Examination of Forestry Data Management Policies for Development and Implementation of Web-based Interorganisational Decision Support Systems in Northwest Europe: Case study of Great Britain

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by

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Abstract

Development and implementation of interorganisational data infrastructure are not only comprises of technical components, but data policies and regulations that guide the availability and accessibility of data are a key component. The advancement in information technology has seen an increased in development of interorganisational information systems to improved access to and exchange of data. However, the existence of data policies and regulations for protecting data and databases through database legislation, contracts, licensing are a challenge to data infrastructure initiatives. But this research found out that the way in which organizations manage their data not only influenced by the respective organization's data management policies, but influenced by extern anal factors, which can be market, contract and agreements with other organizations. A literature study is used to investigate the impacts of data policy on interorganisational data infrastructures and information systems development and implementation. Organizational documents were studied and current data management practices are assessed whether or not adhered to the policies and regulations through interviews, questionnaire and observations. This research explores data policy elements (pricing, ownership, etc) in forestry commission and evaluate whether they pose potential influence in the development and implementation of a web-based decision Support System.
Ultimately, the results can be used as evidence of data management practices that would support or not in support of the development and implementation of a web-based Decision Support Systems (DSS).

Keywords: Data policy, Decision Support Systems, Interorganisation, Development, Implementation, Infrastructure,

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1. Introduction

1.1. Background

The development and implementation of an interorganisation data infrastructures or information systems not only involved technical aspects but also is supported by economic, social, organizational, and legal measures. These systems make use of (spatial) data as a core component for their operations. Many organizations are using desktop-based Decision Support Systems in their day-to-day operations to solve semi-structured (spatial) problems and these tools are limited to individual persons. Due to the need for data and service sharing across jurisdictions, organizations have resorted into interorganisation web-based DSS. A web-based DSS is a computerised system that delivers decision support information or decision support tools to decision support analyst using a web browser(Power, 2002). However, involved organisations create and manage their own data sets, databases and applications guided by different policies and institutional practices. These policies could be seen as guides for good practices, but also can be limitations to other intended developments. Recent studies (Onsrud et al.., 2004, Cavaye, 1998, Williamson et al., 2006, Groot, 1997) on intraorganisation, transnational systems have concluded that more attention has been given to the technical aspects during the development and implementation than the organisational or institutional aspects. The study focuses on data management policies and legal aspects as part of the organisation and institutional matters that guides the availability and accessibility of data sets held by individual organisations. Previous studies carried out by (Rajabifard and Williamson, 2002, Janssen and Dumortier, 2007) have indicated that participants of interorganisation systems can have disagreements about different legal requirements concerning pricing, ownership and privacy in various organisations and countries. Such disagreements can affect the ability of the participants to fully commit (Cavaye, 1998). However, little empirical evidence exists to validate the extent to which various data policies differ or similar between organizations.

Moreover, understanding the relationships of organisation's data management practices in relation to other organisations offers guidance for the implementation of inter-organizational data infrastructures and potentially increasing their probability of success as well as the benefits for all stakeholders.

Therefore, this research aimed at gathering empirical evidence on existing data management policies and practices in forestry commission Great Britain as a basis for the development and implementation of a web-based decision support system.

1.2. Problem Context

The European Commission (EC) of European Union (EU) have passed the INSPIRE Directive[1]. The INSPIRE Directive sets out to address the availability, quality, structure, accessibility, interoperability and sharing of spatial information across a large number of policy and information themes, for all levels of public authority within the Community through the adoption of common standards. This has seen formation of initiatives at all levels local, national and global like ForeStClim a transnational project funded by EU aimed at developing cooperation and forestry management strategies amongst North-western European countries.

The main objective of ForeStClim is to develop a common framework for decision support within in Northwest Europe for assessing the impacts and adaptation response to climate change in the forestry sector. National forestry infrastructures are composed of different networked applications designed and implemented to use datasets and serve very specific purposes at the national, regional or local levels within their jurisdiction. These infrastructures contained with different data and databases standards and packages, guided by different policies and regulations. According to Rajabifard and Williamson (2002), policies are one of the factors that can influence the development of inter-organisational data infrastructures.

Therefore, this research is focused on contributing to the understanding of the theoretical and practical implications of different organisational data management policies as a basis for the development and implementation for a web-based Decision Support Systems in the forestry sector in Great Britain and is carried out as feasibility study to provide meta-information to help assess the tractability of data sharing in ForeStClim partner countries.

1.3. Problem Statement

There are many technological and institutional challenges faced by organizations in development and implementation of data infrastructures(Rajabifard et al., 2002). This mainly includes issues such as access policies, custodianship, pricing of data and standards, the availability of spatial data and metadata; the interoperability, integration and inter-flow of datasets from different parties (this has important implications for the ownership and control of information); multiple trusted data sources (quality and the content of data) and the system conceptual model(Rajabifard and Williamson, 2003). Moreover, most organizations need more data than they can afford, this is due to restriction and cost recovery attached to the data. Organizations often need data outside their jurisdictions or operational areas to carry out their task, therefore information needed to solve cross-jurisdictional problems such as climate change impacts, is often inaccessibility, unavailable and incompatible(Rajabifard and Williamson, 2003). Organizational dimension has been weighted as one of the critical dimensions in inter-organizational (spatial) data infrastructure and practices (Ahmed et al., 2007).

[1] The INSPIRE Directive entered into force on the 15th May 2007 to ensure that the spatial data infrastructures of the European Union Member States are compatible and usable in a Community and transboundary context, the Directive requires that common Implementing Rules (IR) are adopted in a number of specific areas (Metadata, Data Specifications, Network Services, Data and Service Sharing and Monitoring and Reporting).

Similarly, European forest service organizations maintain large different spatial and non-spatial forest databases with different datasets. Thus, is my assumption that these forestry organisations have different data availability and access policies that guide data collection and distribution practices in their jurisdictions.

On these grounds it is deemed necessary to understand different organizations' policies and their incorporation into data management practices upon embark on inter-organizational and cross-jurisdiction data infrastructure initiatives. The inspiration for this study is an assumption that this development project is formulated at the EU regional level and implemented at an organization level without considering the individual organizations' data policies and practices.

Therefore, the basis of this study is an assumption that data availability and access policies and practices will manifest themselves differently in individual organizations and this could have consequences on the development and implementation of the on-line DSS evaluation tool. Therefore, this research is directed at advancing knowledge that will help decision-makers evaluate and understand the likely consequences they might face among competing policies. The consequences of data policy are intertwined with issues such as the ownership and control of spatial information, economics of spatial data production and dissemination, protection of personal information privacy, access to the spatial data compiled and held by government and private agencies, liability for spatial information products and services(Onsrud et al., 2004). The study examined forestry databases, data availability and access policies as a basis for development and implementation of the web-based Decision Support Systems (DSS) in Northwest Europe. It is assumed that findings to this study can serve as background information for development and implementation of a web-based Decision Support Systems within the existing organizational structures.

1.4. Justification

New challenges and requirements for the management of environmental data in relation to climate change impacts require improved data interoperability, data integration and data sharing(Frehner and Brändli, 2006). To address issues of the global environment, it is essential to have a sound scientific understanding of the Earth and its constituent elements and it is more efficient and cost-effective for each nation to share its data and information than to collect everything it needs independently(NAP, 1995). However, In order to take full advantage of this approach, it is important to understand involved organizations' data policies, Procedures, Practices and environment in which they operates. These organizational characteristics then become more influential when a data infrastructure is developed and implemented among different organizations,(Rajabifard and Williamson, 2001). In addition, at a different level, studies have indicated that the development of a Regional Spatial Data Infrastructure (RSDI) is much more challenging than the development of a National SDI initiative within a nation (Rajabifard and Williamson, 2002). Furthermore, it has been pointed out that implementing computer-based especially, on-line-based systems in an organization can result in substantial changes in basic organizational practices(Kling et al., 1992) and its further confirmed that both technological and organizational difficulties are more likely to be encountered in building inter-organizational data infrastructures. Therefore, technological, legal and policy solutions in SDI development and implementation must be addressed in the context of each other and

concurrently(Onsrud et al., 2004). This pre- implementation assessment is to ascertain whether; the planned infrastructure will not face obstacles upon implementation with the existing organizational policies. Moreover, this will help the project stakeholders to understand the nature of data management practices and reach consensus that will lead to successful implementation of a web-based decision support systems.

This study is based on the assumption that most of data infrastructure development projects are being formulated at high level of governance or by international or regional funding agencies. However, little is known about the practices and regulations of the individual organisations. My argument is that, this is sometimes due to incompatibility or overlooked of the involved national and organizations policies which are often given less or no attention during the project formulation and feasibility study phase.

This study is necessary as it reveals data management policy aspects that of interest to the project stakeholders during development and implementation of interorganisational web-based DSS. Hence, the objective of this research is to examine forest organisations' data policies and their incorporation in data management practices in Great Britain as basis for the development and implementation of an evaluation tool and see if there are conflicting policies that can hinder the process of development and implementation of web-based DSS.

1.5. Research Objectives and Questions

1.5.1. Research Main Objective

The main objective is to examine forest databases, dataset availability and access policies as a basis for development and implementation of the Web-based Decision Support System evaluation tool in Northwest Europe.

1.5.2. Research Main Question

What are the existing data management policies and practices in distinct forestry service organizations? And how could they influence the development and implementation of the Web-based Decision Support Systems in Northwest Europe?

In order to achieve the main objective, and answer the main research question, the following sub-objectives and questions have been formulated as presented in table 1 below.

Table 1: Sub-Objective and Questions

Sub objective	Research question
1. To establish the level of heterogeneity and homogeneity in data policies and practices	• What kind of datasets and products exist in the partner organisations? • What aspects of databases, datasets and practices are covered by the policies?

2. To investigate the status and scope of data availability and access policies in relation to organisation practices	• Are the policies, directives incorporated in organisation processes? To what extent are they being incorporated? • What do the policies say about data access? • Are the policies legally enforceable? How are they enforceable?
3. To identify data access processes and mechanisms in the three organisations	• What are the current data access processes and mechanisms? • What is the relationship between organisational policies and EU policies/Directives?

1.6. Conceptual framework

Decision Support Systems (DSS) is an interactive computer-based systems that help people use computers communications, data, documents, knowledge, and models to solve problems and make decisions (Power, 2000). DSS can be function or industrial orientated. Depending on its function, DSS is further categorized into broader categorise depending on its dominant decision support component: communication-driven, data-driven, model-driven, document-driven and knowledge-driven DSS(Power, 2002). Subsequently, DSS can also be categorized according to its implementation coverage; enterprise or desktop (Power, 1997). He further, explained that DSS can be implemented using web technologies which resulted in web-based DSS. Web-based DSS is a computerized system that deriver decision support information or Decision support tools to managers and decision support analyst using a 'thin-client' web browsers like Netscape Navigator or internet explorer(Power, 2000). Through this infrastructure, managers and analysts can have access to data-warehouses. The commonalities in all DSS is that, they help managers and researchers answer questions relevant to a decision situation. Although, a lot have been researched and practically done on DSS, it merely focused on the technical development, implementation and application capabilities (Power, 2004, Sprague**,** R H, Jr. 1980, Power, D 2000), but few studies are done on the relationship of DSS and data policies and institutional arrangements of the organisations where it is implemented.

This research will focus on the data management policies in relation to the Database, Data-driven component of DSS. This is so because data is the core input to the systems. Datasets refers to any organised collection of data or information that has common theme e.g. topological, roads, vegetation. Database is a collection of current and historical structured data from a number of sources that have been organised for easy access and analysis(Power, 2002). Policies are guidelines and regulations that put in place by organisation in relation to acquisition, storage and distribution of data and other products.

Individual Organisations' Data Management Policies and administrative component are critical for the web-based DSS development, implementation, maintenance and its application for standards and datasets amongst stakeholders. Given the importance of information and communication technologies in organisations, it is also essential to understand key factors affecting its use and implementation.

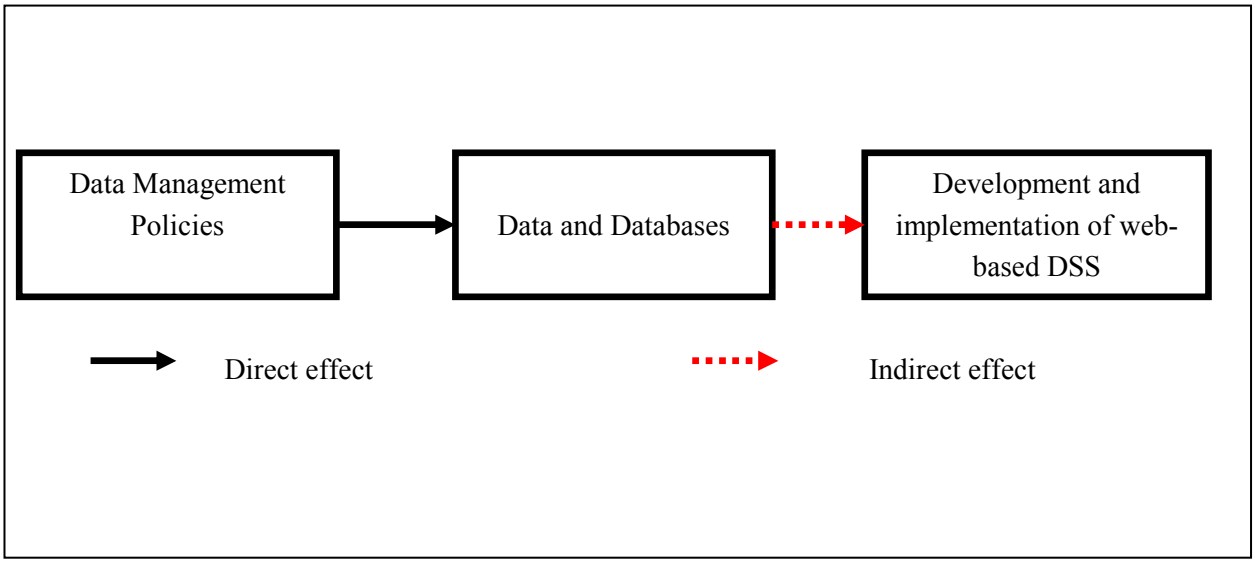


Figure 1: Conceptual Framework

Figure 1, represents the concept of policies, agreements, and procedures that guides and effects the management of data and databases which indirectly can affect the development and implementation of an interorganisational web-based decision support systems. In this research, policies are viewed as guidelines to data management practices but at the same time if two or more organisations have conflicting policies and practices, then it can be a constraint for the implementation of an intraoragnisation data infrastructure.

