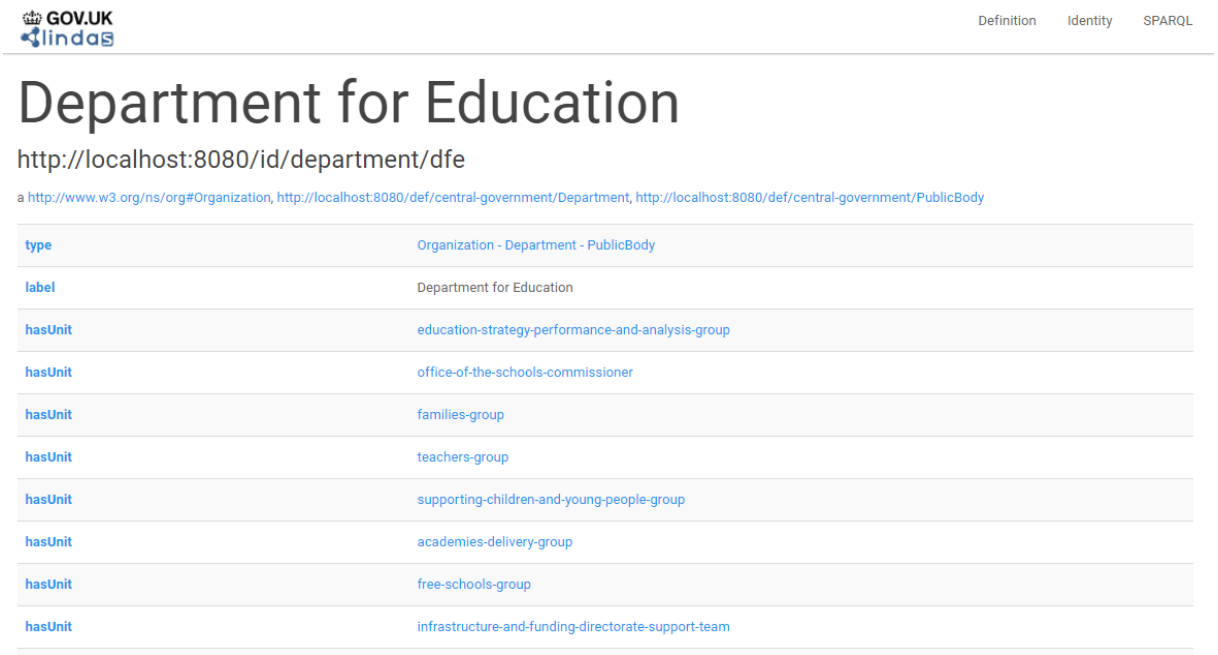
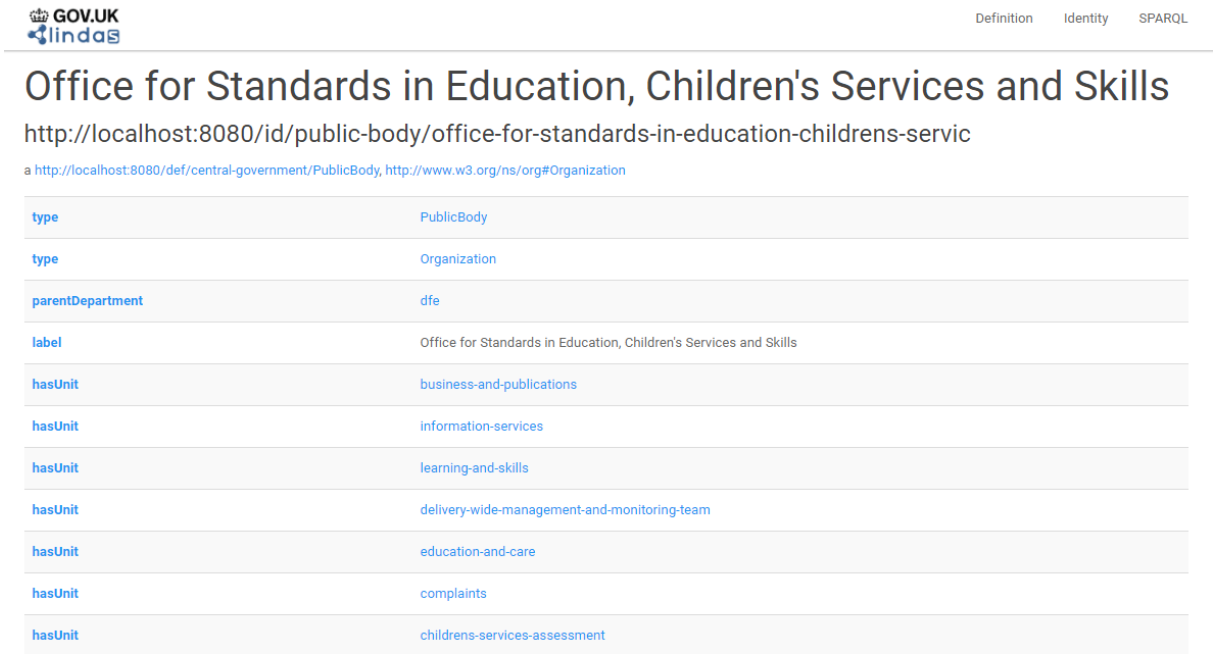
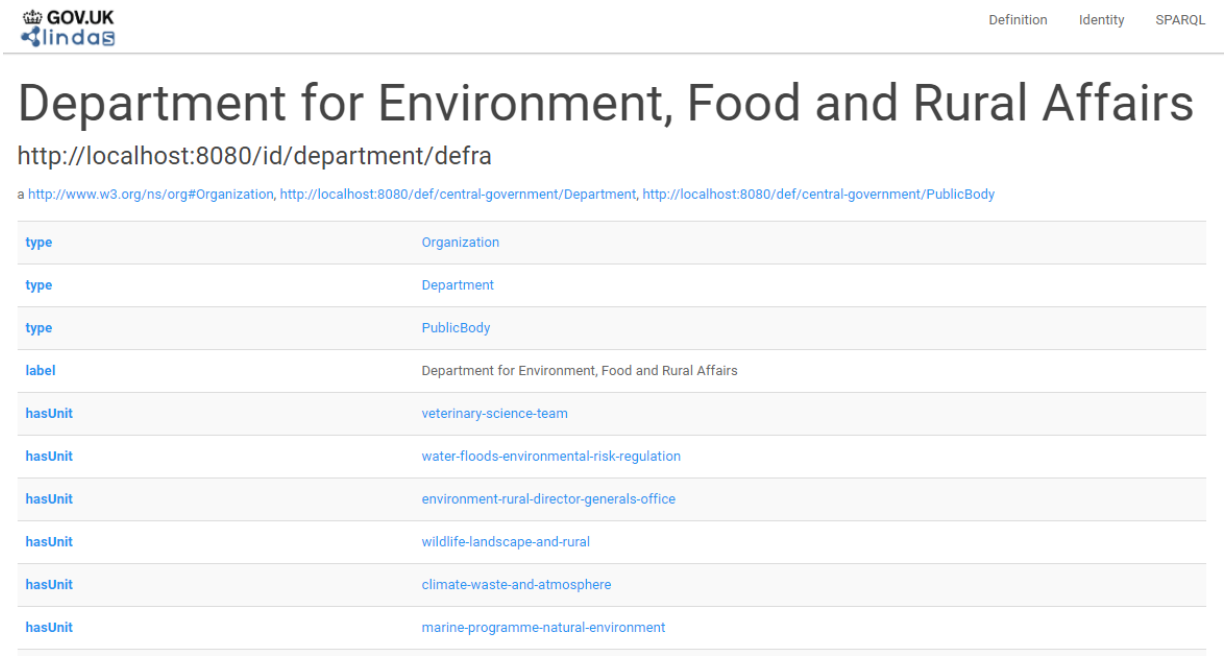


Figure 5. 25 Office of Standard in Education Services and Skills



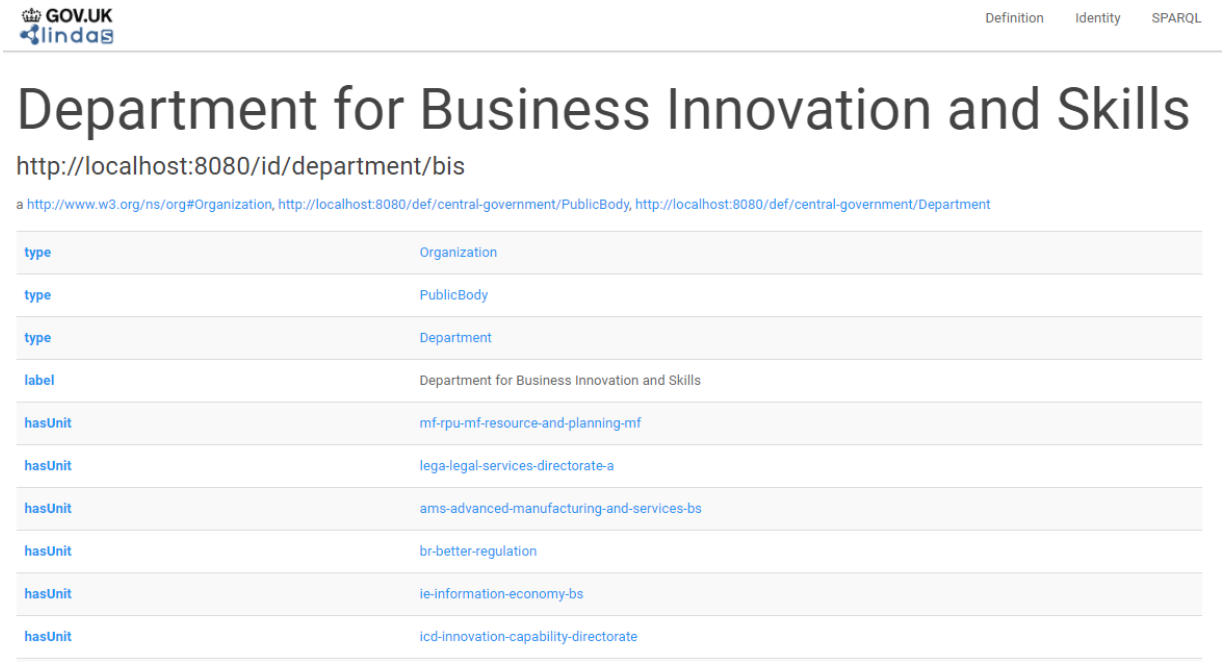
The long-term effects of human activity on the environment have gained public attention. According to the Department of Environment, Food, and Rural Affairs, they are now central policy and research objectives across the globe. For the creation of sustainable societies, it is essential to comprehend how society and the environment interact at all scales—local, regional, national, and transnational—and the UK Data Service is home to many survey datasets related to food and nutrition, including the National Food Survey and the Living Costs. We also have World Bank-produced datasets.

Figure 5. 26 Department of Environment, Food and Rural Affairs Identifiers



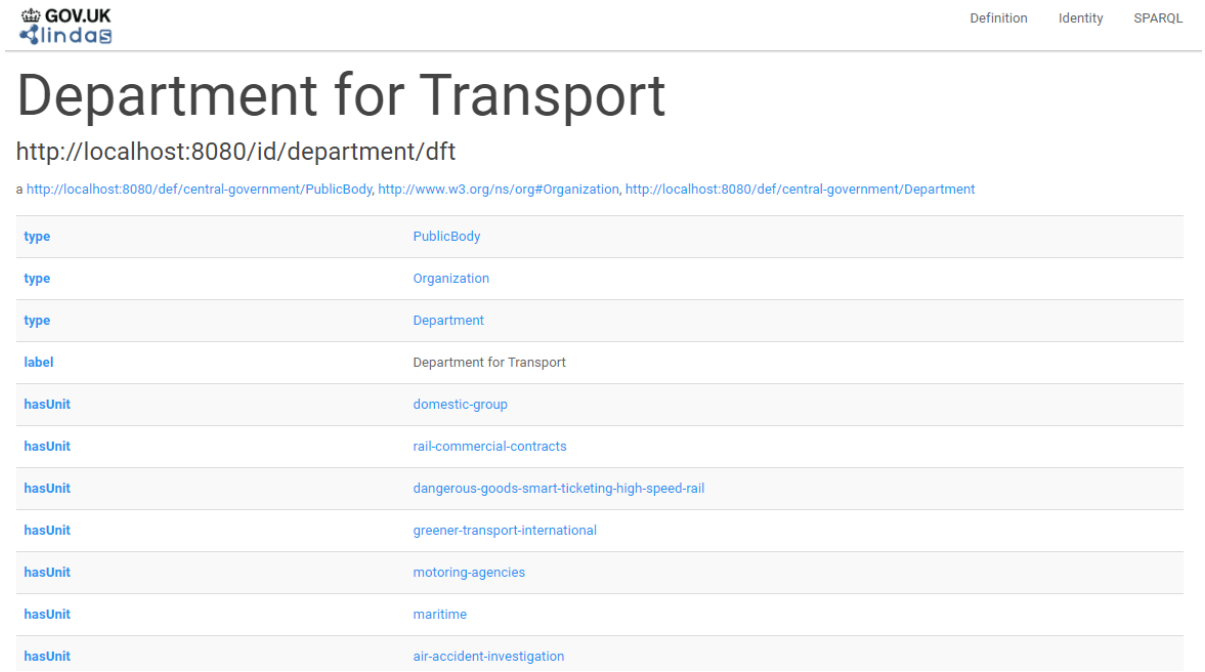
Five hundred analysts have received a cost-efficient Cloud Based Specialist Analytical IT system (CBAS) from the Department of Business Innovation and Skills (BIS). This gives the sector's analysts access to cutting-edge software tools for advanced analyses while providing safe data storage space.