Forestry Commission coordinates and carries out a variety of research projects based in different datasets from various organizations through its research department, Forest Research.

Due to the above-mentioned characteristics and concepts of DSS and lack of literature on data management policies in relation to DSS development and implementation, this research borrows literature from SDI and transnational and interorganisational information systems.

Knowledge and understanding of Policy aspects is crucial to consider for any DSS design and implementation. This will help understand how individual organization incorporate and practice the overall policy in relation to acquisition, dissemination and legal protection of spatial data. For example issues concerning intellectual property rights, privacy and pricing. Indicators might be the existence of any written document pertaining to the policy aspects, regulations or verbal explanation on how the issues are dealt with in day-to-day organizational operations. When it comes to interorganisational initiatives, these aspects might be handled differently within involved organizations and if left without consideration will result in conflict at any stage of a web-based DSS project.

Investigation of existing policies and how they are included in the data management practices will help understand and pinpoint the policy elements that can be of conflict with other organisation's or

national policies and can influence the development and implementation of web-based decision support system in Northwest Europe.

1.7. Research Methodology

1.7.1. Literature Review

The research began with examination of existing literature on topics of policies and, inter-organisational web-based data or information systems initiatives. This initial approach provided insights on what is already done on the topic and what were the recommendations for further investigation. Specifically, this research followed the recommendation by Onsrud et al (2004) on areas that they proposed for further studies to help strengthen the future of the nation's spatial information infrastructure: "Conduct real-time case studies designed to measure the effects of different legal, economic, and information policy choices on the development of spatial information infrastructures". They further stated that Information policy issues arise at all levels, from local to global and from public to private sources and each jurisdiction, whatever its size, has its own culture and set of practices. Therefore, this research was designed to investigate the existing data management policies and practices in forestry organisation in Great Britain. Apart from existing literature, further research approaches were employed to investigate and elicit empirical data on forestry data policies in Great Britain as basis for development and implementation of web-based DSS.

1.7.2. Fieldwork

Fieldwork was undertaken to get empirical data and understanding of forestry data management policies and their incorporation in data management practices in forestry organisations in Great Britain. This was also taken as an opportunity to explore and understand the organisation structure and operations through interactions with many different people and observations of existing artefacts.

1.7.3. Research methods

The following research approaches were employed to ascertain relevant data and information concerning data management policies and practices in Great Britain.

- Documentary study
- Semi-structured interviews with Data managers and technical managers
- Questionnaires
- Observations

1.8. Scope of Research

The research examined data management policies implemented in acquisition, use and exchange of spatial data by forestry organisations in Scotland, Wales and England (Great Britain). The research is not directed to a specific policy element, but tried to identify which ones are being practiced. Pricing, Custodianship, privacy principles and access restrictions were the most interesting to look at but not exclusive to any other that came up during data collection phase. Considering data management issues, an extension to the technical component was made by looking at the existing database packages, software package that used to access and analyse the data. All these elements were looked

at from an organisation management perspective. For instance, in regard to policy elements, questions were asked about charging for data, conditions for use and exchange of data. The sample we aimed for was head of operational departments, data managers and other relevant informants from the forestry organisations in the three countries.

Because data management issues are dealt with also at Great Britain level, the majority of the respondents are at Great Britain level and only three representing the three countries. One would suspect that the data provided by our sample may be indicative of the responses across forestry Commission Great Britain.

1.9. Research design

The research activities were divided into three phases, Pre-fieldwork, Fieldwork and Post-Fieldwork as shown in figure 2 below.

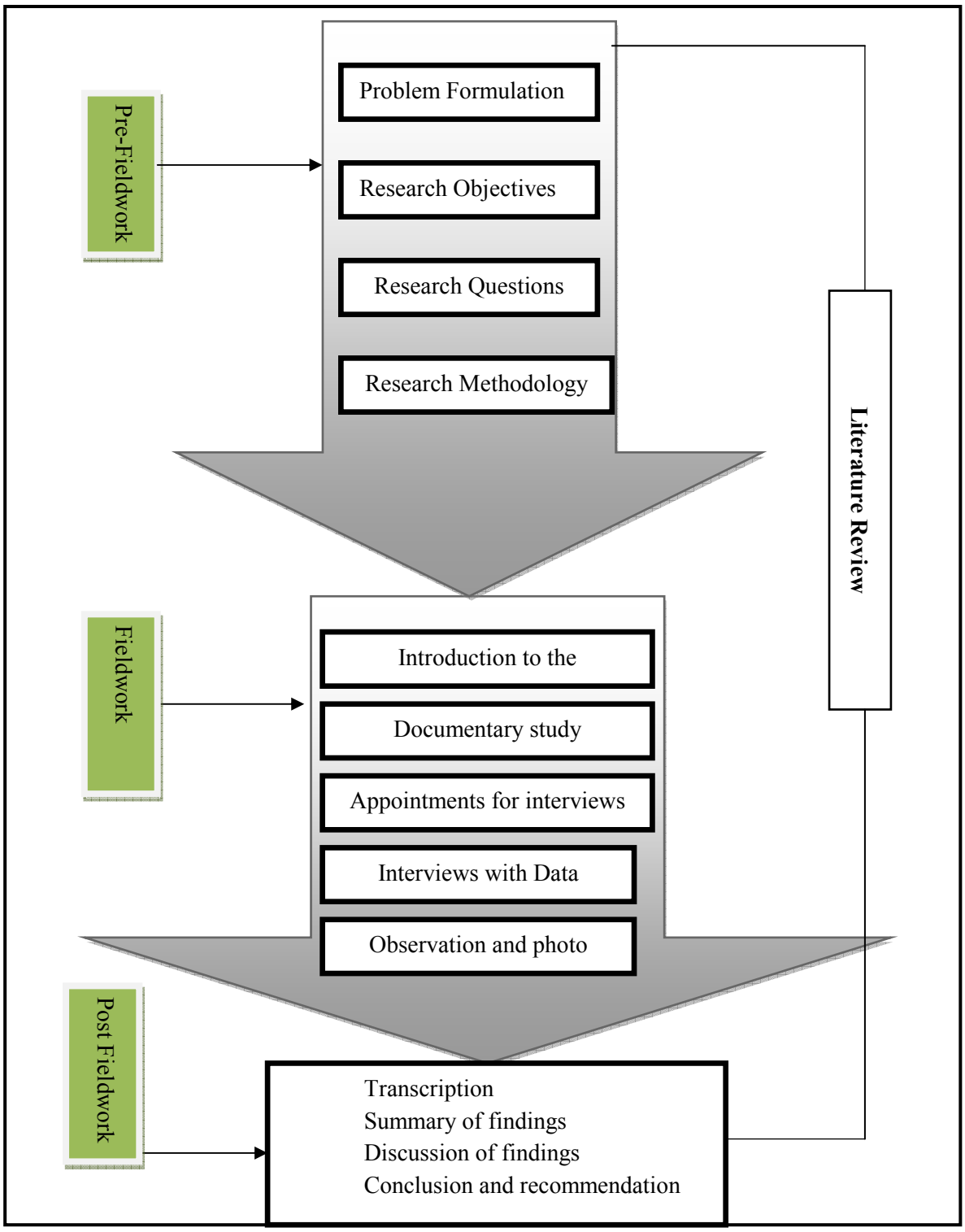


Figure 2: Research Design

1.10. Thesis Structure

Chapter 1: Introduction

This chapter gives an introductory background to the research; outline the research problem statement, justifies why the research is necessary. The Conceptual framework in which the research will be fitted, research objectives and questions and the methodology how the research will be carried out are stipulated.

Chapter 2: Literature Review

This chapter will present a descriptive current state of literature on data policies and development and implementation of web-based Decision Support infrastructures or any other related spatial data infrastructure initiatives. The chapter will further outline data policies as a challenge for inter-organizational data sharing and exchange.

Chapter 3: Methodology

This chapter will describe different data collection approaches and methods that will be employed during the research. This chapter will include a detailed specification of the research design and methods including explanation of the choice of the case study locations.

Chapter 4: Findings

This chapter will give a description on empirical findings of the different database and data policy elements per organization as described by the policy documents and different respondents.

Chapter 5: Discussion

This chapter presents a descriptive analysis of the different data policy elements and their relation to the concept of database, data availability and accessibility. In this chapter, we will attempt to analyze and evaluate policy elements depending on the empirical findings so as to establish the degree and significance of disparity in the policies that are more likely to influence the development and implementation of the web-based decision support system.

Chapter 6: Conclusions and Recommendations

This chapter will summarize conclusions drawn by pointing out the differences and similarities in the data policies. The main research question and objective will be addressed in this chapter. Further research is recommended.

2. Literature Review

2.1. Introduction

The complexity and interdisciplinary nature of environmental problems have seen a growing number of initiatives between public and private sector organizations that discovered the potential of collaborative spatial data development, integration and sharing through related technologies. This have seen an increase in development and application of new tools capable of processing not only numerical aspects, but also spatially related data, which are all needed in decision-making processes(Poch et al., 2004). Furthermore, the growth in globalisation and advancement in technologies, have seen organisations at both national and international levels embarked on initiatives for advanced Web-based retrieval, analysis, and visualization of spatially related environmental data based on the integration or interoperability of distributed data repositories(Frehner and Brändli, 2006). This has resulted in Transnational (Regional) or Inter-organisational Spatial Data Infrastructure.

However, these initiatives have been faced with existing complex organisational structures, technologies, data management policies and practices. Similarly, availability and accessibility of spatial data also plays a role in the successful development and implementation of DSS.

This research will borrow literature from SDI studies due to the lack of literature on data policies and DSS and the commonality of the components and the ideas which aims at developing a common framework for facilitation of sharing, access and utilisation of forestry spatial data across northwest Europe in response to climate change impacts. Hence, in this chapter existing literature on how data management policies and practices can influence the development and implementation of spatial data infrastructure are looked at. The purpose of this chapter is to establish whether and to what extent is data policies have been mentioned as one of the obstacles of inter-organisational/transnational data infrastructures development and implementation.

2.2. Data Policies and information systems, (spatial)data infrastructure

A review on literature about SDI development and implementation, have seen many emphasising surrounding policies as crucial components for the development and implementation of data infrastructures. It is also viewed as factors influencing the development and implementation of inter-organisational data infrastructure. Policies in this research are discussed referred to guidelines, regulations and applicable principles that set down and being practiced by an organisation regarding the data management practices, pricing, and terms and conditions of use and access by other organisations or individuals.

At first, spatial data administrators and practitioners perceived the standardization and also implementation of SDI as a purely technical process for example the standardization of the data definitions, the coding, compatibility of different interfaces and operating systems and the exchange formats. In his study on SDI for sustainable Land management, Groot (1997) indicated that the design, implementation and maintenance of SDI are multi-dimensional and complex. It has technical, Organizational and institutional implications. He explained that SDI development and

implementations operates subject to policies that govern access, use, pricing of data and services, sustained financing, quality management and human resources development. And consequently, these organisational policies usually operate within national information policy restrictions(Groot, 1997).

However, over time, as researches on assessment and evaluation of the SDI initiatives, it became clear that involved parties needed to agree on common policies with respect to the access, use and pricing of their data (Groot, 1997). He further indicated that, without such common policies, organisational policies and guidelines may, in many cases, be in conflict. The ownership of digital spatial data, protection of privacy, access rights to the spatial data compiled and held by governments, and information liability are concepts that require greater clarity in the new, automated context(Onsrud et al., 2004).

Studies around the SDI concepts indicated that; the development, implementation and maintenance of SDI are not, a purely technically challenged. In order for SDIs to operate there are a whole range of policies and institutions that have to be put in place or understood(Williamson, 2004). He further outlined the policies examples as privacy, intellectual property, copyright and pricing. For example a critical challenge is balancing privacy and security with utility of data, or whether a jurisdiction adopts a public good economic model for data pricing or a commercial model or a combination. At the same time involved organisations have to deal with a whole range of policy decisions to be made with regard to the institutional arrangements and governance framework that support both the development and maintenance of the SDI. He further continues that another challenge is to distinguish between the roles of data sponsors and data custodians(Williamson, 2004). This is to determine which data belongs to the organization involved and who is a legal owner of the data and what conditions are subject to the data for distribution to third parties.