Figure 5. 27 Department of Business Innovation and Skills



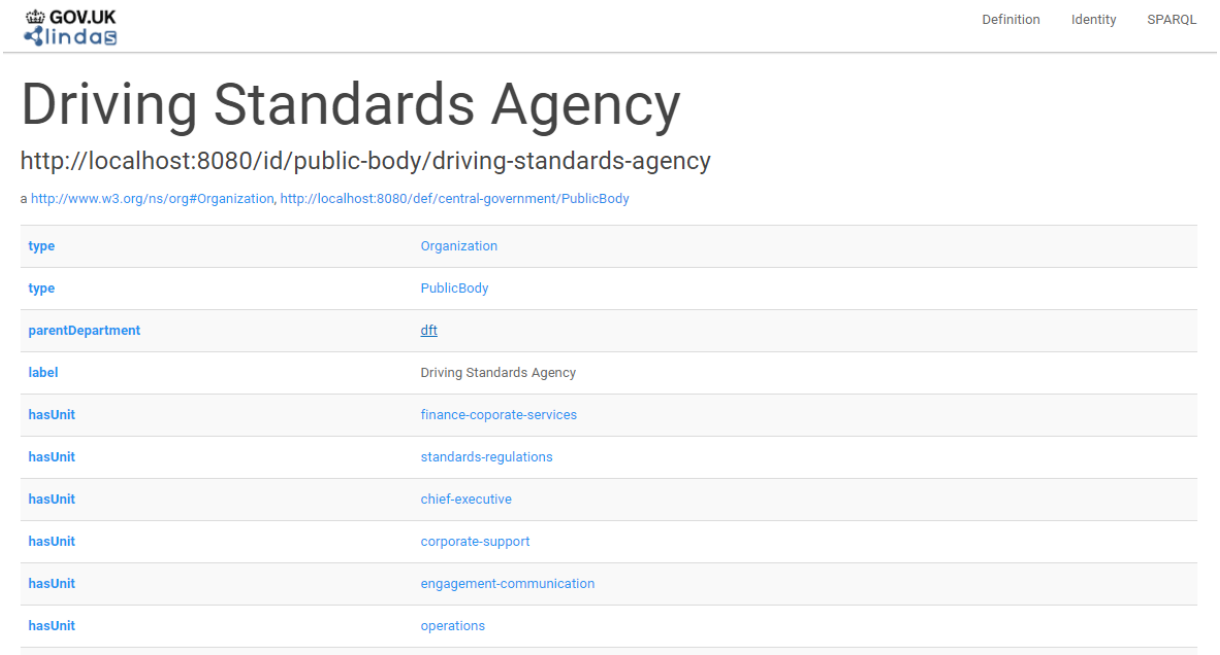
The Department of Transport (DfT) has created a Data Board that brings together internal and external leads on data in transportation to foster awareness of ongoing projects, collaborations, and future new directions

Figure 5. 28 Department of Transport Identifiers



For data releases, the Driving Standard Agency follows rules for anonymization and disclosure control. The Office of Data Release (ODR) at PHE makes decisions on when and how data can be disclosed. a group of senior data endorsers who must approve users and uses before anyone may access the data.

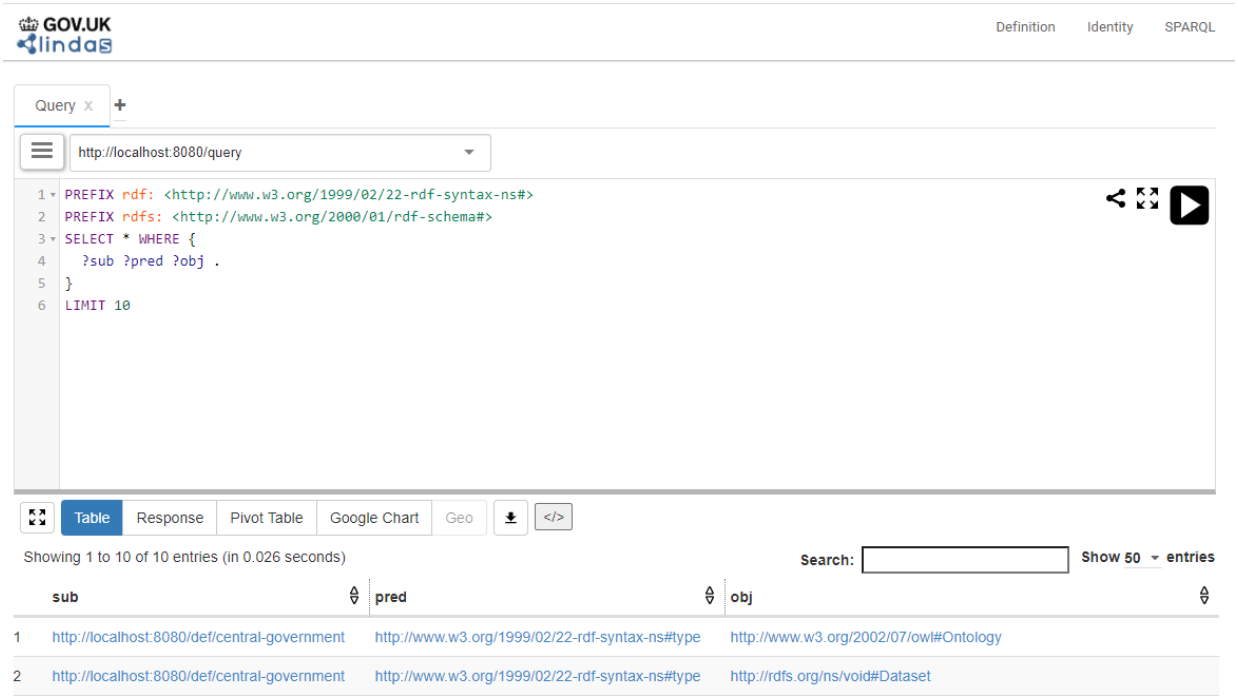
Figure 5. 29 Driving Standard Agency Identifiers



5.4 SPARQL Endpoint for Linked Data

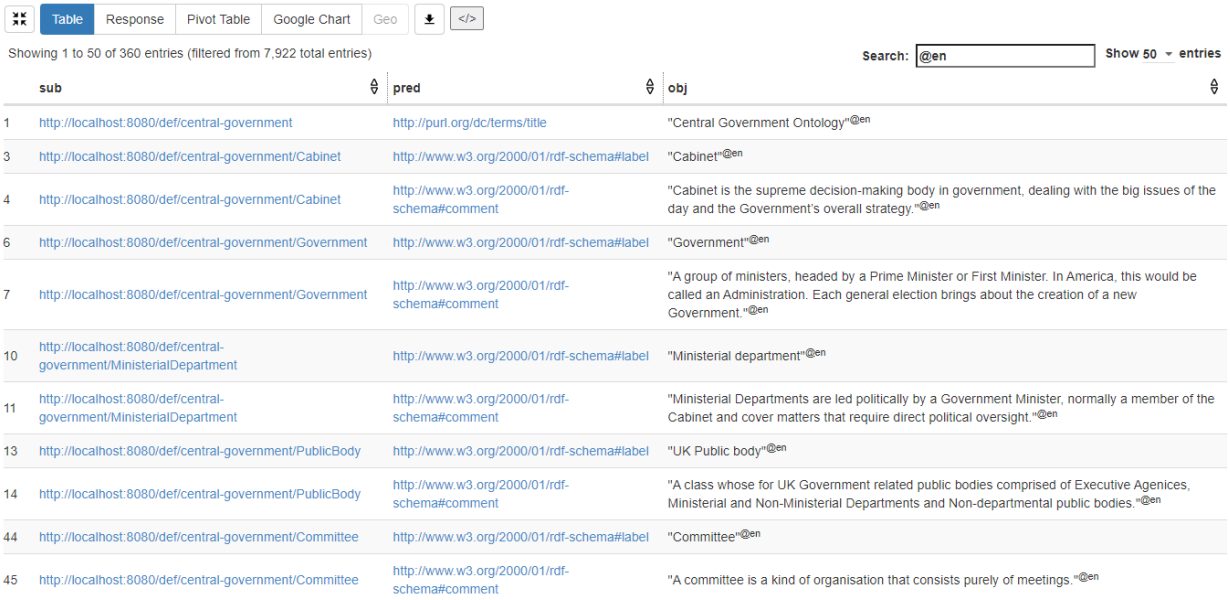
The SPARQL endpoint's components are shown in Figure 27. An RDF Query Language is SPARQL Protocol and RDF Query Language. A REST-based interface called the SPARQL endpoint assists linked data development tools in maintaining triples. Tools for developing linked data give users access to precise information about the triples they have built and the relationships between them.

Figure 5. 30 SPARQL Query section of the system



A local triple-store job is to keep user-built triples and give creators triple files. Use a SPARQL query to search for data from a particular dataset. Such queries can be reused and combined with additional data. The RDF format is available for all LINDAS data.

Figure 5. 31 Table response of SPARQL query



5.5 Evaluation and Discussion

Linked data standards are excellent, but RDF and SPARQL are best tools for many developers. Even though the data is machine-understandable, specification format like RDF/XML and Turtle are inaccessible without specialized analysis tools, creating them difficult for non-specialists. Presenting data as diagrams instead of the further aware tree or table patterns enhances additional hurdle. Toward effectively expend linking data, the data users must assume another way, build an innovative rational method of the data, and actual regularly start using an innovative or unskilled program governance to operate, control and manage. Knowledge from open data government shows that still qualified programmers will find an acquiring straighten to develop the SPARQL-endpoint fully.

After British governance begun publishing data using semantic web service, those previously comfortable with these tools are praised. Many varied parts of programmers advanced that these tools through quality ideas, except numerous were apprehensive. It was not easy to know what information existed and how it was modeled. However, this caused difficult by obtaining an overview of the RDF standards and the potential notations of a specified source.

Relevant data standards appeared to prevent access to open administrative data! We suggested a prototype of SPARQL endpoint, However, essential attributes like combining results by accumulation and calculation needed to be added to the present SPARQL endpoint and the linked data service application. Discussions presented in a different place online were few and far between and user documentation. It was challenging to monitor a development from the service known by programmers to linking data. The option was to take the plunge and provide much time, energy and cost into linking data or be disappointed.

Web services provided through RESTful APIs have exploded in recent years. These web services are expressed using URI relations or query requests and return data in a plain XML or JSON format that is simple to adopt for server and any application to process.

The UK government has therefore supported work to create a middleware based on a standard configuration format that can sit on top of SPARQL endpoints:

- deliver plain XML, JSON and Turtle formats for linking data.
- support simple URI patterns controlling, utilizing, and navigating for linked data
- supports the formation of simple domains specified APIs by data providers.

At the end, we wrote a standard of the web API functions provided by the controller and maintained the formation of native applications.

Linked data service offers an underlying tool that enables additional types of systematic approach to data. All data related to the UK government can correspondingly be accessed via web service API. The essential target is to submit authorized API implementation using web service in a way that is mutually easy for the provider and respected for the consumer, demonstrating that published in different data format offers values that offset the budgets. This approach changes how linked data is raised. Linked data standards, already effective in their preserve appropriate, correspondingly offer the basis for the e-governance to create APIs rapidly. As a result of this work, the e-governance has currently comprised web service as the most efficient way to provide systematic approach to linked data and in formats already familiar to programmers, such as JSON. The UK government is seriously trying to build a network of e-governance data in portion of a more comprehensive linked data service. The use of linked data standards to publish information has significant benefits for governments. Data providers in governance Linked data standards involve they can distribute their data reliably. For data user, linked data service involve they can access management information flexibly and efficiently through, for example, APIs.

The adoption of data service in the UK governance has been a balancing act: among the mainly institution proponents of Linking Data service and the logical issues of data users. necessary

- the need for a centralized, one-stop for official information that is simple to discovery and practice and its decentralized publish.
- Data owners publish their data online, focused on realizing the immediate and long-term benefits of using linked data standards.

Ontology Metrics

Protégé Editor represent a significant tool which allows to display statistics of various metrics for a given ontology in terms of Metrics, Class axioms, Object property axioms, Data property axioms, and Annotation axioms. In this table we have summarized different types in our ontology model.

Metrics		**Class axioms**	
Axiom	560	SubClassOf	41
Logical axiom count	170	DisjointClasses	10
Declaration axioms count	109	**Object property axioms**	
Class count	44	SubObjectPropertyOf	39
Object property count	53	InverseObjectProperties	16
Data property count	4	FunctionalObjectProperty	1
Individual count	0	ObjectPropertyDomain	31
Annotation Property count	12	ObjectPropertyRange	26
Data property axioms		**Annotation axioms**	
DataPropertyDomain	2	AnnotationAssertion	280
DataPropertyRange	4	AnnotationPropertyDomain	1

Table 5.1 Ontology Metrics

The framework for semantic-based services used by the UK's central government. It consists of the UK public body, the Cabinet, the Government Organization, the Post, The Civil Service, and the Committee. Establishing central government ontology design principles, creating an ontology concentrating on categories related by the formed standards indicated in schemas, and appending classes and properties are the processes taken to connect the connected data of the UK government. By using correspondent Classes and sub-Class-Of to construct an sub-classes relations and correspondent Properties and sub-Property-Of to construct an sub-properties relations, it is possible to map the central government ontology that has been implemented in place of linked data for organizations respectively.

Loading Time Dataset as Linked Data

Following the advancements, work with Apache Jena Fuseki Server to run SPARQL queries on Apache Jena Fuseki Server. We usually use on localhost and port 3030 in order to execute Apache Jena Fuseki on the web browser. For example, enter "http://localhost:3030" into the browser. SPARQL query and update support on the Fuseki Server. Jena's SPARQL API supports both the ontology languages OWL and RDFS. When everything is considered, Fuseki is an information-distribution server that may use HTTP and SPARQL to show and update Resource Description Framework (RDF) models website.

Categories of RDF Data	**Triples**	**Size**	**Time**
Main Ontology government	726 triples	*64.5kb*	8.25 sec
Cabinet Office	99 triples	*13.5kb*	2.25 sec
Attorney General's Office	18 triples	*2.7kb*	0.35 sec
Department for Business Innovation and Skills	88 triples	*13.2kb*	2.1 sec
Department for Communities and Local Government	18 triples	*2.6kb*	0.35 sec
Department for Culture, Media and Sport	46 triples	*6.5kb*	0.99 sec
Department of Energy and Climate Change	18 triples	*2.7kb*	0.35 sec
Department for Environment, Food and Rural Affairs	50 triples	*7.2kb*	1.1 sec
Department for Education	64 triples	*9.6kb*	1.30 sec
Department for Transport	70 triples	*9.4kb*	1.35 sec
Department of Health	60 triples	*9.4kb*	1.25 sec

Table 5. 2 Loading Time of RDF Datasets

A SPARQL query may contain multiple service invocations against the same Web resource. In such cases, fetching and loading repeatedly the same resource triples costs both in time and in computer resources. Such a functionality motivates Web publishers to enrich their documents with RDF since it makes their data directly accessible via SPARQL (without needing to set up an endpoint), while it also enables the direct exploitation of RDF data that is created dynamically (e.g. by RESTful Web applications). In future, we will study query planning approaches and more optimization techniques aiming to reduce the transfer of data between server/endpoint and remote sources.

CHAPTER VI:

CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

The main objective of this study was to develop a semantic web service implementation and integration of e-government based on linked data. The Semantic Web and Linked Data aim to take the Web to the next level, A web of data where humans and machines understand data. Machines can make giant qualitative leaps in their use of web data. The necessary technology tools that enable exists (RDF, OWL, SPARQL, etc.) are already in place and supported by internationally renowned organizations. The current challenge is to improve the quality of semantics on the linked data and implement the technologies required for web service and linked data, which are currently, confined primarily to the academic experience, specific communities, and the general public. Appreciations to the open government data movement, the process for linked data have a fantastic opportunity to demonstrate the importance of standards like RDF, OWL, and SPARQL. According to the UK's experience, the community for linked data needed more time to be prepared for a significant e-governance to begin building a network of connected governance data. Although the specifications are established, able, and robust, considerable effort remains before they can be transformed into straightforward publication procedures that government departments and agencies can embrace. The UK Government is seriously attempting to make a linking e-governance data as portion of the comprehensive related data. There are significant values for their open data portal via linking data service for data publish. Data providers in governance Linked data standards involve they can distribute their data reliably. For data user, linked data service involve they can access management information flexibly and efficiently throughout, for example, Web service APIs.

To eliminate the linking data issues, a significant effort has been on realizing instant assistances from using semantic web standards and the longer-term gains; in present and future. Using semantic web service as the underlying tools for building linked data is necessary to address the requirements of a wide variety of data users, not only those who are accustomed to Linking Data.

Significant prospects exist for government data, especially linked data services with statistical and geospatial information. Using this Linked Data standard for government data still requires a lot of work and education. We believe that the UK government's practical application of the Linked Data standard strengthens the Linked Data claim while underlining certain limitations in the experience of the development approach we have been working to address.

6.2 Limitations, Recommendations and Future Work

Improving semantic web service to e-government through implementation and integration based on linked data, such as the UK government, is challenging due to the complicated domain of e-government ontologies. Therefore, research on these topics is just still emerging stage. In addition, standards have been developed to convert data to RDF, JSON, and Turtle formats, which can be used to combine data. Ontologies follow a consistent structure. Differences in vocabulary for naming data or choosing entities and their properties can make a big difference when combining data from sources using different ontologies. A linked open data cloud contains many linked instances with sufficient knowledge available. Though, the reason ontology models are huge significant and varied, it takes period to adopt them manually. Learning the attributes necessary for expressing object-instances of particular classes is challenging. Our future work will concentrate on to build a schema that supports developers quickly retrieve numerous datasets. We suggest a semi-automatic system called the Integration Ontology Schema that can reduce the variety of the ontology models and return commonly applied principal instances for every classes. This model consists of three core elements: Graph-based ontology integration, a machine-learning-based approach for linking the main ontology objects and attributes, and an integrated ontology constructor. Through evaluating these classes of ontology schema, this model creates an outstanding value of unified schema that can simply readable and efficient in acquiring experience from several datasets by applying basic SPARQL query.

This study conclusions with demand to turn for contributors and academic researchers, which examines in what manner e-government can participate to the determination of the Web

service and Linking data community to get a value from its present activities and future opportunities. The point of view of this study to scholars is that linked data can improve e-government systems by using semantic web service. Scientists (computer scientists, data analysts, etc.) who needs to promote from this community's opportunities, ideologies, standards, and techniques should join this effort. This work highlights that many existing awareness, user interface, and analytics must be more developed for sophisticated end-to-end ontology analysis in e-government with RDF, SPARQL, and OWL languages. Though, the ontology domains that e-government provides to the Semantic Web services are enormous. Interdisciplinary efforts, including e-government, are expected to improve these deficits significantly. Only the researcher knows which concepts are needed in the knowledge base to cover the essential aspects of the ontology and the linking data requirements of the interactive interfaces. In the future, contributors and academic researchers will also participate in this work and the ever-growing community.

REFERENCES

Abijaude, J., Viana, H., Santiago, L. M., Sobreira, P. de L., & Greve, F. (2018). I2oTegrator: A Service-Oriented IoT Middleware for Intelligent Object Management. 2018 IEEE Symposium on Computers and Communications (ISCC), 00174–00179. https://doi.org/10.1109/ISCC.2018.8538541

Adadi, A., Berrada, M., Chenouni, D., & Bounabat, B. (2015). A SEMANTIC WEB SERVICE COMPOSITION FOR E-GOVERNMENT SERVICES. https://www.semanticscholar.org/paper/A-SEMANTIC-WEB-SERVICE-COMPOSITION-FOR-E-GOVERNMENT-Adadi-Berrada/8d18be5b56b3db96256970b10afc0846225e3238

Albarghothi, A. (2018, August 1). An Ontology-based Semantic Web for Arabic Question Answering: The Case of E-Government Services. https://www.semanticscholar.org/paper/An-Ontology-based-Semantic-Web-for-Arabic-Question-Albarghothi/414c966224573a387ac8bece4383904c80c90421

Alshehab, A., Alazemi, N. N., & Alhakem, H. A. (2005). SEMANTIC INTEGRATION SHARING FOR E- GOVERNMENT DOMAINS ONTOLOGY: DESIGN AND IMPLEMENTATION USING OWL. . . Vol., 6.

Apostolou, D., Stojanovic, L., Lobo, T. P., Miró, J. C., & Papadakis, A. (2005). Configuring E-Government Services Using Ontologies (M. Funabashi & A. Grzech, Eds.; Vol. 189, pp. 141–155). Kluwer Academic Publishers. https://doi.org/10.1007/0-387-29773-1_10

Attard, J., Orlandi, F., Scerri, S., & Auer, S. (2015a). A Systematic Review of Open Government Data Initiatives. Government Information Quarterly, 32. https://doi.org/10.1016/j.giq.2015.07.006

Attard, J., Orlandi, F., Scerri, S., & Auer, S. (2015b). A Systematic Review of Open Government Data Initiatives. Government Information Quarterly, 32(4), 399–418. https://doi.org/10.1016/j.giq.2015.07.006

Brown, S. (2022). Same Difference: Identity and Diversity in Linked Open Cultural Data. International Journal of Humanities and Arts Computing, 16(1), 1–16. https://doi.org/10.3366/ijhac.2022.0273

Chae, J., Cho, Y., Lee, M., Lee, S., Choi, M., & Park, S. (2016). Design and implementation of a system for creating multimedia linked data and its applications in education. Multimedia Tools and Applications, 75(21), 13121–13134.

https://doi.org/10.1007/s11042-015-2895-8

Correndo, G., Salvadores, M., Yang, Y., Gibbins, N., & Shadbolt, N. (n.d.). Geographical Service: A compass for the Web of Data.

Crichton, C., Davies, J., Gibbons, J., Harris, S., & Shukla, A. (2007). Semantic frameworks for e-government. Proceedings of the 1st International Conference on Theory and Practice of Electronic Governance - ICEGOV '07, 30. https://doi.org/10.1145/1328057.1328066

Davies, R. (2005). A semantic web service-based architecture for the interoperability of e-government services. https://www.academia.edu/69268529/A_semantic_web_service_based_architecture_for_the_interoperability_of_e_government_services

Ding, L., Lebo, T., Erickson, J. S., DiFranzo, D., Williams, G. T., Li, X., Michaelis, J., Graves, A., Zheng, J. G., Shangguan, Z., Flores, J., McGuinness, D. L., & Hendler, J. (2011). TWC LOGD: A Portal for Linked Open Government Data Ecosystems. Journal of Web Semantics, 9((3)).

Ding, L., Mcguinness, D., Hendler, J., & Magidson, S. (2009). The Datagov Wiki: A Semantic Web Portal for Linked Government Data.

Dojchinovski, M., & Vitvar, T. (2018). Linked Web APIs dataset: Web APIs meet Linked Data. Semantic Web, 9(4), 381–391. https://doi.org/10.3233/SW-170259

Farber, M. (n.d.). Linked Crunchbase: A Linked Data API and RDF Data Set About Innovative Companies.

Färber, M., & Lamprecht, D. (2021). The data set knowledge graph: Creating a linked open data source for data sets. Quantitative Science Studies, 2(4), 1324–1355. https://doi.org/10.1162/qss_a_00161

Fass, L. F. (n.d.). The Semantic Web, E-Government and the Digital Divide.