There is no doubt that the challenges associated with determining appropriate and workable policies in support of SDI are central to achieving the SDI vision – simply building SDIs is not just a technological challenge although in some quarters it is perceived as such(Williamson, 2004).

Studies on this subject have been carried out from different perspective but within the conceptual framework of SDI. In their study on factors influencing the development of SDIs, Rajabifard and Williamson (2002), has classified factors and issues that contribute or influence the development of a Regional SDI initiatives into three overarching classes: Environmental Factors, Capacity Factors, and SDI Organization Factors as shown in figure 3.

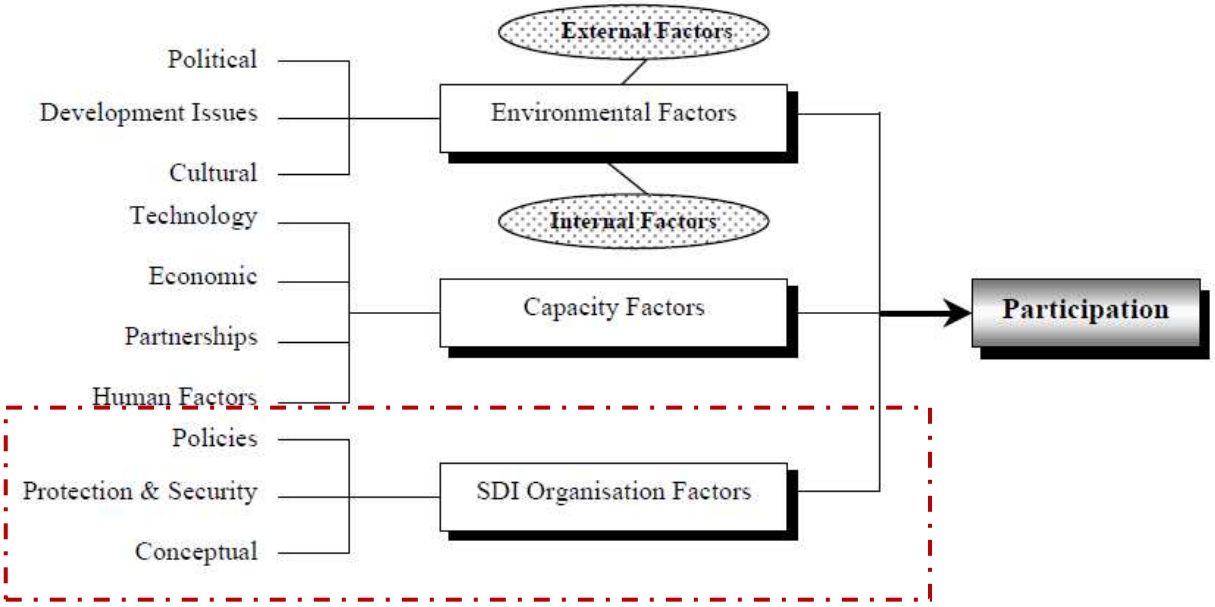


Figure 3: Factors influencing the development of a Regional SDI, adopted form Rajabifard and Williamson (2002)

These factors are said to affect the participation rate in designing and implementation of an SDI by the involved organizations or nations. This study concentrates on the SDI Organizational factors. This class is further divided into three sub-classes: Protection and Security, Conceptual and policies. These are factors can all have an influence on an SDI development and implementation in different ways at different stages. Some examples of SDI Organization Factors are: the suitability and degree of complexity of the SDI conceptual model; the availability of spatial data and metadata; the integration and inter-flow of datasets from different parties (this has important implications for the ownership and control of information); access networks; and multiple trusted data sources(Rajabifard and Williamson, 2002). In addition Crompvoets et al. (2004) have indicated that policies and administrative component of the SDI definition is critical for the construction, maintenance, access and application of standards and datasets for SDI implementation.

Policies and guidelines are required for SDI that incorporates: spatial data access and pricing; funding, spatial data transfer; custodianship; metadata; and standards. Data confidentiality, liability, and pricing are further constraints to inter-organizational GIS efforts. Moreover, studies have pointed out that Data access policies established by individual organizations are ultimately going to affect data exchange activities and benefits accruing to various data users and producers(Nedovic-Budic and Pinto, 1999).

In addition, recent researches have indicated that more attention has been given to the human and technical aspects of SDIs development and implementation, but numerous issues prevent SDIs from fully exploiting all their technical possibilities, with a large number of these issues being of a legal nature (e.g., access and commercialization, privacy, liability, security, etc.). The EU SDI framework is also regulated by legislation that can impede the availability of spatial information. These stem from concerns about privacy, intellectual property ownership, security, and liability (Janssen and Dumortier, 2007). Figure 4 below shows how intellectual right property, Privacy, Security and liability policy elements are perceived to influence the realisation of the INSPIRE Directive

objectives. This has been observed as a challenge for SDI development in most of the parts in the world in realisation of similar initiatives.

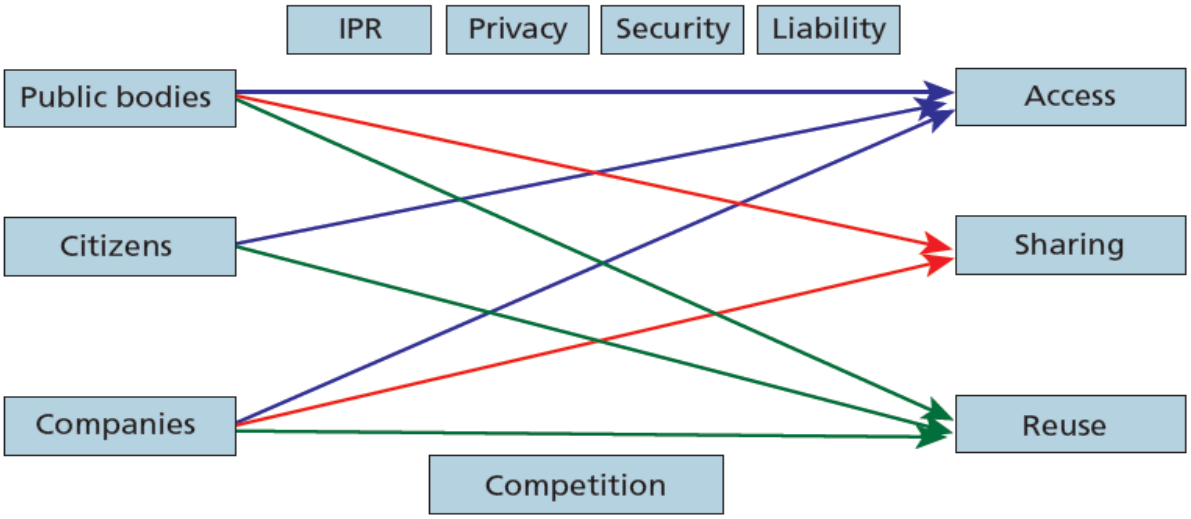


Figure 4: Information policies affecting the EU SDI, adopted from Janssen and Dumortier (2007)

Despite large investments in geographic data development by government and the private sector, there is often a lack of knowledge of the complex policy-related issues arising from the community-wide creation, compilation, exchange, and archiving of large and small spatial data sets. The ownership of digital geographic data, protection of privacy, access rights to the geographic data compiled and held by governments, and information liability are concepts that require greater clarity in the new, automated context(Onsrud et al., 2004). In similar cases dealing with establishment of data infrastructure, Rajabifard et al., (1999) indicated that in addition to the basic core components of SDI, development and implementation at a regional level are affected by external factors. Figure 5 depict both specific factors which is the four components and the external factors as foreseen to be influencing factors for the development and implementation of regional spatial data infrastructure.

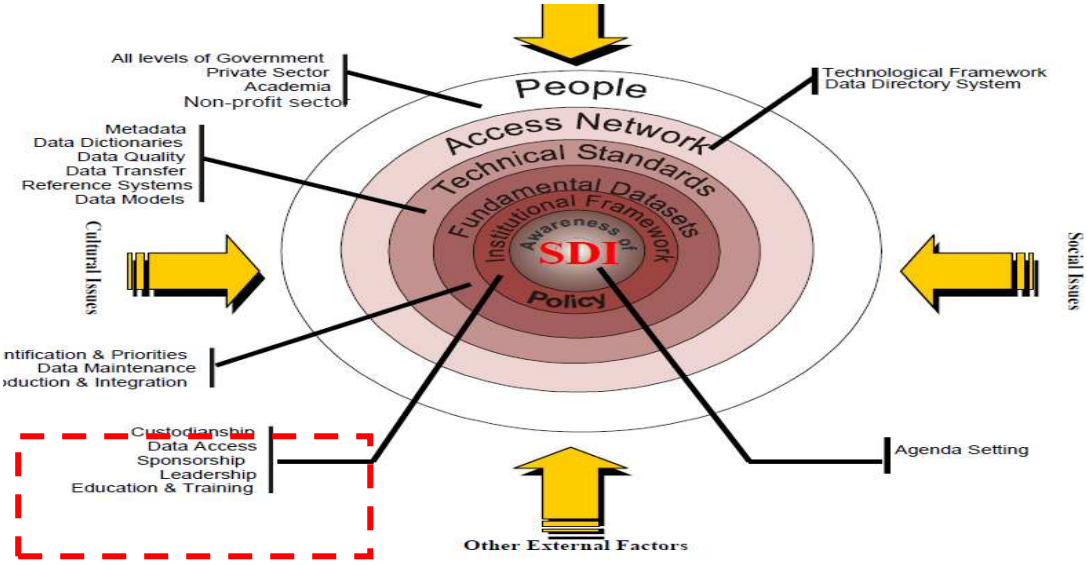


Figure 5: Factors influencing Regional Spatial Data Infrastructure, adopted from Rajabifard et al., (1999)

Development and implementation of a regional SDI is a connection of existing local and corporate SDIs, therefore understanding and considerations of existing local and corporate structure and their institutional arrangements (policies) is crucial as fundamental factors for success of SDIs at any level. Absence of the policies as a component is a hindrance, but incompatibility of existing policies can also be an obstacle especially in cross-border initiatives.

On a general note, Ginzberg (1980) concluded that; it is apparent that certain organisational characteristics are likely to have an unfavourable impact on IS success for all IS which cut across sub-unit boundaries. Pointing out that, these characteristics inhibit true user participation in system design.

A study on Transnational Information Systems (TIS) across Europe also revealed that the development and management of interorganisational information systems can be inhibited by the existing technical, organisational or institutional settings. Out of the many issues pointed out in the research, the author stated that *"(Potential) participants of the TIS can have disagreements about different legal requirements concerning data and privacy in various countries, technical matters or policy with parties outside the TIS and such disagreements can affect the ability of the participants to participate fully"* (Cavaye, 1998). He then concluded that "*A system that is sound from a technical point of view may turn out to be not feasible owing to institutional issues".*

2.3. Data Accessibility, Availability and Policies

Many national, regional, and international programs and projects are working to improve access to available spatial data (GSDI, 2004). However, many are not labelled "SDI project" but they all carry the same concept of making data available through a dedicated network, standards and policies and guidelines in a collaborative and co-ordinated institutional framework.

Access to data and information is dependent upon not only the availability of data but also the capacity of societies, organisations and people to use that data as well as the technologies, policies, standards and governance framework for accessing this data(Williamson, 2004). Spatial data are used by public agencies, the commercial sector, scientific researchers, community interest groups, and individual citizens for wide-ranging purposes. However, availability, accessibility and productive use of spatial data are being hampered by restrictions and conditions subject to it by individuals or organisations in position of data.

Depending on the type of user, but mostly on the purpose for which the spatial data is used, the process of accessing and obtaining data is addressed by different information policies(Janssen and Dumortier, 2007). Organisations keep different types of data which some are created within and others acquired from other organisations through different agreements, conditions and licensing processes. Comparative studies between USA open access and European cost recovery data policies were carried out in relation to the availability, accessibility and use of public data (environmental data). One of the conclusions was:

"…[c]ountries that exercise intellectual property rights over government data…limit the extent to which government-collected data can be used, even in international collaborations. By making it more difficult to integrate global data sets and share knowledge, such a commercialization policy will

fail to achieve the maximum benefits provided by international collaboration in the scientific endeavor."(Weiss, 2004).

Therefore, for Public data and information to be made more accessible there should be in place more transparent, formalized, non-conflicting and well structured policies to regulate sharing and reuse(Giff et al., 2008). This is in part, due to the fact that collection of spatial data involves a lot of effort and resources and guided by different policies in collecting, maintaining and dissemination. However, the limitation in availability and accessibility of spatial information can be attributed to conflicting inter-organizational data policies.

Thus, the focus of this research is to investigate how elements of data policies in forestry commission in Great Britain are being practiced as a basis for development and implementation of web-based decision Support Systems.

2.4. Conclusion

Literature has indicated the effects of data policies on data infrastructure development and implementation. Is evident from the literature data policies have an effect on initiatives that build and implement data infrastructure. Conclusions are pointing to conflicting policies indifferent organisations that affect the availability and accessibility of data. It also concluded that conflicting policies affects the participation of different organisation and countries in interorganisational or inter-regional initiatives.

Therefore, recommendation for prior studies, to review existing data policies for organisations wishing to enter into interorganisation initiatives. This research focused on examining the existing data management policies for forestry commission in Great Britain as basis for the development and implementation of an interorganisation web-based Decision Support Systems in northwest Europe. The empirical findings on data policies are reported in chapter 3 below.

3. Methodology

In order to achieve the outlined objectives in chapter 1, different data collection methods were employed. This chapter describes the research methods and approaches employed to gather empirical data about data management policies and practices in Forestry Commission, Great Britain.

3.1. Introduction

The research began with literature review on data policies as one of institutional factors that influence data management practices in the organisations in relation to availability of and accessibility to data. Review of literature on appropriate research approaches within the domain were carried out.

A case study approach was selected for this research due to the three locations of data collection.

Data collection started with gathering information regarding the Data Management Policies, organization structure and its IS applications, through informants of the organisation and official documents such as organisational Charts and Policy documents. During a three-week field visit, data collection was mainly done by documentary study and interviewing, which addressed interviewee's opinions about the pre-defined variables as well as semi-structured open-ended questions. Other data came from, onsite observation and access to the organisation's intranet. Follow-up e-mails were sent to gather further clarifications and supplementary information.

The research in a chronological order followed these steps: defining case study question, case study design, preparing to collect case study evidence, collecting case study evidence, analyzing case study evidence and reporting case studies(Yin, 2008).

Evidences from all sources will be listed and produce an integrated conclusion that answer the main research question. The outcome of the research is a report with empirical evidence answering the research question from information gathered from real-life experience or observations(Kumar, 2005).

For the purpose of this research, case data are analysed together because of the single spatial data policy document that guide their practices and data management issue are dealt with at great Britain level.

3.2. Case Study Framework

This research is based on ForeStClim an EU-funded environmental project addressing forests and climate change (http://www.forestclim.eu/). The projects aimed to develop cooperation and forestry management strategies amongst North West European countries in response to climate change impacts adaptation. One of the main action plans is to develop a common framework for decision support system within partner countries for assessing the impacts and adaptation response to climate change in the forestry sector. The project covers three states; United Kingdom, Germany and France with specific forests as pilot areas.

This research focused on forestry commission organisations in Scotland, Wales and England (Great Britain). These three countries were selected due to the assumption that each country has a different

legal framework within their jurisdiction and could have an influence on the data management policies in the three forestry organisations.

The study area is Great Britain; the case study locations are the three forest organizations in Scotland, Wale and England.

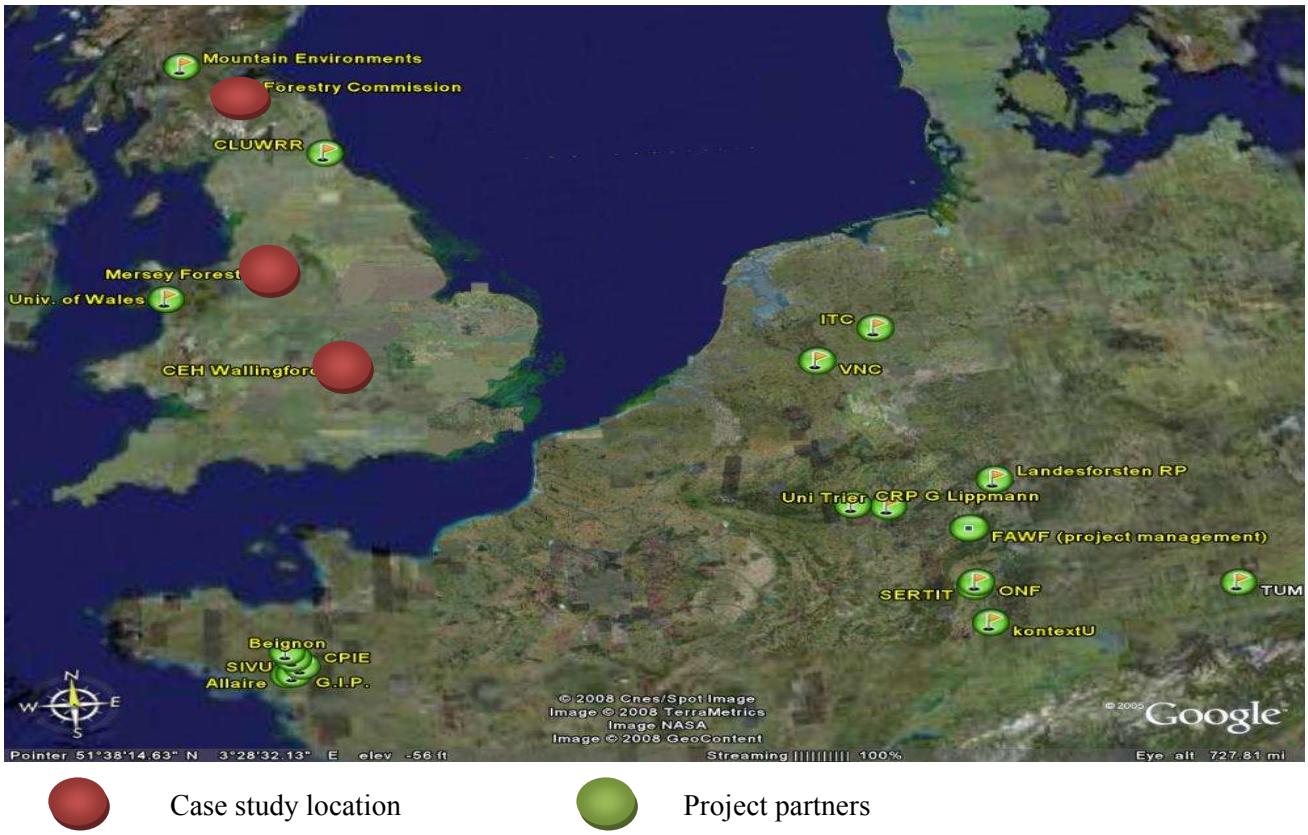


Figure 6: Study Location map

Understanding how organisations manage their data and what kind of data management policies, guidelines are in place is a crucial component of any inter-organisational initiatives aimed at developing and implementing a data intensive system. Policies and guidelines affect the collective goal of making data available and accessible in many different ways. Economic and legal scholars have argued that the current, relatively open, access-to-data environment is beneficial to advancing knowledge and the economy(Van Loenen and Onsrud, 2004). However, little empirical evidence exists to highlight the extent to which various data availability and access policies environments' do or do not contribute to the innovation for development cross-jurisdiction data infrastructures. This research is aimed at investigating various data policy elements or principles, how they are incorporated in data management practices and the likelihood that they can influence the design and implementation of web-based decision support system with a case study of forestry organisations in Great Britain.

3.3. Literature review

A literature study was used to explore existing studies on factors influencing the development and implementation of Data and/or information Infrastructures. There are no literatures specifically relating Decision Support Systems (DSS) and data management policies. Literature on DSS had focused on its application and the technical aspects required for its development. However, a lot have been written about (spatial) data infrastructure and information systems in relation to data and the management policies that guide its availability and accessibility. Therefore, references are made to both data policies in relation to spatial data infrastructure and information systems.

3.4. Research Organisations and Participants

The research targeted forestry management organisations in Scotland, Wales and England (Great Britain). Potential respondents (19 people) were initially identified and sent an e-mail invitation to participate in the research during my field work. They were provided a link: http://www.doodle.com/4ky4z9bd9bmk5v3r, to a site where they can indicate their availability and preferred dates. Only 7 people filled in their availability. A second e-mail was sent and telephone follow-ups were made. Then a follow-up email requesting for the interview was sent to each candidate who indicated their availability. See the content in **appendix B**; however, only eleven (11) people were interviewed. These includes, 3 country GIS managers, 2 information services at Great Britain level, 4 data managers at Great Britain level, 1 intellectual property manager Great Britain level and 1 software developer, Great Britain level. These were mainly people who deals with database or systems Administration data acquisition and management or who deals closely with software, hardware and data repositories in the organisations. They are heads of operational departments that over sees the daily acquisition, use and exchange of spatial data in regards to compliance or non-compliance to guiding regulations. In Forest Research, there are in-house developed desktop Decision Support Systems, therefore interview, with the Software Developer is carried out to get empirical data on experiences and factors of data availability and access policies that influences the development and implementation of these tools.

Respondents were selected depending on their positions in the organisation and were perceived to be in good position of providing relevant information concerning data policies and practices within their respective operational departments. Table 2 presents respondents to in this research.

Table 2: Interview Respondents

Code	Position	Location	approach	Data
01IM	Mapping & Geodata Programme Leader(IFOS and M&G)	Forestry Commission	Interview	Audio record + Rough drawing of SDR structure
02EW	Forester GIS Manager(Operational Support)	Forestry Commission	Interview	Audio record+ Rough Drawing of FC structure
03SM	Infrastructure Manager(IS)	Forestry Commission	Interview	Audio record+ Digital copy of Division Activities
04DS	System Development Manager(IS)	Forestry Commission	Interview	Audio record
05CM	Intellectual Property Right Manager	Forest Research	Interview	Audio record + filled in questionnaire(Hardcopy)
06DH	CGIS Manager Scotland	Forestry Commission	Interview	Audio record + filled in questionnaire(Hardcopy)+ Rough Drawings
07SB	Software and IT Support	Forest Research	Interview	Audio record + filled in questionnaire(Digital copy) + Rough drawings
08PB	CGIS Manager	Forestry Commission England	Questionnaire	Questionnaire (Digital copy)
09ML	Head of Survey, Measurement and Remote Sensing(IFOS)	Forest Research	Interview	Audio record
10GM	CGIS Manager(Wales)	Forestry Commission Wales	Questionnaire	Questionnaire (Digital copy)
11PT	Head of Data Centre	Forest Research	Questionnaire	Questionnaire (Digital copy)

3.5. Operationalization of policy concepts

The institutional arrangements in question in this research are the data management policies, regulations and practices of the organisation over acquisition, use and allocation of (spatial) data. The data management policies and practices can be operationalised as follows: examining the existing procedures of data acquisition by the organisation from external sources, looking at whether the data is freely available or charged for. Secondly, looking at the conditions attached to the data for use and

pass on to 3rd parties. Examples licensed, contract agreements, copyright and privacy. Other elements are concerned with custodianship of and access restrictions to the data. These elements are selected on the basis of their significance in data infrastructure development and implementations as can found at all level of governance (GSDI, INSPIRE and EUROGIS, PSI). Their relevance is strengthened by how they are being practiced in the organisations in relation to data collection, analysis and distribution. Empirical evidence is obtained from organisational documents with the complementary evidence from semi-structured interviews and questionnaire.

Interpretation is based on the contents of policy documents and the interview scripts and observation notes. And, this will help to establish the significance of data policies and how it can influence the development, implementation and institutionalisation of the web-based Decision Support Systems (DSS) that is underdevelopment in ForeStClim project. The methods for data collection are explained below.

3.6. Secondary sources

3.6.1. Documentary study

To examine and understand the existing data management policies, guidelines and regulations; documentary study was carried out as a source of evidence for this research. Several digital administrative documents and regulatory principles on Forestry Commission (FC) data management policies were made available to on the first week of fieldwork. Organizational charts were presented and explained which helped in understanding the forestry organisation structure and operational divisions in relation to data flow, management and processing practices. This was relevant and useful in this research as it contributed to the understanding how different department and divisions are involved in data handling practices and how they practically implement the content of forestry data policies. The main document is the Forestry Commission Data Policy; it stipulates how different data policy elements, regulations and conditions are to be implemented in relation with FC data Acquisition, Management, Supply and data Owners and Custodianship. Table 1 below, contains some of the collected relevant documents and a summarised stipulation from their content. UK Data Protection Act 1998 and Freedom of Information (Scotland) Act 2002 were referred to as freely available online.

Table 3: Secondary data collected

Document Grouping	Document Name	Content
Forestry Commission	Spatial Data Needs FC(Report,2004)	Recommendations for developing policy and practice in spatial data management and use from the FC spatial review group
	Decision Tree for the Supply of Spatial Data	Depict the decision procedures; how considerations are made by Forestry Commission staff in supplying data to third parties

	Forestry Commission Spatial Data Policy	Explains the different data policy elements, regulations and conditions in relation with FC data Acquisition, Management, Supply and Custodianship.
	Licence for the use of Forestry Commission Data	Form to be filled in (…….): Names of Contractor and Licensor, reason for data acquisition and descriptions about the type of the data and the specific conditions subject to its use, pass on to third parties, or alterations.
	Departmental Business Plans(IFOS and IS)	Description of the objective and activities for the respective departments.
	FC Metadata Policy	Description of the metadata standards (ISO19115), and responsible persons for metadata for different datasets with some exceptions.
Ordnance Survey	Contractor Licence of Ordnance Survey Data	To be filled in (…….): names of the Licensor and contractor. And descriptions of agreements and conditions to which the dataset involved is subjected to.
National Policy	Freedom of Information (Scotland) Act 2002(online) Environmental Information (Scotland) Regulations 2004(online)	Stipulation of entitlement for access to public information and the conditions attached to it. Access to environmental information held by public authority by electronic mean which are easily accessible.
	UK Data Protection Act 1998(online)	Stipulation of personal data protection principles. Definition of which data is personal or sensitive and conditions that information is subjected to.