Fonou Dombeu, J. V., & Huisman, M. (2011). Semantic-Driven e-Government: Application of Uschold and King Ontology Building Methodology for Semantic Ontology Models Development. International Journal of Web & Semantic Technology, 2(4), 111–120. https://doi.org/10.5121/ijwest.2011.2401

Fragkou, P., & Maglaras, L. (2022a). Transforming Points of Single Contact Data into Linked Data. Computers, 11(8), 122. https://doi.org/10.3390/computers11080122

Fragkou, P., & Maglaras, L. (2022b). Transforming Points of Single Contact Data into Linked

Data. Computers, 11(8), 122. https://doi.org/10.3390/computers11080122

Galiotou, E., & Fragkou, P. (2013). Applying Linked Data Technologies to Greek Open Government Data: A Case Study. Procedia - Social and Behavioral Sciences, 73, 479–486. https://doi.org/10.1016/j.sbspro.2013.02.080

Garijo, D. (2017). WIDOCO: A Wizard for Documenting Ontologies. The Semantic Web – ISWC 2017, 10588, 94–102. https://doi.org/10.1007/978-3-319-68204-4_9

Goel, A., Knoblock, C. A., & Lerman, K. (n.d.). Exploiting Structure within Data for Accurate Labeling using Conditional Random Fields.

Goudos, S. K., Loutas, N., Peristeras, V., & Tarabanis, K. (2007). Public Administration Domain Ontology for a Semantic Web Services EGovernment Framework. IEEE International Conference on Services Computing (SCC 2007), 270–277. https://doi.org/10.1109/SCC.2007.89

Gruninger, M., & Lee, J. (2002). Ontology Applications and Design. CACM, 45. https://doi.org/10.1145/503124.503146

Gugliotta, A., Domingue, J., Cabral, L., Tanasescu, V., Galizia, S., Davies, R., Gutierrez Villarias, L., Rowlatt, M., Richardson, M., & Stincic, S. (2008). Deploying Semantic Web Services-Based Applications in the e-Government Domain. In S. Spaccapietra (Ed.), Journal on Data Semantics X (pp. 96–132). Springer. https://doi.org/10.1007/978-3-540-77688-8_4

Gupta, R., Pujara, J., Knoblock, C. A., Sharanappa, S. M., Pulavarti, B., Hoberg, G., & Phillips, G. (2018). Feature Selection Methods For Understanding Business Competitor Relationships. Proceedings of the Fourth International Workshop on Data Science for Macro-Modeling with Financial and Economic Datasets, 1–6. https://doi.org/10.1145/3220547.3220550

H. Ramadhan, M. (2021). Approaches to Web Service Composition for the Semantic Web. Qubahan Academic Journal, 1(3), 35–43. https://doi.org/10.48161/qaj.v1n3a78

Hyland, B., & Wood, D. (2011). The Joy of Data—A Cookbook for Publishing Linked Government Data on the Web. In Linking Government Data (pp. 3–26). Springer. https://doi.org/10.1007/978-1-4614-1767-5_1

Jain, S., & Kumar, P. (2018). Semantic Web, Ontologies and E-Government: A Review. 2.

Janev, V., Mijović, V., & Vraneš, S. (2018). Using the Linked Data Approach in European e-Government Systems: Example from Serbia. International Journal on Semantic Web and Information Systems (IJSWIS), 14(2), 27–46.

https://doi.org/10.4018/IJSWIS.2018040102

Jarrar, M., Deik, A., & Farraj, B. (2011). Ontology-based Data and Process Governance Framework-The Case of e-Government Interoperability in Palestine. https://www.semanticscholar.org/paper/Ontology-based-Data-and-Process-Governance-Case-of-Jarrar-Deik/35cca3cda01579344a829961feaa96084fc1df76

Kim, H. (2002). Predicting How Ontologies for the Semantic Web Will Evolve. CACM, 45. https://doi.org/10.1145/503124.503148

Klischewski, R. (2003a). Semantic Web for e-Government. In R. Traunmüller (Ed.), Electronic Government (pp. 288–295). Springer. https://doi.org/10.1007/10929179_52

Klischewski, R. (2003b). Towards an Ontology for e-Document Management in Public Administration – the Case of Schleswig-Holstein. In Proceedings HICSS-36. IEEE.

Knoblock, C. A., Szekely, P., Ambite, J. L., Goel, A., Gupta, S., Lerman, K., Muslea, M., Taheriyan, M., & Mallick, P. (2012). Semi-automatically Mapping Structured Sources into the Semantic Web. In E. Simperl, P. Cimiano, A. Polleres, O. Corcho, & V. Presutti (Eds.), The Semantic Web: Research and Applications (Vol. 7295, pp. 375–390). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-30284-8_32

Kumbhar, M. A., Kumbhar, A. D., & Gavekar, V. (2010). Semantic Web for E-Governance. Journal of Algorithms & Computational Technology, 4(4), 533–553. https://doi.org/10.1260/1748-3018.4.4.533

Lenk, K., & Traunmüller, R. (2002). Electronic Government: Where Are We Heading. In R. Traunmüller & K. Lenk (Eds.), Electronic Government. Springer. https://doi.org/10.1007/978-3-540-46138-8_1

Lin, C., Su, H., Knoblock, C. A., Chiang, Y.-Y., Duan, W., Leyk, S., & Uhl, J. H. (n.d.). Building Linked Data from Historical Maps.

Marjit, U., Roy, R., Santra, S., & Biswas, U. (2009a). A semantic web service based approach to E-Governance. 2009 Second International Conference on the Applications of Digital Information and Web Technologies, 232–237. https://doi.org/10.1109/ICADIWT.2009.5273834

Marjit, U., Roy, R., Santra, S., & Biswas, U. (2009b). A Semantic Web Service Based Approach to E-Governance. 232–237. https://doi.org/10.1109/ICADIWT.2009.5273834

Michel, F., Faron-Zucker, C., & Gandon, F. (2018). SPARQL Micro-Services: Lightweight Integration of Web APIs and Linked Data.

Missikoff, M. (2002). Harmonise – an ontology-based approach for semantic interoperability. ERCIM News, 51.

N., N., J., A., & Abd, H. (2017). E-government Frameworks based on Semantic Web Services: A Comprehensive Study. International Journal of Computer Applications, 158(7), 12–19. https://doi.org/10.5120/ijca2017912848

Paunović, L., Simić, K., Dadić, J., Jovanić, B., & Barać, D. (2012). THE IMPACT OF APPLYING THE CONCEPT OF THE SEMANTIC WEB IN E-GOVERNMENT. Innovative Issues and Approaches in Social Sciences, 5(2). https://doi.org/10.12959/issn.1855-0541.IIASS-2012-no2-art11

Peristeras, V., Goudos, S. K., Loutas, N., & Tarabanis, K. (2009). AN ONTOLOGICAL REPRESENTATION OF PUBLIC SERVICES: MODELS, TECHNOLOGIES AND USE CASES. Rinton Press, Vol.8, No.3(245–267).

Raamkumar, A. S., Thangavelu, M. K., Kaleeswaran, S., & Khoo, C. S. G. (2015). Designing a Linked Data Migrational Framework for Singapore Government Datasets. arXiv:1504.01987. https://doi.org/10.48550/arXiv.1504.01987

Rahman, H. (Ed.). (2009). Social and Political Implications of Data Mining: Knowledge Management in E-Government. IGI Global. https://doi.org/10.4018/978-1-60566-230-5

Ramnandan, S. K., Mittal, A., Knoblock, C. A., & Szekely, P. (2015). Assigning Semantic Labels to Data Sources. In F. Gandon, M. Sabou, H. Sack, C. d'Amato, P. Cudré-Mauroux, & A. Zimmermann (Eds.), The Semantic Web. Latest Advances and New Domains (Vol. 9088, pp. 403–417). Springer International Publishing. https://doi.org/10.1007/978-3-319-18818-8_25

Staab, S., Studer, R., Schnurr, H.-. P., & Sure, Y. (2001). Knowledge processes and ontologies. *Intelligent Systems, 16*. https://doi.org/10.1109/5254.912382

Kareem, S., Kanth, P., Bhargav, R., & Rao, B. (2013). The Complete Reference and an Overview of Cloud Computing. *International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3*(Issue 11).

Lawrence, s., Giles, C., & Bollacker, K. (1999). Digital Libraries and Autonomous Citation Indexing. *Journal of IEEE COMPUTER*, 67 - 71.

Leiner, B., Cerf, V., Clark, D., Kahn, R., Kleinrock, L., Lync, D., . . . Wolf, S. (1999). *A Brief History of the Internet.* arXiv preprint cs.

Oxera.com. (2015, October). *The benefits of online platforms main findings.* Retrieved

from www.oxera.com: https://www.oxera.com/getmedia/84df70f3-8fe0-4ad1-b4ba-d235ee50cb30/The-benefits-of-online-platforms-main-findings-(October-2015).pdf.aspx?ext=.pdf

Rittinghouse, J., & Ransome, J. (2010). *Cloud Computing: Implementation, Management, and Security.* New York: Taylor and Francis Group.

Schober, M. (2016). *Introduction to Advanced Nursing Practice.* Springer.

Sotto, L., Treacy, B., & McLellan, M. (2010). *Privacy and Data Security Risks in Cloud Computing.* Electronic Commerce & Law Report.

Zamani, A., Akhtar, M., & Ahmad, S. (2011). Emerging Cloud Computing Paradigm. *International Journal of Computer Science Issues IJCSI, Vol. 8*(Issue 4).

Sabol, T. (n.d.). Semantic Web in e-Government.

Sakakibara, S., Saiki, S., Nakamura, M., & Yasuda, K. (2017). Generating Personalized Dialogue Towards Daily Counseling System for Home Dementia Care. In V. G. Duffy (Ed.), Digital Human Modeling. Applications in Health, Safety, Ergonomics, and Risk Management: Health and Safety (Vol. 10287, pp. 161–172). Springer International Publishing. https://doi.org/10.1007/978-3-319-58466-9_16

Sheridan, J., & Tennison, J. (n.d.). Linking UK Government Data.

Shinavier, J. (n.d.). Real-time #SemanticWeb in <= 140 chars.

Shinavier, J. (2010). Real-time #SemanticWeb in <= 140 chars. https://www.semanticscholar.org/paper/Real-time-%23SemanticWeb-in-%3C%3D-140-chars-Shinavier/a780803e041308d433e338294c2ba7a17287d716

Sidoroff, T., & Hyvonen, E. (n.d.). Semantic E-government Portals – A Case Study.

Staab, S., Studer, R., Schnurr, H.-. P., & Sure, Y. (2001). Knowledge processes and ontologies. Intelligent Systems, 16. https://doi.org/10.1109/5254.912382

Taheriyan, M., Knoblock, C. A., Szekely, P., & Ambite, J. L. (2012). Rapidly Integrating Services into the Linked Data Cloud. In P. Cudré-Mauroux, J. Heflin, E. Sirin, T. Tudorache, J. Euzenat, M. Hauswirth, J. X. Parreira, J. Hendler, G. Schreiber, A. Bernstein, & E. Blomqvist (Eds.), The Semantic Web – ISWC 2012 (Vol. 7649, pp. 559–574). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-35176-1_35

Taheriyan, M., Knoblock, C. A., Szekely, P., & Ambite, J. L. (2013). A Graph-Based Approach to Learn Semantic Descriptions of Data Sources. In C. Salinesi, M. C. Norrie, & Ó. Pastor (Eds.), Advanced Information Systems Engineering (Vol. 7908,

pp. 607–623). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-41335-3_38

Tambouris, E., Gorilas, S., Kavadias, G., Apostolou, D., Abecker, A., Stojanovic, L., & Mentzas, G. (2004). Ontology-Enabled E-gov Service Configuration: An Overview of the OntoGov Project. In M. A. Wimmer (Ed.), Knowledge Management in Electronic Government (pp. 122–127). Springer. https://doi.org/10.1007/978-3-540-24683-1_13

the Department of Informatics, University of Piraeus, Greece, Theocharis, S. A., Tsihrintzis, G. A., & the Department of Informatics, University of Piraeus, Greece. (2016). Knowledge Management Systems in the Public Sector: Critical Issues. Lecture Notes on Software Engineering, 4(1), 59–65. https://doi.org/10.7763/LNSE.2016.V4.224

Theocharis, S. A., & Tsihrintzis, G. A. (2012). Semantic Web Technologies in e—Government. International Journal of Computer and Information Engineering, 6(4), 528–535.