3.7. Primary sources

3.7.1. Interviews

To understand the relationship between the above-mentioned documents (policies) and their incorporation in the day-to-day data management practices, semi-structured interviews with predefined leading questions were carried out. Interviews were mostly guided conversations rather than structured queries. This approach was deemed relevant to provided empirical data and facts by respondents who are part of the organizations' management and operational divisions. Respondents

are selected based on their positions and responsibilities in forestry commission organization. It was assumed they are more involved in the managements, operations, administrations and understand the concepts of forestry inventories, data policies, guidelines and practices associated with them. Interview questions were formulated around seven(7) main themes: Datasets, Databases and desktop tools, availability and accessibility, intra-organisation relations, inter-organisations, Intellectual property rights and overall related questions depending on the contents of the policy and other additional information. This method was selected because it enables me to interactively communicate with the people who are the implementers of the policies and helps to uncover issues and relationships not envisage prior to starting data collection.

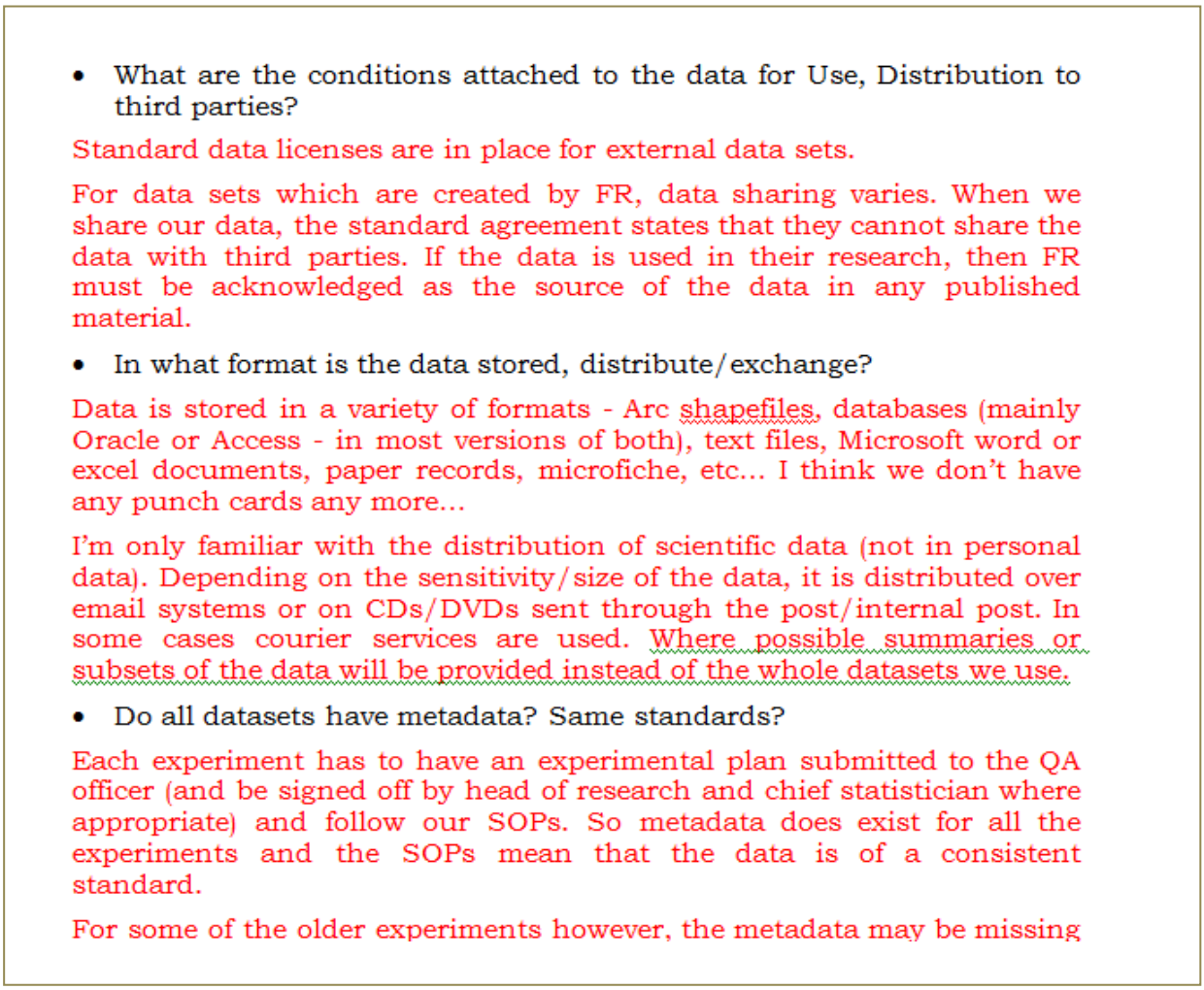
3.7.2. Questionnaire

Specific questions were developed for each element of study in an attempt to acquire enough empirical data and information from respondents to determine how they incorporate the policy document contents in data management and processing practices and how they perceive inter and intra-organisation data sharing in relation to different data policy elements.. This approach was engaged due to busy schedules and unavailability of pre-identified respondents. Fortunately, forestry organizations in Great Britain have only one data policy and that clearly proved most of the answers were similar to a large extent. However, there was slightly interesting differences based on departmental operations.

The questionnaire consisted of eight sections. The first section is a cover page with a general ethical statement, and personal information (e.g., name of the interviewee, interviewer, Position and Date). The position of the respondent was necessary because it help to understand the answers and their perspective. The second section, dataset specifics, this section was intending to elicit information about the type of datasets held by the organization, who are the originators, quality of the documentation(metadata),among others, this help to understand different datasets and who are the custodian and what are the conditions attached to it. Specific questions were based on one or more of the policy elements example pricing, copyright, custodianship and privacy. See **appendix A** for all the questions used in the questionnaire.

The questionnaire was distributed through emails and the respondents filled it in themselves and sent it back. Similar to the interviews, the questionnaire contained questions related to the policy documents.

Respondents were requested to explain their answers as much as possible, of which they did as shown in the extract below. Upon completion, questionnaires were sent back as email attachments. The information provided through the questionnaire together with data collected through other approaches are analysed and incorporated in the chapter describing the empirical nature of data policies in Great Britain.



- What are the conditions attached to the data for Use, Distribution to third parties?

Standard data licenses are in place for external data sets.

For data sets which are created by FR, data sharing varies. When we share our data, the standard agreement states that they cannot share the data with third parties. If the data is used in their research, then FR must be acknowledged as the source of the data in any published material.

- In what format is the data stored, distribute/exchange?

Data is stored in a variety of formats - Arc shapefiles, databases (mainly Oracle or Access - in most versions of both), text files, Microsoft word or excel documents, paper records, microfiche, etc... I think we don't have any punch cards any more...

I'm only familiar with the distribution of scientific data (not in personal data). Depending on the sensitivity/size of the data, it is distributed over email systems or on CDs/DVDs sent through the post/internal post. In some cases courier services are used. Where possible summaries or subsets of the data will be provided instead of the whole datasets we use.

- Do all datasets have metadata? Same standards?

Each experiment has to have an experimental plan submitted to the QA officer (and be signed off by head of research and chief statistician where appropriate) and follow our SOPs. So metadata does exist for all the experiments and the SOPs mean that the data is of a consistent standard.

For some of the older experiments however, the metadata may be missing

Figure 7: Extract from one filled-in questionnaire

3.7.3. Observations

Observation of existing artefact was carried out as a supplementary source of evidence as one component of the study problem is linked to the existence of technology and how they are being used in relation to data management policies. Therefore, observation of the technology and its inclusion in the office data management practices is an invaluable aid for understanding the interplay of databases and data policies. I observed the database contents; schemas and themes under which different datasets are stored.

3.8. Preparation for Data Analysis

After data collection, data consistency was checked during fieldwork and follow-ups especially with respondents through questionnaires were done where abbreviations were used. Audio records were transcribed in digital word documents and the responses are categorised under the main themes as predefined. Similarly, rough sketches that were drawn by interview respondent in attempt to illustrate the relationship between their divisions and/or operations and other divisions' are scanned and categorised under different predefined themes as the respondent explained while drawing. Example sketches that illustrate the different data themes in the Spatial Data Repository (SDR), these at the same time can also be interpreted as data sources with the aid of audio recorded explanation

(transcripts). The data will then be presented in chapter 4 below under different themes and analysis in the discussion and conclusions.

3.9. Fieldwork limitations

Fieldwork was carried out in an organisational set-up, where pre-identified respondents were busy with their day-to day activities; therefore arrangement of interview appointments was not easy. Some postponed and some were too busy for face-to-face interviews therefore preferred questions to be sent to them instead. Some identified respondents were on leave for the whole months, thus only used the questionnaire. Overall, respondents have shown knowledge and interest in the subject matter.

3.10. Conclusion

This chapter have provided a summary of activities and research methods employed during data collection phase. From the literature, data management policy elements were identified and helped in formulation of leading questions for the interviews. As indicated in this chapter, data collection was done through face-to-face interviews, questionnaire, documentary study and direct observation. A combination of this approaches helped to understand the existing data policy and the relationship between the policy document and the actual practice. These approaches complement each other in therefore ensure a complete data at the end.

Documentary study was used to study what the organisations data management entail, but was not enough to confirm whether what is in the documents was the same as the actual practice of day-today in the organisation. Therefore, interviews and observations were used to gather empirical evidence on how the organisation manages its data in relation to acquisition, use, access and supply. Questionnaires were used to reach respondents who were in far locations and those did not have time to sit for interviews. Responses from questionnaires have some short comings due to the fact that I could not ask follow up questions at that same moment for clarifications. An observation was used to observe the existing artefact in terms of hardware, software that contributes to access and availability of data e.g. web browsers, servers, and information posters on the walls. Also, observation helped with interpreting the reactions of the respondents during interviews. The data collected with the above-mentioned methods and approaches are presented in chapter 4 below.

4. Findings

This chapter presents the findings of this research on data management policies and practices in Great Britain under the different headings as it was collected in the field. I will describe the existing data management policies and practices in relations to data acquisition, supply and use in forestry commission and explore the extent to which data management policies and practices in Great Britain can influence the development and implement of web-based DSS in North West Europe.

4.1.1. Organisational Settings

Forestry Commission is a government department responsible for the protection and expansion of Great Britain's forests and woodlands. It provides advice and support to the UK Government through the Department of Environment, Food and Rural Affairs(DEFRA) and to the devolved administrations in England, Scotland and Wales(FC, 2009). Forestry Commission Great Britain has six (6) main operational divisions; Human Resources (HR), Information Services (IS), Inventory for Forecasting, Operation and Support (IFOS), Forest Research (FR), Forest Enterprise (FE), and corporate and forestry support (CFS) figure 8 represents the diagram composed as a result of the rough drawings from different interview respondents and the organogram presented during the introduction week. These operational departments provide services and support to the three devolved country forestry offices (Scotland, Wales and England). Furthermore, in each country, there are forest districts offices where most of the projects and surveys; example National Forest Inventory (NFI) are being implemented from.

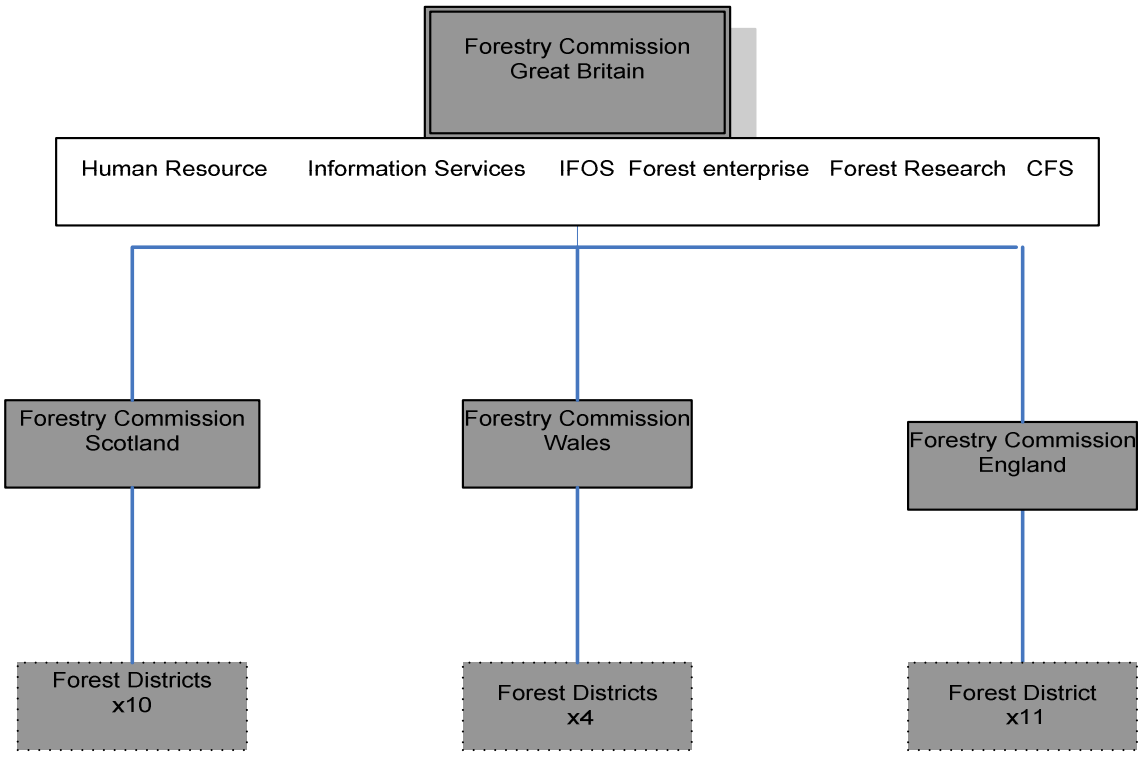


Figure 8: Forestry Commission Organisational structure

Forest Research is an agency of Forestry Commission, divided into 3 scientific research centres (divisions); Centre for Forest Resources and Management, Centre for Forestry and Climate Change and Centre for Human and Ecological Sciences. Forest Research conducts forestry and ecological researches at Great Britain level; carry out environmental experiments in relation to forest growth and suitability site classification so as to provide information to the planning and forestry management divisions and decision-makers for informed policy formulation. The overarching operational divisions have different goals and objectives as evident from the divisions' "Business Plans" obtained from the field. However, all divisions make use of spatial data from the central Spatial Data Repository in one way or another.

The Inventory for Forecasting and Operation Services(IFOS) is responsible for most of spatial data acquisition, management and maintenance at Great Britain level, however different operational divisions has personnel responsible for the management of all datasets created and used within their respective division.

Therefore, examining the relations between the organisational structure and its operations was crucial in understanding the flow of data and the role of data management policies within the organisation and with external data providers. Most importantly, it helps with identification of custodians of each dataset.

4.1.2. Spatial Data Policy for Forestry Commission

This section presents some points from Forestry Commissions' policy document. The fundamental step for any organisation that deals with data or information and wishing to implement good data management procedures is to define a Data Policy(FC, 2008). A policy is a plan of action adopted by an individual or organisation. The data management policy component of an organization ranges from different agreements, arrangements and guidelines in place to increase awareness and good practices in data management.

The policy framework for the model of availability and access to data collected and created by Forestry Commission, whether public or private, covers the acquisition, safe keeping, management, use, sharing, exchange and disposal of all FC's spatial data(FC, 2008).

The following are stipulations how Forestry Commission plans to manage its data in relationship with other organisations. The points in this list are selected due to the space and their relevance to this study. The whole document is available in a digital format.

"POLICY MANAGEMENT"

1. *The FC by means of the FC Spatial Data Group will review and, if necessary, revise its Spatial Data Policy periodically;*
2. *The FC will monitor and take account of any new corporate "position statements" that may affect its Spatial Data Policy;*
3. *The FC will monitor and take account of any new external policies or initiatives that may affect its Spatial Data Policy;*

4. *The FC Spatial Data Policy will take precedence over any more local data policies;*
5. *The FC Spatial Data Policy will apply to all FC spatial datasets, whether material, analogue or digital;*
6. *The FC Spatial Data Policy will cover datasets created internally and those obtained from external source(FC, 2008).*

"DATA ACQUISITION"

With regard to the acquisition of spatial data the following selected quotes from the Forestry Commission Spatial Data Policy applies:

1. *1."before the start of any project that consideration be given to creation of robust data models appropriate for the business requirements to which the data will be put and that consideration is given to future interoperability with other data and systems";*
2. *"That those acquiring data from 3rd parties consider the wider need within the organisation and licences the use of the data for use throughout the entire Forestry Commission";*
3. *"that, before the start of any project that involves the acquisition of spatial data, due consideration be given to the "post-project" stewardship [including IPR aspects] of data collected, acquired for or produced by the project" (FC, 2008).;*

"DATA SUPPLY"

With regard to the supply of spatial data to third parties, the Forestry Commission:

1. *Will play due heed to the guidelines in the Spatial Data Decision Tree published on eConnect when considering supply of FC and non-FC datasets to 3rd parties; see* **Appendix D**
2. *Will, under appropriate end-use conditions, exchange spatial data for purposes where it is clear that this will lead to a contribution to knowledge or objectives within FC's remit, or to benefits in kind;*
3. *Will regard data as a potentially tradable asset for reciprocal exchange agreements with non-Governmental organisations, without prejudice to current contractual arrangements;*
4. *Will ensure completion of appropriate FC Spatial Data Licences or Ordnance Survey Contractors licences(FC, 2008).*

"DATA MANAGEMENT"

According to the Forestry Commission Spatial Data Policy, With regard to managing its spatial data holdings, the Forestry Commission:

1. *Will have defined points of contact, Data Managers and Custodians, associated with each dataset, with whom agreement must be reached as part of the planning for any new activities that may utilise such datasets, so that the full implications, in terms of data management can be established at the outset. (The roles and responsibilities of Data Managers and Custodians are defined in Section 8);*
2. *Will maintain appropriate metadata records for all spatial data holdings in accordance with Forestry Commission's Metadata Policy;*

3. *Will ensure that spatial data adhere to British, European and international standards and classifications, unless there are specific reasons for not doing so, in which case these reasons will be explained*;
4. *Every spatial dataset held within the FC, whether created/captured within FC or acquired from an external Data Provider, must have an FC Data Owner.*
5. *At a corporate level any dataset created or commissioned anywhere in the Forestry Commission is owned by the FC, and the FC has legal rights over that data, including intellectual property rights and copyright. In practice this corporate ownership is delegated to the individual parts of the organisation such as the Countries or Service Boards(FC, 2008).*

4.1.3. Data management issues arises from interviews

The forestry sector encompasses a wide range of different datasets and information from communities' of ecologists, social scientists, and geographers - yet in many cases it is discrete in that it has its own structures, its own governance and funding mechanisms. Therefore, knowledge and understanding of the different data sets in forestry commission was necessary to know which data exist, who owns it and under what condition of access, use, exchange and distribution it is held. This is more so especially when embark on an interorganisational, web-base system, where various people from different organizations and countries' jurisdiction will have access to the data and data analysis services. Hence, this section outlines information regarding data sets in Forestry Commission as gathered from the field. With the purpose of

Data ownership

The ways used to protect a dataset, provide access and any other action that in regard to a certain dataset depends on the owner. Ownership of data implies having rights to control the data which comprises of a complex set of rights: rights to use, sell, rent, give away, abandon, consume, or even destroy(Van Loenen, 2001). According to forestry commission's spatial data management policy, *"there are operational roles and responsibilities and are aimed at individuals/posts rather than at a corporate level"*. The 3 roles are; Data providers which are referred to as the source of datasets acquired from outside the Forestry Commission. This can be for datasets that have been purchased, e.g. GetMapping, Ordnance Survey, or for datasets that have been given free of charge from other organisations, e.g. SNH, Utility companies. More than 50% of the respondents perceived that a proportion of 25% of the data used in forestry commission is created in-house, whereas 75% of the data is acquired from external sources. Furthermore, respondents felt that of the 75% external sourced data, a large number is from government departments through the Pan Governmental Agreement[2].

[2] The Pan Government Agreement provides central government departments with access to a wide range of Ordnance Survey digital map products. The PGA is a 3 year agreement that started in April 2003.

Data owner are individuals or post in whom responsibility has been vested by the FC for the managerial and financial control of the data. According to forestry commission data policy *"Every spatial dataset held within the FC, whether created/captured within FC or acquired from an external Data Provider, must have an FC Data Owner"*. Some of data owners' responsibilities worthy noting are:

- To ensure that the dataset is managed in accordance with FC Spatial Data Management Policy;
- To define access restrictions (for viewing, editing and deleting) and security requirements for the dataset;
- When the dataset is to be released outwith the FC, to define terms and conditions of release, including charging and IPR;
- Ensures that metadata exists to standards specified in the FC's Metadata Policy

Data Custodians are individual or post given responsibility and accountability for the day to day management and maintenance of a spatial dataset within the FC. Their responsibilities include:

- To ensure that the dataset is managed in line with the defined access and security requirements;
- To ensure that when dataset is released outwith the FC it is done so within the defined policy, terms and conditions and that an appropriate data licence agreement is in place;
- To ensure that any infrastructure implications of storing and accessing the dataset are considered and addressed;
- To draw up metadata to standards specified in the FC's Metadata Policy.

At a corporate level any dataset created or commissioned anywhere in the Forestry Commission is owned by the FC, and the FC has legal rights over that data, including intellectual property rights and copyright. Other datasets, particularly Ordnance Survey data is licensed with conditions of use stated in the license document.

A significant amount of data is acquired from external sources, therefore, it is deemed crucial for any organization or agencies wishing to embark onto initiatives involving data with FC to take notice of the existing contract and agreements between Forestry Commission and its external data providers depending on the data sets required. It is also important to know the data provider in case an additional query beyond the corporate owner arises.

Data Pricing

Under this section answers to questions relating to whether forestry commission has a data charging policy and whether they pay to get data from external providers are outlined. In the spatial data policy there is no a clear mention of charging for data, but there are observations made with regard to the acquisition and supply of spatial data to third parties. The following statements are worthy noting:

- With regard to the acquisition of spatial data the FC will determine initial costs of data capture and the costs relating to ongoing, potentially long-term, data management, once data have been collected;

- In managing its spatial data holdings FC will facilitate access by staff to spatial data holdings, on the basis of appropriate end-use and onward dissemination conditions, and charging/licensing arrangements;

- With regard to the supply of spatial data to third parties FC Will regard data as a potentially tradable asset for reciprocal exchange agreements with non-Governmental organisations, without prejudice to current contractual arrangements;

These statements are selected only on the basis that there are financial aspects mentioned in them but not necessarily that prove that forestry commission have a data charging policy.

The following are views from interview respondents:

Majority have indicated that they pay in some occasions to acquire data from external sources; especially data from private organisations.

On the other hand, when asked whether Forestry Commission has a data charging policy? The general response was: "*FC does not have a charging policy: data is funded by government*". But majority of respondents have indicated that the practice is different depending on circumstances, as quoted:

06DH *"Generally data is not charged for- if ever a charge is made, it is likely to be purely for administrative charge involved in burning CD etc"*. in the same line, respondent **08PB** indicated that: that: "*In most cases any charge would be covering administration only and the cost of generating the orders is not worth the bothe*r". As we are government we can't really be seen to profit from public data".

"Some data is commercially sensitive. If the data has been partly obtained outside the organization, then other restrictions may apply. Other restrictions apply on a case by case basis" **11PT**.

Responses vary though from individuals in different operational departments. **07SB, 11PT** indicated that a "*data charging policy is underdevelopment* and further explained *"there are some datasets that have a modest commercial value but these often have relationships with data from other suppliers (…….), charging is often to facilitate the cost recovery of serving the query rather than paying towards the creation of a dataset".*

Respondent **11PT** have indicated that "*Under Environmental Information regulation (EIR) and Freedom of Information Act (FOI), we're often obliged to supply data at minimum costs. As a crown body, we're obliged to send data to other crown bodies without charge".*

"……we don't charge anymore, not at the moment. Because of the credit crunch and finances are changing. That might change in future, they may not…..but because we are public body there is a big incentive that we should not charge"

The general impression is that, there is no a data charging policy in forestry commission Great Britain. However, there is payment for administrative work involved in data provision. Payments are done on the depending on the medium, the type of dataset and analysis process. There is an indication also that payment depends on individual cases: example is the last statement (this section 4.1.3.2) from the policy document which states that: "*data is regarded as a potentially tradable asset for reciprocal exchange agreements with non-Governmental organisations".* This means that when dealing with non-governmental organisations, a charge is considered. Respondents also explained that charging can be as a result of influences from other pattners in the project. An example was given where Forestry Commission is involved in a European project "COST E43" (http://www.metla.fi/eu/cost/e43/index.html) that aimed at "improving and harmonising the existing national forest resource inventories in Europe". The respondent has indicated that the project is faced

by a lot of data management policy issues. Some of the partners are charging for the data, therefore influence others.

Access standards

Data on the Spatial Data Repository are said to be the master datasets, therefore can not be edited. Access is controlled by a password mechanism depending on the individuals' position. Consequently, working datasets are stored on individuals' computers. All datasets are subjected to some form of use; distribute conditions depending on its to be agreed up on with one or all of these individuals: provider, owner and custodian, where they have to agree to the proposed purpose for acquisition. Respondents indicated that all datasets held on SDR has metadata with the standard: ISO 19115. But "*due to many data providers and data predate the emergence of good practice guidance*"**07SB,** some data do not have metadata and some datasets are as a result of research experiments, therefore have in-house metadata format.

4.1.4. Data management in relation to national and international laws

This section present and discuss findings with regards to the involvements of national and internal policies in data management in Forestry Commission as perceived by the responded. Forestry Commission is a public organisation; therefore, its operations are guided by the respective country, UK and international policies. Respondents indicated that as a public body, its operations concerning data supply is within the limit of Freedom of Information (Scotland) Act 2002 and UK Data Protection Act 1998. The Freedom of Information (Scotland) Act 2002 states: *An Act of the Scottish Parliament to make provision for the disclosure of information held by Scottish public authorities or by persons providing services for them; and for connected purposes(OPSI, 2002).* This act made provision for Forestry Commission to provide requested data by any person free of charge or with minimum cost as calculated(OPSI, 2002).

The UK Data Protection act 1998 states: *An Act to make new provision for the regulation of the processing of information relating to individuals, including the obtaining, holding, use or disclosure of such information(OPSI,* 1998*)* .The UK Data Protection act 1998 is used in relation to the Grant Scheme data. This scheme helps individuals towards the cost of planting and managing their woodlands. Hence, the personal information of individuals who benefited from the grant and the amount is kept by Forestry Commission. Furthermore, the act is applied to the management of data associated with protection of endangered tree species (native species) in Great Britain. Majority also mentioned the Environmental Information (Scotland) Regulations 2004 which came into power in January 2005. "This regulation is from the European Directive on access to environmental information and it gives everyone the right to ask for environmental information held by a Scottish public authority" (SIC, 2004).There is equivalent legislation which covers the rest of the UK, which is enforced and promoted by the UK Information Commissioner.