Theocharis, S. A., & Tsihrintzis, G. A. (2016). Knowledge Management Systems in the Public Sector: Critical Issues. Lecture Notes on Software Engineering, 4(1), 59–65. https://doi.org/10.7763/LNSE.2016.V4.224

Theocharis, S., & Tsihrintzis, G. A. (2023). Semantic Web: The Evolution of the Web and the Opportunities for the e-Government. In S. Theocharis & G. A. Tsihrintzis (Eds.), Semantic Knowledge Modelling via Open Linked Ontologies: Ontologies in E-Governance (pp. 51–123). Springer International Publishing. https://doi.org/10.1007/978-3-031-20585-9_3

Umbrich, J., Karnstedt, M., Parreira, J. X., Polleres, A., & Hauswirth, M. (2012). Linked Data and Live Querying for Enabling Support Platforms for Web Dataspaces. 2012 IEEE 28th International Conference on Data Engineering Workshops, 23–28. https://doi.org/10.1109/ICDEW.2012.55

Varga, L. Z., Hajnal, Á., & Werner, Z. (2004). An Agent Based Approach for Migrating Web Services to Semantic Web Services. In C. Bussler & D. Fensel (Eds.), Artificial Intelligence: Methodology, Systems, and Applications (Vol. 3192, pp. 371–380). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-540-30106-6_38

Vitvar, T., Kerrigan, M., Overeem, A. V., Peristeras, V., & Tarabanis, K. A. (2006). Infrastructure for the Semantic Pan-European E-Government Services. Semantic Web Meets EGovernment, Papers from the 2006 AAAI Spring Symposium, Technical Report SS-06-06, Stanford, California, USA, March 27-29, 2006, 135–137. http://www.aaai.org/Library/Symposia/Spring/2006/ss06-06-023.php

Vu, B., Knoblock, C., & Pujara, J. (2019). Learning Semantic Models of Data Sources Using Probabilistic Graphical Models. The World Wide Web Conference on - WWW '19, 1944–1953. https://doi.org/10.1145/3308558.3313711

Vu, B., Pujara, J., & Knoblock, C. A. (2019). D-REPR: A Language for Describing and Mapping Diversely-Structured Data Sources to RDF. Proceedings of the 10th International Conference on Knowledge Capture, 189–196. https://doi.org/10.1145/3360901.3364449

Wang, H. H., Gibbins, N., Payne, T., Saleh, A., & Sun, J. (2007). A Formal Semantic Model of the Semantic Web Service Ontology (WSMO). 12th IEEE International Conference on Engineering Complex Computer Systems (ICECCS 2007), 74–86. https://doi.org/10.1109/ICECCS.2007.9

Weise, M., Lohmann, S., & Haag, F. (n.d.). LD-VOWL: Extracting and Visualizing Schema Information for Linked Data.

Xiao, Y., Xiao, M., & Zhao, H. (2007). An Ontology for e-Government Knowledge Modeling and Interoperability. 2007 International Conference on Wireless Communications, Networking and Mobile Computing, 3600–3603. https://doi.org/10.1109/WICOM.2007.891

Zhou, C., Xu, C., Chen, H., & Idehen, K. (n.d.). Browser-based Semantic Mapping Tool for Linked Data in Semantic Web.

APPENDIX A

The following code used RDF Turtle depiction of the RDF graph snippet visualized in Figure 13 in central government ontology.

```
<?xml version="1.0" encoding="utf-8"?>
<rdf:RDF
   xmlns:dct="http://purl.org/dc/terms/"
   xmlns:foaf="http://xmlns.com/foaf/0.1/"
   xmlns:opmv="http://purl.org/net/opmv/ns#"
   xmlns:org="http://www.w3.org/ns/org#"
   xmlns:owl="http://www.w3.org/2002/07/owl#"
   xmlns:parl="http://localhost:8080/def/parliament/"
   xmlns:payband="http://localhost:8080/def/senior-civil-service-pay-band/"
   xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
   xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
   xmlns:skos="http://www.w3.org/2004/02/skos/core#"
   xmlns:time="http://www.w3.org/2006/time#"
   xmlns:void="http://rdfs.org/ns/void#"
   xmlns:xsd="http://www.w3.org/2001/XMLSchema#"
   xmlns="http://localhost:8080/def/central-government/">
  <owl:Ontology rdf:about="http://localhost:8080/def/central-government">
    <dct:title xml:lang="en">Central Government Ontology</dct:title>
    <void:exampleResource rdf:resource="http://localhost:8080/def/central-
government/Cabinet"/>
    <void:exampleResource rdf:resource="http://localhost:8080/def/central-
government/Government"/>
    <void:exampleResource rdf:resource="http://localhost:8080/def/central-
government/GovernmentOrganisation"/>
    <void:exampleResource rdf:resource="http://localhost:8080/def/central-
government/MinisterialDepartment"/>
    <void:exampleResource rdf:resource="http://localhost:8080/def/central-
government/PublicBody"/>
    <void:vocabulary rdfs:resource="http://purl.org/net/ns#"/>
    <void:vocabulary rdfs:resource="http://localhost:8080/def/central-
government/"/>
    <void:vocabulary rdfs:resource="http://localhost:8080/def/parliament/"/>
    <void:vocabulary rdf:resource="http://www.w3.org/2000/01/rdf-schema#"/>
    <void:vocabulary rdf:resource="http://www.w3.org/2002/07/owl#"/>
    <void:vocabulary rdf:resource="http://www.w3.org/2004/02/skos/core#"/>
    <void:vocabulary rdf:resource="http://www.w3.org/2006/time#"/>
    <void:vocabulary rdf:resource="http://www.w3.org/ns/org#"/>
    <void:vocabulary rdf:resource="http://xmlns.com/foaf/0.1/"/>
    <rdf:type rdf:resource="http://rdfs.org/ns/void#Dataset"/>
    <rdfs:label xml:lang="en">Central Government Ontology</rdfs:label>
```

```
    <rdfs:seeAlso rdf:resource="http://www.data.gov.uk/en/
/UKgovernment/Centralgovernment/DG_0533444"/>
  </owls:Ontology>
  <rdfs:Class rdf:about="http://localhost:8080/def/central-
government/ExecutiveAgency">
    <rdfs:comment xml:lang="en">An excutive agencies, also referred as a last-
stage agency, is part of a government sections that is preserved as
administratively and budgetrly distinct in directive to transmit ready around
portion of the decision-making roles of the United Kindom goverment, Scotish
Goverment, Walesh Asembly or Nortern Irelland Excutive</rdfs:comment>
    <rdfs:isDefindBy rdf:resource="http://localhost:8080/def/central-
goverment"/>
    <rdfs:label xml:lang="en">Excutive agencies</rdfs:label>
    <rdfs:seeAlso
rdf:resource="http://dbpedia.org/resource/Executive_agency"/>
    <rdfs:subClassOf rdf:resource="http://localhost:8080/def/central-
government/PublicBody"/>
    <owl:disjointWith rdf:resource="http://localhost:8080/def/central-
government/MinisterialDepartment"/>
    <owl:disjointWith rdf:resource="http://localhost:8080/def/central-
government/NonDepartmentalPublicBody"/>
    <skos:note rdf:resource="http://wikpedia.org/wiki/Excutive_agencies"/>
    <skos:prefLabel xml:lang="en">Excutive agencies</skos:prefLabel>
  </rdfs:Class>
  <rdfs:Class rdf:about="http://localhost:8080/def/central-
government/MinisterialDepartment">
    <rdfs:comment xml:lang="en">Minstrial Depatments are run polticaly by a
Goverment Minster, normaly a menber of the Cabenet and covar maters that
reqire straight polical error.</rdfs:comment>
    <rdfs:isDefnedBy rdf:resource="http://localhost:8080/def/central-
goverment"/>
    <rdfs:label xml:lang="en">Minsteral depatment</rdfs:label>
    <rdfs:seeAlso
rdf:resource="http://wikipedia.org/resource/Depatments_of_the_United_Kingdom_G
overnment"/>
    <rdfs:ClassOf rdf:resource="http://localhost:8080/def/central-
government/PublicBody"/>
    <owl:disjointWith rdf:resource="http://localhost:8080/def/central-
government/ExecutiveAgency"/>
    <owl:disjointWith rdf:resource="http://localhost:8080/def/central-
government/No-MinsteralDepatment"/>
    <sko:note
rdf:resource="http://wikpedia.org/wiki/Depatments_of_the_United_Kingdom_Govern
ment"/>
```

```
    <sko:prefLabel xml:lang="en">Minsteral depatment</skos:prefLabel>
  </rdfs:Class>
  <rdfs:Class rdf:about="http://localhost:8080/def/central-government/No-
MinsteralDepatment">
    <rdfs:comment xml:lang="en">A no-minsteral goverment depatment is a
section or minstry of a goverment that is controlled by a Goverment Minster or
Goverment Administrator, and anwers straight to a legisilature</rdfs:comment>
    <rdfs:isDefnedBy rdf:resource="http://localhost:8080/def/central-
government"/>
    <rdf:label xml:lang="en">Non-ministerial depatment</rdf:label>
    <rdf:ClassOf rdfs:resource="http://localhost:8080/def/central-
government/PublicBody"/>
    <owl:disjointWith rdf:resource="http://localhost:8080/def/central-
government/MinisterialDepartment"/>
    <skos:note rdf:resource="http://wikpedia.org/resource/No-
ministerial_government_department"/>
    <sko:note rdf:resource="http://en.wikipedia.org/wiki/Non-
ministerial_government_department"/>
    <sko:prefLabel xml:lang="en">Non-ministerial department</skos:prefLabel>
  </rdf:Class>
  <rdf:Class rdf:about="http://localhost:8080/def/central-
government/PublicBody">
    <rdfs:comment xml:lang="en">A part whose UK Goverment associated community
bodes included of Excutive Agenicy, Minsteral and No-Minsteral Depatment and
No-depatmental community figures.</rdfs:comment>
    <rdfs:isDefnedBy rdf:resource="http://localhost:8080/def/central-
government"/>
    <rdf:label xml:lang="en">UK Public body</rdf:label>
    <rdf:subClass
rdfs:resource="http://www.w3c.org/ns/org#FormalOrganization"/>
    <sko:prefLabel xmls:lang="en">UK Public body</sko:prefLabel>
  </rdf:Class>
  <rdf:Class rdfs:about="http://localhost:8080/def/central-
government/SalaryRange">
    <rdf:coment xmls:lang="en">A salary range.</rdf:coment>
    <rdf:isDefnedBy rdf:resource="http://localhost:8080/def/central-
government"/>
    <rdf:label xmls:lang="en">Salary Range</rdf:label>
  </rdf:Class>
  <rdf:Class rdfs:about="http://localhost:8080/def/central-
government/Secretariat">
    <rdfs:comment xml:lang="en">An organsation that delivers information and
funding to another organsation, frequently a comitee.</rdf:comment>
```

```
    <rdfs:isDefnedBy rdf:resource="http://localhost:8080/def/central-
government"/>
    <rdf:label xmls:lang="en">Secritarat</rdf:label>
    <rdf:subClass rdfs:resource="http://www.w3c.org/ns/org#Organization"/>
  </rdf:Class>
  <rdf:Class rdf:about="http://localhost:8080/def/central-
government/WorkingTime">
    <rdfs:comment xml:lang="en">A repisenitation of the expanse that sombody
the whole thing.</rdf:comment>
    <rdfs:isDefnedBy rdf:resource="http://localhost:8080/def/central-
government"/>
    <rdf:label xmls:lang="en">Working Time</rdf:label>
  </rdf:Class>
</rdf:RDF>
```

APPENDIX B:

The following code used in RDF for cabinet classes and properties:

```
<?xml versions="1.0" encodding="utf-8u"?>
<rdfs:RDF
   xmlns:dct="https://purl.orgs/dc/terms/"
   xmls:foaf="https://xmls.com/foaf/0.2/"
   xmls:opmv="https://purl.org/net/opmv/ns#"
   xmls:org="https://www.w3.org/ns/org#"
   xmls:owl="https://www.w3.org/2002/07/owl#"
   xmlns:parl="http://localhost:8080/def/parliament/"
   xmls:rdf="https://www.w3.org/1998/02/22-rdf-syntax-ns#"
   xmls:rdfs="https://www.w3.org/2001/01/rdf-schema#"
   xmls:skos="https://www.w3.org/2003/02/sko/core#"
   xmls:time="https://www.w3.org/2006/time#"
   xmls:void="https://rdfs.org/ns/void#"
   xmls:xsd="https://www.w3.org/2001/XMLSchema#"
   xmls="https://localhost:8080/def/central-government/">
  <rdfs:Class rdf:about="http://localhost:8080/def/central-
government/Cabinet">
    <rdfs:comment xml:lang="en">Cabbinet is the highest policymaking bodies in
goverment, commerce with the immense problems of the daytime and the
Goverment's general plan.</rdfs:comment>
    <rdfs:isDefnedBy rdf:resource="http://localhost:8080/def/central-
government"/>
    <rdfs:label xml:lang="en">Cabinet</rdfs:label>
    <rdfs:subClassOf rdf:resource="http://localhost:8080/def/central-
government/MinsteralCommittee"/>
    <skos:prefLabel xml:lang="en">Cabinet</skos:prefLabel>
  </rdfs:Class>
  <rdfs:Class rdf:about="http://localhost:8080/def/central-
government/CabinetCommittee">
    <rdfs:comment xml:lang="en">Cabbinet comitees decrease the load on
Cabbinet by allowing cooperative choices to being takken by minor grroup of
minster.</rdf:comment>
    <rdfs:comment xml:lang="en">Those are showed as to be parts witin
goverment that repport to a Cabbinet.</rdfs:comment>
    <rdfs:isDefinedBy rdf:resource="http://localhost:8080/def/central-
government"/>
    <rdf:label xmls:lang="en">Cabbinet Comitee</rdfs:label>
    <rdf:subClass rdfs:resource="http://localhost:8080/def/central-
government/MinsteralCommittee"/>
    <rdfs:subClassOf
rdfs:resource="http://www.w3c.org/ns/org#OrganizationalUnit"/>
```

```
    <sko:prefLabel xmls:lang="en">Cabinet Committee</sko:prefLabel>
  </rdfs:Class>
  <rdfs:Property rdfs:about="http://localhost:8080/def/central-
government/atendsCabinet">
    <rdfs:type rdfs:resource="http://www.w3c.org/2001/07/owl#ObjectProperty"/>
    <rdf:comment xmls:lang="en">The cabbinet that individual be present (not
as a complete participant).</rdf:comment>
    <rdfs:domains rdf:resource="http://localhost:8080/def/central-
government/Post"/>
    <rdfs:isDefinedBy rdf:resource="http://localhost:8080/def/central-
government"/>
    <rdf:label xmls:lang="en">Atends Cabbinet</rdfs:label>
    <rdf:range rdfs:resource="http://localhost:8080/def/central-
government/Cabbinet"/>
    <rdf:subclassOf rdfs:resource="http://www.w3.org/ns/org#memberOf"/>
    <owls:inverseOf rdfs:resource="http://localhost:8080/def/central-
government/hasCabinetAttendee"/>
  </rdfs:Property>
  <rdfs:Property rdfs:about="http://localhost:8080/def/central-
government/cabinetCommitteeOf">
    <rdfs:type rdfs:resource="http://www.w3.org/2002/07/owl#ObjectProperty"/>
    <rdf:coment xmls:lang="en">The goverment that is cabbinet comittee
for.</rdf:comment>
    <rdf:domains rdfs:resource="http://localhost:8080/def/central-
government/CabinetCommittee"/>
    <rdfs:isDefinedBy rdf:resource="http://localhost:8080/def/central-
government"/>
    <rdf:label xmls:lang="en">Cabbinet Comitee Of</rdfs:label>
    <rdf:range rdf:resource="http://localhost:8080/def/central-
government/Government"/>
    <rdf:subclassOf rdfs:resource="http://www.w3.org/ns/org#unitOf"/>
    <owls:inverseOf rdfs:resource="http://localhost:8080/def/central-
govenment/hasCabbinetComittee"/>
  </rdfs:Property>
  <rdfs:Property rdfs:about="http://localhost:8080/def/central-
government/cabbinetOf">
    <rdfs:type rdfs:resource="http://www.w3.org/2002/07/owl#ObjectProperty"/>
    <rdf:comment xmls:lang="en">The goverment or excutive that is the cabbinet
of.</rdf:comment>
    <rdf:domains rdf:resource="http://localhost:8080/def/central-
government/Cabinet"/>
    <rdfs:isDefnedBy rdf:resource="http://localhost:8080/def/central-
government"/>
    <rdf:label xmls:lang="en">Cabinet Of</rdfs:label>
```

```
    <rdf:range rdfs:resource="http://localhost:8080/def/central-
government/Government"/>
    <rdf:subPropatyOf rdfs:resource="https://www.w3.org/ns/org#unitOf"/>
    <owls:inverseOf rdfs:resource="https://localhost:8080/def/central-
government/hasCabinet"/>
  </rdfs:Property>
  <rdfs:Property rdfs:about="https://localhost:8080/def/central-
government/hasCabinet">
    <rdf:type rdf:resource="https://www.w3.org/2002/07/owl#ObjectProperty"/>
    <rdfs:comment xml:lang="en">The cabbinet of government.</rdfs:comment>
    <rdfs:domain rdf:resource="http://localhost:8080/def/central-
government/Government"/>
    <rdfs:isDefinedBy rdf:resource="http://localhost:8080/def/central-
goverment"/>
    <rdf:label xmls:lang="en">Cabinet</rdf:label>
    <rdf:range rdfs:resource="httsp://localhost:8080/def/central-
government/Cabinet"/>
    <rdfs:subclassOf rdfs:resource="https://www.w3.org/ns/org#hasUnit"/>
    <owls:inverseOf rdfs:resource="http://localhost:8080/def/central-
goverment/cabinetOf"/>
  </rdfs:Property>
  <rdfs:Property rdfs:about="http://localhost:8080/def/central-
government/hasCabinetAttendee">
    <rdf:type rdf:resource="http://www.w3.org/2002/07/owl#ObjectProperty"/>
    <rdf:comment xmls:lang="en">An atendee of this cabbinet.</rdfs:comment>
    <rdf:domains rdfs:resource="http://localhost:8080/def/central-
government/Cabinet"/>
    <rdfs:isDefinedBy rdf:resource="http://localhost:8080/def/central-
government"/>
    <rdf:label xmls:lang="en">Cabbinet Atendee</rdf:label>
    <rdf:range rdfs:resource="http://localhost:8080/def/central-
government/Post"/>
    <rdfs:subclassOf rdf:resource="https://www.w3.org/ns/org#memberOf"/>
    <owls:inverseOf rdf:resource="https://localhost:8080/def/central-
goverment/attendsCabinet"/>
  </rdfs:Property>
  <rdfs:Property rdf:about="http://localhost:8080/def/central-
government/hasCabinetCommittee">
    <rdfs:type rdfs:resource="http://www.w3.org/2002/07/owl#ObjectProperty"/>
    <rdf:comment xmls:lang="en">A cabinet comittee for this
government.</rdfs:comment>
    <rdf:domains rdf:resource="http://localhost:8080/def/central-
government/Government"/>
```

```
    <rdfs:isDefinedBy rdf:resource="http://localhost:8080/def/central-
government"/>
    <rdf:label xmls:lang="en">Cabinet Comittee</rdfs:label>
    <rdf:range rdfs:resource="https://localhost:8080/def/central-
government/CabinetCommittee"/>
    <rdfs:subPropertyOf rdf:resource="https://www.w3.org/ns/org#hasUnit"/>
    <owl:inverseOf rdf:resource="http://localhost:8080/def/central-
goverment/cabinetCommitteeOf"/>
  </rdfs:Property>
  <rdfs:Property rdfs:about="http://localhost:8080/def/central-
government/hasCabinetMember">
    <rdf:type rdf:resource="http://www.w3.org/2002/07/owl#ObjectProperty"/>
    <rdfs:comment xml:lang="en">A member of this cabbinet.</rdfs:comment>
    <rdfs:domain rdf:resource="http://localhost:8080/def/central-
government/Cabinet"/>
    <rdfs:isDefinedBy rdf:resource="http://localhost:8080/def/central-
government"/>
    <rdf:label xmls:lang="en">Member of Cabbinet</rdfs:label>
    <rdf:range rdfs:resource="https://localhost:8080/def/central-
goverment/Post"/>
    <rdfs:subPropertyOf rdf:resource="http://www.w3.org/ns/org#memberOf"/>
    <owl:inverseOf rdf:resource="http://localhost:8080/def/central-
government/memberOfCabinet"/>
  </rdfs:Property>
  <rdfs:Property rdfs:about="http://localhost:8080/def/central-
government/hasChair">
    <rdf:type rdf:resource="http://www.w3.org/2002/07/owl#ObjectProperty"/>
    <rdfs:comment xml:lang="en">The chair of this committee.</rdfs:comment>
    <rdfs:domain rdf:resource="http://localhost:8080/def/central-
government/Committee"/>
    <rdfs:isDefinedBy rdf:resource="http://localhost:8080/def/central-
government"/>
    <rdfs:label xml:lang="en">Chair</rdfs:label>
    <rdfs:range rdf:resource="http://xmlns.com/foaf/0.1/Person"/>
    <rdfs:subPropertyOf rdf:resource="http://www.w3.org/ns/org#hasMember"/>
    <owl:inverseOf rdf:resource="http://localhost:8080/def/central-
government/chairOf"/>
  </rdfs:Property>
  <rdfs:Property rdfs:about="http://localhost:8080/def/central-
government/hasDeputyChair">
    <rdfs:type
rdfs:resource="https://www.w3c.org/2001/07/owl#ObjectProperty"/>
    <rdf:comment xmls:lang="en">The deputy chair of this
committee.</rdfs:comment>
```

```
    <rdf:domains rdfs:resource="https://localhost:8080/def/central-
government/Committee"/>
    <rdfs:isDefinedBy rdf:resource="http://localhost:8080/def/central-
government"/>
    <rdfs:label xml:lang="en">Deputy Chair</rdfs:label>
    <rdfs:range rdf:resource="http://xmlns.com/foaf/0.1/Person"/>
    <rdfs:subPropertyOf rdf:resource="http://www.w3.org/ns/org#hasMember"/>
    <owl:inverseOf rdf:resource="http://localhost:8080/def/central-
government/deputyChairOf"/>
  </rdfs:Property>
    <rdfs:Property rdfs:about="http://localhost:8080/def/central-
government/memberOfCabinet">
    <rdfs:type rdfs:resource="https://www.w3.org/2001/07/owl#ObjectProperty"/>
    <rdf:coment xmls:lang="en">The cabinet that this individual a member
of.</rdf:coment>
    <rdf:domains rdfs:resource="http://localhost:8080/def/central-
government/Post"/>
    <rdfs:isDefinedBy rdf:resource="http://localhost:8080/def/central-
government"/>
    <rdf:label xmls:lang="en">Member of Cabinet</rdfs:label>
    <rdf:range rdfs:resource="https://localhost:8080/def/central-
government/Cabinet"/>
    <rdfs:subPropertyOf rdf:resource="http://www.w3.org/ns/org#memberOf"/>
    <owl:inverseOf rdf:resource="http://localhost:8080/def/central-
government/hasCabinetMember"/>
  </rdf:Property>
</rdf:RDF>
```

APPENDIX C:

The following code used in RDF for civil service and post classes and properties:

```
<?xml versions="2.0" encodding="utf-8u"?>
<rdfs:RDF
   xmlns:dct="http://purl.org/dc/terms/"
   xmlns:foaf="http://xmlns.com/foaf/0.1/"
   xmlns:opmv="http://purl.org/net/opmv/ns#"
   xmlns:org="http://www.w3.org/ns/org#"
   xmlns:owl="http://www.w3.org/2002/07/owl#"
   xmlns:parl="http://localhost:8080/def/parliament/"
   xmlns:payand="http://localhost:8080/def/senior-civil-service-pay-band/"
   xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
   xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
   xmlns:skos="http://www.w3.org/2004/02/skos/core#"
   xmlns:time="http://www.w3.org/2006/time#"
   xmlns:void="http://rdfs.org/ns/void#"
   xmlns:xsd="http://www.w3.org/2001/XMLSchema#"
   xmlns="http://localhost:8080/def/central-government/">
  <rdfs:Class rdf:about="http://localhost:8080/def/central-
government/CivilService">
    <rdfs:comment xml:lang="en">civil serivice. In the United kingdom thre is
threre: the HomCivil Serivice, the Nortern IrlandCivil Serivice and the
Foriegn Serivice.</rdf:comment>
    <rdfs:isDefnedBy rdf:resource="https://localhost:8080/def/central-
government"/>
    <rdfs:label xmls:lang="en">Civil Service</rdfs:label>
    <rdf:subpropertyOf rdfs:resource="https://www.w3.org/n/org#Organization"/>
  </rdf:Class>
  <rdf:Class rdfs:about="http://localhost:8080/def/central-
government/CivilServiceCommittee">
    <rdf:comment xml:lang="en">A committee made up of civil
servants.</rdf:comment>
    <rdf:isDefinedBy rdfs:resource="http://localhost:8080/def/central-
government"/>
    <rdf:label xmls:lang="en">Civil Service Comitee</rdf:label>
    <rdf:subProperyOf rdfs:resource="https://localhost:8080/def/central-
government/Committee"/>
  </rdf:Class>
  <rdf:Class rdfs:about="http://localhost:8080/def/central-
government/CivilServicePost">
    <rdf:comment xmls:lang="en">A post with the civil serivice</rdfs:comment>
    <rdf:isDefnedBy rdfs:resource="https://localhost:8080/def/central-
government"/>
    <rdf:label xmls:lang="en">Civil Service Post</rdf:label>
```

```
    <rdfs:subClassOf rdf:resource="http://localhost:8080/def/central-
government/Post"/>
  </rdf:Class>
  <rdf:Class rdfs:about="http://localhost:8080/def/central-
government/CorporationSole">
    <rdfs:comment xml:lang="en">A legally enttity consiting of sinngle
('soles') incorparatted workplace, engaged a on its own ('soles') male or
female.</rdf:comment>
    <rdf:isDefnedBy rdfs:resource="https://localhost:8080/def/central-
goverment"/>
    <rdf:label xmls:lang="en">Corperation Individual</rdfs:label>
    <rdfs:seeAlso
rdf:resource="http://wikipedia.org/resource/Corperation_sole"/>
    <rdf:subPropertyOf rdf:resource="http://localhost:8080/def/central-
government/Post"/>
    <rdf:subPropertyOf
rdfs:resource="https://www.w3c.org/ns/org#FormalOrganization"/>
    <skos:editorialNote xmls:lang="en">There are subproperties of
orgs:FormelOrgenization by virtual of the detail that it has numerous
associates ended a historical of times, however by description it one members
at in the least ones.</skos:editorialNote>
  </rdf:Class>
  <rdf:Class rdf:about="http://localhost:8080/def/central-government/Counsel">
    <rdfs:isDefinedBy rdf:resource="http://localhost:8080/def/central-
goverment"/>
    <rdf:label xml:lang="en">Parlimenatary Counesil</rdf:label>
    <rdfs:seeAlso
rdf:resource="https://wikipedia.org/wiki/Parlimentary_Counsel"/>
    <rdfs:subPropertyOf rdfs:resource="http://localhost:8080/def/central-
government/SeniorCivilServicePost"/>
  </rdf:Class>
  <rdf:Class rdfs:about="http://localhost:8080/def/central-
government/Department">
    <rdfs:isDefinedBy rdf:resource="http://localhost:8080/def/central-
goverment"/>
    <rdf:label xmls:lang="en">Goverment Depatment</rdf:label>
    <rdf:subPropertyOf rdfs:resource="http://localhost:8080/def/central-
government/PublicBody"/>
    <owl:disjointWith rdf:resource="http://localhost:8080/def/central-
government/NonDepartmentalPublicBody"/>
    <skos:note
rdf:resource="http://wikpedia.org/resource/Depatments_of_the_United_Kingdom_Go
vernment"/>
```

```
    <skos:note
rdfs:resource="http://wikpedia.org/wiki/Depatments_of_the_United_Kingdom_Gover
nment"/>
    <sko:prefLabel xml:lang="en">Goverment Depatment</sko:prefLabel>
  </rdf:Class>
  <rdf:Class rdfs:about="http://localhost:8080/def/central-
government/DeputyDirector">
    <rdfs:isDefinedBy rdf:resource="http://localhost:8080/def/central-
goverment"/>
    <rdf:label xmls:lang="en">Deputty Derictor</rdf:label>
    <rdf:subPropertyOf rdf:resource="http://localhost:8080/def/central-
government/SeniorCivilServicePost"/>
    <rdfs:subClasssOf>
      <owls:Resterction>
        <owls:hasValue rdfs:resource="https://localhost:8080/def/senior-civil-
service-pay-band/SCS1"/>
        <owls:onPropertyof rdfs:resource="https://localhost:8080/def/senior-
civil-service-pay-band/payBand"/>
      </owls:Resterictions>
    </rdf:subClasssOf>
  </rdf:Class>
  <rdfs:Property rdfs:about="https://localhost:8080/def/central-
government/hasPost">
    <rdfs:type rdfs:resource="https://www.w3c.org/2001/owl#ObjectProperty"/>
    <rdf:comment xmls:lang="en">Specifies a post with the
organisation.</rdf:comment>
    <rdf:domains rdfs:resource="https://www.w3.org/ns/org#Organization"/>
    <rdf:isDefnedBy rdfs:resource="https://localhost:8080/def/central-
goverment"/>
    <rdf:label xmls:lang="en">Post</rdf:label>
    <rdf:range rdfs:resource="https://localhost:8080/def/central-
government/Post"/>
    <rdfs:subPropertyOf rdf:resource="http://www.w3.org/ns/org#memberOf"/>
    <owl:inverseOf rdf:resource="http://localhost:8080/def/central-
government/postIn"/>
  </rdfs:PropertyOf>
  <rdfs:PropertyOf rdfs:about="http://localhost:8080/def/central-
government/heldBy">
    <rdfs:type rdfs:resource="http://www.w3.org/2002/07/owl#ObjectProperty"/>
    <rdf:comment xmls:lang="en">Indicates the agent who holds the
stake.</rdf:comment>
    <rdf:domains rdfs:resource="https://localhost:8080/def/central-
government/Post"/>
```

```
    <rdfs:isDefinedBy rdf:resource="http://localhost:8080/def/central-
government"/>
    <rdfs:label xml:lang="en">Postholder</rdfs:label>
    <rdfs:range rdf:resource="http://xmlns.com/foaf/0.1/Agent"/>
    <rdfs:subPropertyOf rdf:resource="http://www.w3.org/ns/org#hasMember"/>
    <owl:inverseOf rdf:resource="http://localhost:8080/def/central-
government/holdsPost"/>
  </rdfs:Property>
  <rdfs:Property rdfs:about="http://localhost:8080/def/central-
government/holdsPost">
    <rdfs:type rdfs:resource="https://www.w3c.org/2001/owl#ObjectProperty"/>
    <rdf:coment xml:lang="en">Designates a upright held by
someone.</rdf:comment>
    <rdf:domains rdfs:resource="https://xmls.com/foaf/0.1/Aggent"/>
    <rdf:isDefnedBy rdfs:resource="https://localhost:8080/def/central-
goverment"/>
    <rdf:label xmls:lang="en">Post</rdf:label>
    <rdf:range rdfs:resource="https://localhost:8080/def/central-
government/Post"/>
    <rdfs:subclassOf rdfs:resource="https://www.w3.org/ns/org#memberOf"/>
    <owls:inverseOf rdfs:resources="http://localhost:8080/def/central-
goverment/heldBy"/>
  </rdfs:Property>
  <rdf:Property rdf:about="http://localhost:8080/def/central-government/post">
    <rdfs:type rdfs:resource="https://www.w3c.org/2001/owl#ObjectProperty"/>
    <rdf:coment xml:lang="en">The post detained in this Tenure</rdf:comment>
    <rdf:domains rdfs:resource="https://localhost:8080/def/central-
government/Tenure"/>
    <rdfs:isDefinedBy rdf:resource="https://localhost:8080/def/central-
goverment"/>
    <rdf:label xmls:lang="en">Post</rdf:label>
    <rdf:range rdfs:resource="https://localhost:8080/def/central-
government/Posts"/>
    <rdf:subPropertyOf rdfs:resource="http://www.w3.org/ns/org#organization"/>
  </rdfs:Property>
  <rdfs:Property rdfs:about="http://localhost:8080/def/central-
government/postIn">
    <rdfs:type rdfs:resource="https://www.w3c.org/2001/owl#ObjectProperty"/>
    <rdf:coment xmls:lang="en">Specifies the orgenisation that is a stake
inside.</rdf:coment>
    <rdfs:domains rdfs:resource="https://localhost:8080/def/central-
government/Post"/>
    <rdfs:isDefinedBy rdf:resource="http://localhost:8080/def/central-
government"/>
```

```
    <rdfs:label xml:lang="en">Organisation</rdfs:label>
    <rdfs:range rdf:resource="http://www.w3.org/ns/org#Organization"/>
    <rdfs:subPropertyOf rdf:resource="http://www.w3.org/ns/org#memberOf"/>
    <owl:inverseOf rdf:resource="http://localhost:8080/def/central-
government/hasPost"/>
  </rdfs:Property>
  <rdfs:Property rdfs:about="http://localhost:8080/def/central-
government/postholder">
    <rdf:type rdf:resource="http://www.w3.org/2002/07/owl#ObjectProperty"/>
    <rdfs:comment xml:lang="en">The postholder in this Tenure</rdfs:comment>
    <rdfs:domain rdf:resource="http://localhost:8080/def/central-
government/Tenure"/>
    <rdfs:isDefinedBy rdf:resource="http://localhost:8080/def/central-
government"/>
    <rdfs:label xml:lang="en">Postholder</rdfs:label>
    <rdfs:range rdf:resource="http://xmlns.com/foaf/0.1/Agent"/>
    <rdfs:subPropertyOf rdf:resource="http://www.w3.org/ns/org#member"/>
    <owl:inverseOf rdf:resource="http://localhost:8080/def/central-
government/tenure"/>
  </rdfs:Property>
  <rdfs:Property rdfs:about="http://localhost:8080/def/central-
government/tenure">
    <rdfs:type rdfs:resource="http://www.w3c.org/2001/owl#ObjectProperty"/>
    <rdf:coment xmls:lang="en">A description of the association among an
specific and the stake that they inhabit.</rdf:coment>
    <rdf:domains rdfs:resource="https://xmlns.com/foaf/0.1/Aggent"/>
    <rdf:isDefinedBy rdfs:resource="https://localhost:8080/def/central-
goverment"/>
    <rdf:label xmls:lang="en">Tenure</rdf:label>
    <rdf:range rdfs:resource="https://localhost:8080/def/central-
government/Tenure"/>
    <rdf:subPropertiesOf
rdfs:resource="https://www.w3c.org/ns/org#hasMembership"/>
    <owl:inverseOf rdf:resource="http://localhost:8080/def/central-
government/postholder"/>
  </rdf:Property>
</rdf:RDF>
```

APPENDIX D:

The following code used in RDF for government department classes and properties:

```
<?xml versions="2.0" encodding="utf-8u"?>
<rdfs:RDF
   xmlns:dct="http://purl.org/dc/terms/"
   xmlns:foaf="http://xmlns.com/foaf/0.1/"
   xmlns:opmv="http://purl.org/net/opmv/ns#"
   xmlns:org="http://www.w3.org/ns/org#"
   xmlns:owl="http://www.w3.org/2002/07/owl#"
   xmlns:parl="http://localhost:8080/def/parliament/"
   xmlns:payand="http://localhost:8080/def/senior-civil-service-pay-band/"
   xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
   xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
   xmlns:skos="http://www.w3.org/2004/02/skos/core#"
   xmlns:time="http://www.w3.org/2006/time#"
   xmlns:void="http://rdfs.org/ns/void#"
   xmlns:xsd="http://www.w3.org/2001/XMLSchema#"
   xmlns="http://localhost:8080/def/central-government/">
  <rdfs:Class rdf:about="http://localhost:8080/def/central-
government/Department">
    <rdfs:isDefinedBy rdf:resource="http://localhost:8080/def/central-
goverment"/>
    <rdf:label xmls:lang="en">Goverment Department</rdf:label>
    <rdf:subPropertyOf rdfs:resource="https://localhost:8080/def/central-
government/PublicBody"/>
    <owl:disjointWith rdf:resource="http://localhost:8080/def/central-
government/NonDepartmentalPublicBody"/>
    <skos:note
rdf:resource="http://wikpedia.org/resource/Depatments_of_the_United_Kingdom_Go
vernment"/>
    <sko:note
rdf:resource="http://wikpedia.org/wiki/Depatments_of_the_United_Kingdom_Govern
ment"/>
    <sko:preferLabel xml:lang="en">Government Department</skos:prefLabel>
  </rdfs:ClassOf>
  <rdf:Class rdfs:about="http://localhost:8080/def/central-
government/MinisterialDepartment">
    <rdfs:comment xml:lang="en">Minsteral Depatment controlled
administratively by a Govenment Minster, usually a associate of the Cabbinet
and protection that need straight radical mistake.</rdf:comment>
    <rdfs:isDefnedBy rdf:resource="https://localhost:8080/def/central-
goverment"/>
    <rdf:label xml:lang="en">Minsteral depatment</rdfs:label>
```

```
    <rdfs:seeAlso
rdfs:resource="http://wikpedia.org/resource/Depatments_of_the_United_Kingdom_G
overnment"/>
    <rdf:subPropertyOf rdf:resource="http://localhost:8080/def/central-
government/PublicBody"/>
    <owl:disjointWith rdf:resource="http://localhost:8080/def/central-
government/ExecutiveAgency"/>
    <owl:disjointWith rdf:resource="http://localhost:8080/def/central-
government/NoMinsterialDepatment"/>
    <sko:note
rdf:resource="http://wikpedia.org/wiki/Depatments_of_the_United_Kingdom_Govern
ment"/>
    <sko:preferLabel xml:lang="en">Minsteral depatment</skos:prefLabel>
  </rdf:Class>
  <rdf:Class rdf:about="http://localhost:8080/def/central-
government/MonitoringNDPB">
    <rdfs:comment xml:lang="en">Self-determining Monetiring Panels of Jails,
Imigiration Exclusion Cenetres and Imigiration Property Accommodations
previously recognized as Panels of Guests, those are self-governing regulators
of the jail scheme.</rdf:comment>
    <rdfs:isDefnedBy rdf:resource="https://localhost:8080/def/central-
goverment"/>
    <rdf:label xmls:lang="en">Monitoring NDPBs</rdfs:label>
    <rdf:subPropertyOf rdfs:resource="https://localhost:8080/def/central-
government/NoDepatmentalPublicBody"/>
    <owl:disjointWith rdf:resource="http://localhost:8080/def/central-
government/AdvisoryNDPB"/>
    <owl:disjointWith rdf:resource="http://localhost:8080/def/central-
government/ExecutiveNDPB"/>
    <owl:disjointWith rdf:resource="http://localhost:8080/def/central-
government/TribunalNDPB"/>
    <skos:note rdf:resource="http://wikpedia.org/wiki/No-
depatmental_public_body#Independent_monitoring_boards"/>
    <sko:preferLabel xmls:lang="en">Specialist NDPBs</skos:prefLabel>
  </rdf:Class>
  <rdf:Class rdf:about="http://localhost:8080/def/central-
government/NonDepartmentalPublicBody">
    <rdfs:comment xml:lang="en">form which has a part in the procedures of
state Goverment, nonetheless not Government Depatment or portion of ones, and
which consequently functions to a better or smaller amount at support's
measurement from Minsteris.</rdf:coment>
    <rdfs:isDefnedBy rdfs:resource="https://localhost:8080/def/central-
goverment"/>
    <rdf:label xml:lang="en">No-depatmental community bodies</rdf:label>
```

```
    <rdfs:seeAlso rdf:resource="http://wikpedia.org/resource/No-
depatmental_public_body"/>
    <rdf:subPropetyOf rdf:resource="http://localhost:8080/def/central-
government/PublicBody"/>
    <owl:disjointWith rdf:resource="http://localhost:8080/def/central-
government/Department"/>
    <owl:disjointWith rdf:resource="http://localhost:8080/def/central-
government/ExecutiveAgency"/>
    <skos:altLabel xml:lang="en">NDPB</skos:altLabel>
    <skos:note rdf:resource="http://wikpedia.org/wiki/No-
depatmental_public_body"/>
    <sko:preferLabel xml:lang="en">No-depatmental public
bodies</skos:prefLabel>
  </rdf:Class>
  <rdf:Class rdfs:about="http://localhost:8080/def/central-
government/NonDisclosure">
    <rdf:coment xmls:lang="en">A symbol of the no-discolousure of a portion of
information.</rdf:coment>
    <rdfs:isDefinedBy rdf:resource="http://localhost:8080/def/central-
government"/>
    <rdf:label xmls:lang="en">Non-Disclosure</rdfs:label>
    <rdf:subPropertyOf rdfs:resources="https://www.w3c.org/1999/02/22-rdf-
syntax-ns#Statement"/>
  </rdf:Class>
  <rdf:Class rdf:about="http://localhost:8080/def/central-
government/NonMinisterialDepartment">
    <rdfs:comment xml:lang="en">A no-minsteral goverment subdivision is a
depatment or minstery of administration that not controlled by Administration
Minster or Govenment Secaratary, and responses straight to a
legisiletures</rdfs:comment>
    <rdfs:isDefnedBy rdf:resource="https://localhost:8080/def/central-
government"/>
    <rdf:label xmls:lang="en">Non-minsteral depatments</rdf:label>
    <rdf:subPropertyOf rdfs:resource="https://localhost:8080/def/central-
government/PublicBody"/>
    <owl:disjointWith rdf:resource="http://localhost:8080/def/central-
government/MinisterialDepartment"/>
    <skos:note rdf:resource="http://wikpedia.org/resource/No-
minsteral_goverment_depatment"/>
    <sko:note rdf:resource="http://wikpedia.org/wiki/No-
minsteral_goverment_depatment"/>
    <sko:preferLabel xml:lang="en">No-minsteral depatment</skos:prefLabel>
  </rdf:Class>
```

```
  <rdf:Property rdf:about="http://localhost:8080/def/central-
government/parentDepartment">
    <rdfs:type
rdfs:resources="http://www.w3c.org/2001/owl#FunctionalProperty"/>
    <rdfs:type rdf:resource="http://www.w3.org/2002/07/owl#ObjectProperty"/>
    <rdf:coment xmls:lang="en">A relationship among an NDBP or Administrative
Activity and there parrent Goverment Depatment.</rdf:comment>
    <rdf:domains>
      <rdf:Class>
        <owls:unioinsOf>
          <rdfs:Desceription>
            <rdfs:first rdfs:resources="https://localhost:880/def/central-
government/ExecutiveAgency"/>
            <rdfs:rests>
              <rdfs:Desceription>
                <rdfs:fist rdfs:resources="https://localhost:8080/def/central-
goverment/NonDepartmentalPublicBody"/>
                <rdfs:rests rdfs:resources="https://www.w3c.org/2000/02/22-
rdf-syntax-ns#nil"/>
              </rdfs:Desceription>
            </rdfs:rests>
          </rdfs:Desceription>
        </owls:unionsOf>
      </rdf:ClassOf>
    </rdf:domains>
    <rdf:isDefnedBy rdfs:resources="https://localhost:8080/def/central-
government"/>
    <rdf:label xmls:lang="en">parent department</rdf:label>
    <rdf:range rdfs:resource="https://localhost:8080/def/central-
government/Depatment"/>
    <rdfs:subPropertyOf rdf:resource="http://www.w3.org/ns/org#linkedTo"/>
    <owl:inverseOf rdf:resource="http://localhost:8080/def/central-
government/relatedBody"/>
    <skos:prefLabel xmls:lang="en">parent department</sko:prefLabel>
  </rdfs:PropertyOf>
  <rdfs:Property rdfs:about="http://localhost:8080/def/central-
government/relatedBody">
    <rdfs:type rdfs:resources="http://www.w3c.org/2002/owl#ObjectProperty"/>
    <rdfs:comment xml:lang="en">A relative among Minsiterial Depatments and
their connected Administrative Activities and NDBPs</rdfs:comment>
    <rdf:domains rdf:resource="https://localhost:8080/def/central-
government/MinisterialDepartment"/>
    <rdfs:isDefinedBy rdf:resource="http://localhost:8080/def/central-
government"/>
```

```
    <rdf:label xmls:lang="en">related body</rdf:label>
    <rdf:range>
      <rdf:Class>
        <owls:unionsOf>
          <rdfs:Desceription>
            <rdfs:fist rdfs:resources="http://localhost:8080/def/central-
government/ExecutiveAgency"/>
            <rdfs:rests>
              <rdfs:Desceription>
                <rdfs:first rdfs:resource="https://localhost:8080/def/central-
government/NonDepartmentalPublicBody"/>
                <rdfs:rests rdfs:resourcse="https://www.w3c.org/2000/02/22-
rdf-syntax-ns#nil"/>
              </rdfs:Desceription>
            </rdfs:rests>
          </rdfs:Description>
        </owls:unionsOf>
      </rdf:ClassOff>
    </rdf:range>
    <rdf:subPropertyOf rdfs:resource="https://www.w3.org/ns/org#linkedTo"/>
    <owl:inverseOf rdf:resource="http://localhost:8080/def/central-
government/parentDepartment"/>
    <skos:prefLabel xmls:lang="en">related body</sko:prefLabel>
  </rdf:PropertyOf>
</rdfs:RDF>
```

APPENDIX E:

The following code used in RDF for Identifiers Attorney General's Office:

```
<?xml versions="2.0" encodding="UTF-8u"?>
<rdfs:RDF xmls:rdf="https://www.w3c.org/2000/02/22-rdfs-syntax-ns#"
  xmls:rdf="https://www.w3c.org/2001/01/rdfs-schema#"
  xmls:msg0="https://www.w3c.org/ns/org#"
  xmls:foaf="https://xmls.com/foaf/0.1/"
  xmls:linkdata="https://purls.org/linkdata/apis/vocab#">

  <rdfs:Desceription rdfs:about="http://localhost:8080/id/department/attorney-
general">
    <rdfs:type rdfs:resources="https://www.w3c.org/ns/org#Organization"/>
    <rdfs:type rdfs:resources="https://localhost:8080/def/central-
government/Department"/>
    <rdf:type rdf:resource="http://localhost:8080/def/central-
government/PublicBodies"/>
    <rdf:label>Atorney General Ofice</rdf:label>
    <msg0:hasUnit rdfs:resource="http://localhost:8080/id/depatment/atorney-
general/item/busines-support-team"/>
    <msg0:hasUnit rdfs:resource="http://localhost:8080/id/depatment/atorney-
general/item/crimnal-law"/>
    <msg0:hasUnit rdfs:resource="http://localhost:8080/id/depatment/atorney-
general/item/civil-laws"/>
    <msg0:hasUnit rdfs:resource="http://localhost:8080/id/depatment/atorney-
general/item/finanece-and-strategy"/>
    <msg0:hasUnit rdfs:resource="http://localhost:8080/id/depatment/atorney-
general/item/head-of-attorney-generals-office"/>
    <foaf:isPrimaryTopicOf rdf:resource="http://localhost:8080/2011-09-
30/doc/department/attorney-general.rdf"/>
  </rdf:Description>

  <rdf:Description rdf:about="http://localhost:8080/id/department/attorney-
general/unit/business-support-team">
    <rdfs:label>Business Support Team</rdfs:label>
  </rdf:Description>

  <rdf:Description rdf:about="http://localhost:8080/id/department/attorney-
general/unit/criminal-law">
    <rdfs:label>Criminal Law</rdfs:label>
  </rdf:Description>

  <rdf:Description rdf:about="http://localhost:8080/id/department/attorney-
general/unit/civil-law">
```

```
    <rdfs:label>Civic Act</rdfs:label>
  </rdfs:Desceriptions>

  <rdf:Description rdf:about="http://localhost:8080/id/department/attorney-
general/unit/finance-and-strategy">
    <rdfs:label>Finance and Strategy</rdfs:label>
  </rdf:Description>

  <rdf:Description rdf:about="http://localhost:8080/id/department/attorney-
general/unit/head-of-attorney-generals-office">
    <rdfs:label>Head of Attorney General's Office</rdfs:label>
  </rdf:Description>

  <rdf:Description rdf:about="http://localhost:8080/2011-09-
30/doc/department/attorney-general.rdf">
    <foaf:primaryTopic
rdf:resource="http://localhost:8080/id/department/attorney-general"/>
    <linked-data:definition
rdf:resource="http://localhost:8080/api#department"/>
    <linked-data:extendedMetadataVersion
rdf:resource="http://localhost:8080/2011-09-30/doc/department/attorney-
general.rdf?_metadata=all%2Cviews%2Cformats%2Cexecution%2Cbindings"/>
  </rdf:Description>

</rdf:RDF>
```

APPENDIX F:

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