Table 4 represents a summary of different data management policy elements that were predetermined before fieldwork and filled in with information from the field on how they are implemented. Some of the information is provided by respondents and other from documents.

Table4: Elements of Data Management Policy (compiled from various sources)

Policy Element	Source	How it implemented?
Intellectual property right	Spatial Data Policy(confirmed through interviews)	All Data, in all Formats, Tools"© Crown Copyright. All rights reserved [year]".
Pricing	Interviews	Public data "No charging" only Administrative charges. Other charges depend on individual cases.
Access restriction	Interviews and Observation	Depending on individuals and their position access is Password controlled
Open and unrestricted access	Interviews, Observation, Freedom of Information (Scotland) Act 2002	Intranet Web-browsers(available to view) National Inventory Survey(final document available on internet)
Network and system restriction	Interviews	Forestry Commission Network, need to apply for permission to the head of IS
National security and privacy laws	Interviews and UK Data Protection Act 1998 CHAPTER 29	Mostly applied to the Grant Scheme and endangered species data (attribute restriction)
Metadata and database standards;	Interview and FC Metadata Policy	To a large extent All Spatial datasets especially "SDR" "corporate data" have metadata ISO19115 Database packages Oracle spatial (Proprietary) and MS Access
Re-use	Interviews and Contractor Licence of Ordnance Survey Data, Licence for Forestry Commission Data	License form to be Filled in by contractors and other 3rd parties; see Appendix

Data format	Interviews and FC Spatial Data Policy	Vector data Shapefiles, imagery, Raster, statistical Standard for Forestry Commission at Great Britain level, may find other format at districts level
custodianship	FC Spatial Data Policy and interviews	All datasets has an in-house data owner and responsible person in the source organization.

4.1.5. Issues relating to Database management system

Databases (repositories) and desktop tools are important components of DSS for the access, analysis and storage of spatial data and related services in general as facilitated by technology. Each organization stores its data in its own database which results in a number of heterogeneous data types and database systems with condition of access and use attached on it. These includes standards for databases packages, interfaces and internet network systems for access and distribution and data analysis tools to carry out spatial and non-spatial analysis.
Empirical Information on the existing database management system, structure, and standards policies in Forestry Commission Great Britain are crucial for the expansion of organisational DSS to a web-based interorganisational DSS.
Data is stored under different server boxes in a proprietary database packages Oracle with Arc SDE. The official data analysis software or tool is ArcGIS with an additional special extension "Forester". Due to extensive, various rising needs from different research projects, individual operational divisions especially in Forest Research, additional semi-open-source tools are developed out of experiments. The following are responses from respondents from forestry commission and forest research on the issue of databases and application tools.

Of the 11 respondents, 10 indicated that Forestry Commission uses Oracle as its "corporate" database, "*although Microsoft Access is used locally as a result of desktop oriented initiatives which are confined to small scale use* **07SB***".* The following are views from some of the respondents as per database standards and policies:
From Forestry Commission Great Britain perspective, **"***the main database technology in Forestry Commission is based in Oracle/SDE as a "corporate" package"(….) and this means that people have to make sure whatever database they choose should have an oracle tool if spatial use"* **03SM** and **04DS**.

On the other hand, **11PT** indicated that; "In *FR, we are encouraged to use Microsoft Access for small databases (……) The FR standard is Access '97 despite it being so old and with significant security issues".* He further explained *"However, copies of 2000/2003 and now 2007 versions of the software are in use in the organisation which are required to ensure we can read Access databases supplied by external parties. For multi-user and large databases, the FR standard is Oracle. Various versions are in use on various servers through the organisation. Currently there are databases in use on Oracle 4, 6, 7.3, 8i and 10g".*

On the question about existing desktop tools respondents has this to say: *"our corporate GIS tool is ArcGIS and ArcView with various versions connecting into oracle/sde database. In addition there are GIS data processing tools, like ER Mapper, ERDAS for image processing and managing and image web-server for delivering images on web-browsers"* **03SM** and **04DS**.

"…….mainly we use Oracle and ESRI products (……..) we want to concentrate in Oracle and ESRI products because forestry commission spent million of dollars in building Oracle and ESRI infrastructure" **09ML.**

What about the tools developed by Forest research e.g. Ecological Site Classification (ESC)?
"They make use of the data that we have here at the data centre, but we have no involvement in the application (……) are this tools open-source or proprietary?: *they may develop them with open-source in mind by using open-source products, but because of the products that the rest of forestry commission use, which are (…….) ESRI products there has to be prompted to work in ArcView or ArcGIS if they are going to be use by Forestry commission staffs out with forest research. A lot of these products forest research is developing them for Forestry Commission use, but they also want to sell them to private sector, so there is a bit of dilemma I suppose(……..) Forest research have an unfortunate habit of going away and developing something without really thinking how it will be used in the organisation"***03SM** and **04DS**.

The quotes reflect that there is contradiction practices between forest research tools development and forestry commission software regulations.

Appendix F illustrates an overall picture of Forestry Commission database distribution in the forest districts and the linkage between the main data analysis tool s e.g. ArcGIS (Forester) as well as the intranet web browsers to the Oracle Spatial Data Repository (SDR) via an intranet network. This structure has been drawn by one of the respondent as he tries to explain how data is stored and access within Forestry Commission. Each country is divided into forest districts and within each forest district there is an office, and each Forest District office has an Oracle database containing its datasets required for everyday operations and also datasets collected in the field for different forest surveys. The forest districts' databases are channelled to the central database (SDR) for update once a year via the internal network of the forestry commission to form a Single Great Britain Dataset. There are also National databases in the devolved countries. The Spatial Data Repository is a Database that contains base maps as well as fundamental required datasets for forest management and forestry commissions' corporate operations.
Data is stored under different schemas depending on the data source, Forestry Commission, Non-Forestry Commission, Ordnance Survey (Base Maps and Aerial photograph) and access to each of these schemas is password controlled depending on the individuals' access right.

Updating of the central database is done with datasets from all national and districts offices through file transfer mechanisms preferably once a year or depending on availability to form a single Great Britain dataset. Each office can then utilize required datasets from the central database for their own use. All district and national offices are connected to the Central database through intranet.

For this research, it worth noticing the word "corporate", this means that forestry commission has a business agreement with both ESRI and Oracle firms. The responses indicated that they have spent a lot of money to build the existing infrastructure with the two brands, therefore treat them as business partners. Any other applications that will be introduced in the organisation have to be comply and compatible with the existing systems.

4.1.6. Inter-organisation relations

This section looked at the existing relationship between forestry commission and other organisations. Information was gathered on how they acquire data from other organisations and how they exchange their data with other organisations.

Forestry Commission obtains a significant amount of its spatial data from different organisations, private sector, academic, Non-Government Organisations (NGOs) and from other government departments. Respondents from all three countries and other operational department (IFOS, Forest research) indicated that the Master maps, Imagery and topographic data were the most commonly sourced state data from Ordnance Survey a mapping agency of Great Britain. When asked if the data they acquired from the state government agencies was easily accessible?, respondents could not really give a clear answer but explained that *even if there is a policy by the governments to make data and information collected by public departments freely available*, they emphasized on the existence of licensing, copyright restriction and high cost of acquiring data especially on the Macaulay soil and OS data as hindrance to easily acquiring the data. On the separate question on the pricing of the data, respondents agreed that they do not charge for data, but indicated that it depends on what the data is going to be used for – if commercial projects, that payment consideration have to be done. "*Usually we don't - although this is based on the basis that the data is used for research only - not for commercial gain*" **11PT**.

The majority of respondents (90%) frequently mentioned the following organisations and agencies as main source of data: Ordnance Survey (OS), Scottish Natural Heritage, British Geological Survey, and Centre for Ecology & Hydrology, Scottish Wildlife Trust, Natural England, English Heritage, National Trust, British waterways, Environment agency, Welsh assembly Government and Universities. The respondents further indicated that an insignificant number of public individuals requests data on not so often occasions. This is due to the fact that datasets created within Forestry Commission are research orientated therefore, required at a high-level of decision making or for research projects.

Out of these institutions, Respondents perceived that most of their data exchange activities are done with public organisations, followed by private sector and academic institutions. The following statement(s) was an indicative of the general feeling of some respondents "*We work in partnerships with various academic and research organisations. We usually exchange data freely within those partnerships as relevant to the research"***11PT**.
Based on overall responses, it led to the question whether respondents foresee any policy or practice conflicts should forestry commission embark on an interorganisational data infrastructure initiative? Respondent felt that, that should not be a problem if it fits with European Directives' requirements. Some of the quotes from such response are:

".....FC are moving towards becoming INSPIRE compliant" **06DH.** *How does it relate to INSPIRE? (.....)Because we are working towards the big picture, which is European Directives"* **03SM** and **04DS.**

"…….. don't know how it will interact but I foresee no problems". Other respondents feel that there will be data related issues. Respondents were quoted as saying: *"There will be issues with some datasets"* **07SB. "***OS licensing will conflict with this"* **10GM.**

4.2. Conclusion

The research findings indicate that there is a single data management framework with no formal significant difference in practices. The existence of a policy document alone does not necessarily explain the inclusion of what the policy stipulates in daily data management practices, therefore empirical evidences how specific policy elements are implemented within the organisation operations' is crucial to understand. In this case the way in which different policy elements are practiced by individual operational departments is slightly different due to their day-to-day operations and needs and objectives, and some claimed to be unaware of the policy. Some slightly different issues in practice are more need to be observed before the implementation of a web-based Decision Support Systems.

5. Discussion

The main objective of this research was "to gather information on the existing data management policies and practices by forestry organizations in management of spatial datasets as a basis for development and implementation of a web-based Decision Support Systems. A web-based Decision Support System combines both aspects of technical and institutional data management arrangements. Therefore, it would seem appropriate to discuss whether organizational data management policies and practices in forestry commission Great Britain posed particular difficulties in the development and implantation of a web-based DSS in northwest Europe.
Decision-making support system has advanced over time and across disciplines. In a typical DSS, data is acquired and stored in a database and used as an input to the Decision Support System processes. The decision makers, researchers and analysts use computer interfaces to access and organize the data so as to experiment to find the best solution to the a studied problem. On many occasions, data needed to input in the system are acquired from different public and private organizations.

Throughout the paper we have argued that there is a need for knowledge and understanding of existing individual organizations' data management policies and practices for the development and implementation of an interorganisational web-based DSS. This is due to the fact that, development and implementation of a web-based DSS not only comprises technical aspects but also is supported by economic, social, organizational, and legal measures. This research explorer the policies which is part of organisational and can also include legal measure. During the development process, gaps in knowledge and data are identified as well as the feasibility and effort required to obtain this missing information. Building awareness of what is available now, in the nearby future, and in the long term, helps to manage the expectations of the different groups involved and avoids misunderstanding of what the can be achieved and not.

Therefore, knowledge and understanding of data management policies of individual organization is needed to obtain meaningful insights of the likelihood consequences, for the development and implementation of an interorganisation web-based Decision Support System.

5.1. Data policy, practices and Organisational Structure

Although Great Britain is made up of three individual countries (Scotland, Wales and England), the research has found out that Forestry Commissions operations are guided by a single data management policy across all three countries. The policy document stipulates the plan of action to be considered during data acquisition, management and supply see section 4.1.2. For some selected points that deemed relevant to this study. These are terms to be for all data managers expected to follow in their dairy practices. It then emerged that due to external factors, occasionally, the policy is overlooked in supplying of data to third parties.

Data management practices in relation to different policy elements are implemented differently in different operational departments depending on different on the project requirements. Although forestry commission Great Britain has one data management policy and support the concept of free access to public data and information for the public and free sharing with other public organizations

through Pan Governmental Agreement and other national policies in as referred to by , the strategies implemented to achieve this goal by specific operational departments are somewhat influenced by external circumstances, resulting in each case being treated with a different access and sharing manner.

Therefore, this research found out that the way in which data management practices are carried out in forestry commission are not totally a reflection of the policies but a combination of the policies, the influences of public sector sharing legislations, the nature of the spatial data market, and the activities of the different operational departments acquisition and exchange of spatial data. The above issues as they affect and influence the Data management practices will be presented and discussed in the following paragraphs:

5.1.1. Data accessibility and availability Policies

Forestry commission is a government department responsible for the protection and expansion of Great Britain's forests and woodland. Information, including spatial information, is needed for the formulation and implementation of decision-making policies. Accessibility and availability of spatial data is associated with the technical and physical functionalities. Therefore, this research found out that technically, forestry commission is fairly established and well organised internally. However, a much broader range of issues includes the institutional settings, the legal framework, the financial, physical, and intellectual accessibility of spatial information or data exist(Giff et al., 2008). Forestry Commission has a data management policy that sets a framework for access and availability of data under their holdings.

As mentioned in chapter 4 section 4.2.2, Forestry Commission spatial data policy covers four main area of data management, Acquisition, Supply, data management and Responsibilities. According to the findings, acquisition of data is done through field collection by forestry commission personnel in different operational departments. The respondents indicated that to a large extent, these are project specific data funded by government. Other data is acquired from other public departments and private organisations.

Forestry commission is a public organisation and should not charge for the data, however, respondents has indicated that due to the nature of its operational activities, there are cases when charging is necessary. The respondents gave an example of the datasets (Base maps, Satellite imagery, and aerial photographs) they acquire from Ordnance Survey office, they narrated that this data is expensive and they have paid large amount of money for its acquisition.

Imagery and topographical maps are part of the foundation data for every spatial data infrastructure. In this case the implementation of an interorganisational of a web-base interorganisational Decision support System may require the use of imagery and topographical maps. This data is acquired from Ordnance survey of Britain. According to the findings of this research ordnance survey data are paid for, therefore fall in the category that perceived to be commercially sensitive as perceived by respondents as mentioned under section 4.1.3. Therefore, sometimes products of this data are charged for.

Another example that influence charging for the data as perceived by respondents include, international projects, one respondent indicated that, projects that are funded by international

organisations example European Union requires data from organisation in all countries. Some of the organisation have charging policies or are profit orientated organisations, therefore they end up charging and they influence others. This can be an implication for the project; therefore prior knowledge of the policies and practices of all involved organisations regarding data pricing is crucial. So that a budget can be drawn up in case charging will arise. If this not well taken care at the beginning of the projects, there will be conflicting interest at the latter stage which may result in some organisations not willing to supply the data to the developed system.

Some of Forestry Commissions' operational Departments are well established organisations with further operational divisions and human capacity. The good example is Forest Research which is a research agency for Forestry Commission, carrying out researches across the three devolved countries (Scotland, Wales and England). The findings of this research indicate that even though Forestry Commission does not have a data charging policy, some respondents indicated that there is a charging policy underdevelopment for Forest Research. According to some personal communications, it has emerged that Forestry research is in a process to become an independent institution, meaning it will have to generate its own funds. Therefore, prior arrangements and knowledge of what will happen in future, in case there will be a need to use Forest Research data without a charge. What will be the implications after the implementation of the policy? Will Forest Research start charging for the data used in the project? Or stop supplying data? With this questions in mind, it deem necessary to understands the organisational policies, practices and in additions institutional arrangements.

With regard to national and international policies and regulations, the findings indicate that Forestry Commission operates within the limit of national and UK laws and regulations. Therefore, for the development and implementation of a web-based interorganisation data infrastructure, especially with involvement of partner organisations from different national jurisdiction attention should be given to the senior legislations. This is so because there will be a need to find a balance between the different organisational policies and practices, national legislations and the initiative objectives. This will help minimise conflict at all stage of the project. Respondents have indicated that Forestry Commission operates within the limits of the Freedom of Information (Scotland) Act 2002, Data Protection Act, Environmental Information Regulation and the Pan Governmental Agreement as mentioned in section 4.14. These laws and regulations are important to check against the projects objectives. For example the data protection act and environmental laws that prohibit the publication of endangered species. It is important that the project partners have prior knowledge of these legislations from each country so that a balance between them is found to adhere to all without conflicts.

The technical capacity within forestry commission is adequate and it can be reflected by its ability to provide online data transfer within all offices in Great Britain. Through observation and responses of the interviewees, the research findings indicates that all National forestry offices and district have each an Oracle(spatial) database management system with ArcGIS, Forester as their analysing system in place and all are connected to the head office through the intranet service. There is an intranet web browser for each national office and one for Great Britain.

Forestry commission has a well established spatial information systems made up of the Oracle database packages, desktop and server software packages for analysis and presentation of the data. However, respondents indicated that Forestry Commission takes Oracle and ArcGIS software which are proprietary products as their "corporate" software. This indicates that Forestry Commission has a business agreement with Oracle and ESRI. On the other hand, in Forest Research there are other desktop data analysis tools. These tools are in-house developed out of experiments depending on the research needs. These tools are perceived to be open-source. According to interview respondents and personal communications, Forestry Commission does not allow open-source software, is a policy. Respondents indicated that any software that is introduced in Forestry Commission should be able to be used by everyone in the organisation and should be compatible with their corporate packages. It is important to know the organisations' software policy especially when agreements with other organisations or companies are involved. This can have an implication on the development and implementation of the web-based interorganisational DSS if partner organisations have different software and database policies. However, respondents indicated that if need arises, arrangements can be made to with the head of IS for considerations.

5.2. Interorganisational relations

This section looked at the different relationships forestry commission have with other organisations regarding spatial data acquisition and distribution. Inter-organisation data sharing initiatives are crucial for enhancement of overall performance of any organisation(Babazadeh et al., 2008). According to the interview respondents, forestry commission acquire and exchange data with many organisations at different levels. Some of the data from external providers have conditions of use and distribution attached to it. The relation between Forestry Commission and Ordanance Survey (OS) is one of the crucial and critical examples when it comes to conditions attached to data. Forestry commission obtain topographical maps of different sizes from OS and aerial photographs of different resolutions to be use in the three countries' forestry offices including the research station. These datasets are licensed for the use of forestry commission and have an additional license to be filled in by contractors, should forestry commission have a job by consultants that involves any of OS data. These licenses stipulate the conditions attached to the dataset, example, copyright, licensed use: what can be done with the data and confidentiality.

These conditions can be a constraint to the implementation of a web-based interorganisational initiative due to the fact that there will be a number of 3rd parties. Questions of who is going to be responsible for the license agreement? And how can they ensure the use of the data by the partners is within the limit of the agreement, have to be addressed by the project stakeholders.

6. Conclusion and Recommedations

6.1. Conclusion

The development and implementation of an interorganisation data infrastructure is multi-dimensional. It has technical, organizational and institutional implications that affect the way in which the partner organizations perceive to achieve their objectives and goals.

This research explored current data management policies and practices in Great Britain Forestry Commission that guide spatial data management, acquisition, and supply. On average all departments in forestry commission uses and exchange spatial data for one or more scientific researches, we suspect that the data provided by our sample mostly data managers and head of departments may be indicative of the responses across forestry commission Great Britain. Although addressed only in part and for a small subset of data managers, the main question guiding this research has been as follow: ***What are the existing data management policies in distinct forest service organizations? And how could they influence the development and implementation of the Web-based Decision Support Systems in Northwest Europe?***

Case study findings showed that there is a single Spatial Data Policy document for forestry commissions across Great Britain. However, due to external factors and the specifications of cases, practices are different. External factors as mentioned by interview respondents can be: contracts, agreements and licenses with data providers, the terms of this agreements and licenses can limit the availability and accessibility of data for the interorganisation web-based decision support systems. Pricing of the data was said to be depended on cases.
this research concludes that there is no major differences in the data management policies in the three countries, therefore, does not foresee consequences for the development and implementation of a web-based decision system within great Britain. However, there is a need to pay attention to the existing contracts and agreements between forestry commission and other organisations in relation to data and databases, example Ordanance survey and ESRI. The issue of Forest research becoming autonomous is also of interest; due to the fact that there will be a charging policy, therefore consideration has to be given as long-term plan.
Furthermore, attention have to be given to national laws, example data protection act and environment information regulation. Access to data is very strictly controlled by a password mechanism; this could also impede the successful implementation of the web-based DSS, if data is highly protected.
Overall, respondent have indicated that they as an organisation working towards being INSPIRE complaints; therefore they foresee no major conflict.

6.2. Recommendation

This thesis focused on data management policies and practices in forestry commission Great Britain as a basis study for the development and implementation of an interrogation web-based decision support systems in northwest Europe. Interorganisational initiatives of this kind primarily require data from all involved partner organisations and other agencies. Therefore, researches examining the same

principles regarding data management policies and practices in the other partner organisations might provide insights on whether different data management policies exists in the partner organisations.. Such studies should enable comparison so as to judge the effectiveness of current data policies in organisations practices and ultimately provide insights for the likelihood for conflict or smooth development and implementation of web-based interorganisation decision support systems in northwest Europe.

7. References

Ahmed, F, Capretz, L F & Sheikh, S A 2007 Institutionalization of software product line: An empirical investigation of key organizational factors. Journal of Systems and Software 80 836-49.

Babazadeh, N, Mansourian, A, Farnaghi, M & Tateai, M 2008 WebGIS Enabled e-Government: A Case Study of Natural Resource Management. World Applied Sciences Journal 3 17-24.

Cavaye, A L M 1998 An exploratory study in investigating transnational information systems. The Journal of Strategic Information Systems 7 17-35.

FC 2008 Spatial Data Policy. Forestry Commission Edinburgh.

FC 2009 Annual Report and Accounts 2008-09. The Stationery Office, London.

ForeStClim 2008 INTERREG IVB North West Europe-Project Document.

Frehner, M & Brändli, M 2006 Virtual database: Spatial analysis in a Web-based data management system for distributed ecological data. Environmental Modelling & Software 21 1544-54.

Giff, G, van Loenen, B & Zevenbergen, J 2008 PSGI Policies in Norway and England: are they within the Spirit of Recent EU Directives? International Journal 3 118-45.

Groot, R 1997 Spatial data infrastructure (SDI) for sustainable land management. ITC Journal 3 287-94.

GSDI 2004 Global Spatial Data Infrastructure:Developing Spatial Data Infrastructures (http://www.gsdi.org/docs2004/Cookbook/cookbookV2.0.pdf) Accessed 21 October.

Janssen, K & Dumortier, J 2007 Legal Framework for a European Union Spatial Data Infrastructure: Uncrossing the Wires. Research and Theory in Advancing Spatial Data Infrastructure Concepts, Esri Press, Redlands California 231-44.

Kling, R, Kraemer, K, Allen, J, Bakos, Y, Gurbaxani, V & King, J 1992 Information systems in manufacturing coordination: economic and social perspectives. Society for Information Management.

Kumar, r 2005 Second Edition:Research Methodology;A step-by-step guide for beginners SAGE, London.

NAP 1995 On the full and open exchange of scientific data (http://www.nap.edu/readingroom.php?book=exch&page=summary.html) Accessed 27 August 2009.

Nedovic-Budic, Z & Pinto, J 1999 Understanding interorganizational GIS activities: A conceptual framework. Citeseer.

Onsrud, H, Poore, B, Rugg, R, Taupier, R & Wiggins, L 2004 The future of the spatial information infrastructure. A research agenda for geographic information science 225-55.

OPSI 1998 Data Protection Act 1998 (http://www.opsi.gov.uk/Acts/Acts1998/ukpga_19980029_en_1) Accessed 23 October 2009.

OPSI 2002 Freedom of Information (Scotland) Act 2002 (http://www.opsi.gov.uk/legislation/scotland/acts2002/asp_20020013_en_1) Accessed 24 october 2009.

Poch, M, Comas, J, Rodriguez-Roda, I, Sanchez-Marre, M & Cortés, U 2004 Designing and building real environmental decision support systems. Environmental Modelling and Software 19 857-73.

Power, D 1997 What is a Decision Support Systems? (http://dssresources.com/papers/whatisadss/index.html) Accessed 01 January 2010.

Power, D 2000 Web-based and model-driven decision support systems: concepts and issues.

Power, D 2002 Decision support systems: concepts and resources for managers Greenwood Publishing Group.

Rajabifard, A, Feeney, M & Williamson, I 2002 Directions for the Future of SDI Development. International Journal of Applied Earth Observation and Geoinformation 4 11-22.

Rajabifard, A & Williamson, I 2001 Spatial data infrastructures: concept, SDI hierarchy and future directions. Proceedings of GEOMATICS 80.

Rajabifard, A & Williamson, I 2002 Key Factors Influencing Regional SDI Development and Relevance to Global and other Levels.

Rajabifard, A & Williamson, I 2003 Anticipating the cultural aspects of sharing for SDI development.

SIC 2004 Environmental Information (Scotland) Regulations (http://www.itspublicknowledge.info/Law/Legislation.asp) Accessed 07 February.

Van Loenen, B 2001 Access to Geographic Scientific and Technical Data in an Academic Setting. The University of Maine.

Van Loenen, B & Onsrud, H 2004 Geographic Data for Academic Research: Assessing Access Policies. Cartography and geographic information science 31 3-18.

Weiss, P 2004 Borders in Cyberspace: Conflicting Public Sector Information Policies and their Economic Impacts. Public Sector Information in the Digital Age: Between Markets, Public Management and Citizens' Rights 137.

Williamson, I 2004 Building SDIs-the challenges ahead. Global Spatial Data Infrastructure - 7th Conference (GSDI-7)

Yin, R 2008 Case study research: Design and methods Sage publications, INC.

Appendix A: Questionnaire questions

Datasets

1. What kind of (spatial) datasets or themes do you have?(i.e. biomass, land cover, weather, roads)
2. Which of these datasets have been created within the organization?
3. Which of these have been acquired from other organizations?
4. What are the conditions attached to the data for Use, Distribution to third parties?
5. In what format is the data stored, distribute/exchange?
6. Do all datasets have metadata? Same standards?
7. Do you have an organizational policy about data charging?
8. What criteria are used for data charging? Marginal, VAT?
9. According to FC Data policy; Chapter 7: Data Supply: data will be delivered in standards digital format: what are the standards digital formats in FC?
10. Are there specific regulations for each medium?(CD, DVD, Zip, online, face to face)
11. What is being licensed, data or tools (software)?
12. Which Data delivery mechanisms are in place?(website, map server)
13. Who may access the data? And how?
14. Which data is publicly available?
15. What is the medium of data dissemination? Exchange? Publication?
16. According to FC Data policy; Chapter 7 Data Supply: Will specify formally any restrictions on the use of data outside the FC: Is there specific restriction for specific datasets?

Databases& desktop tools

1. What type of database packages exist?
2. What platforms/ operating system do the database support/ used in the office?
3. Which database structure?(Single, multiple)
4. Which standard?(open,propriatery)
5. How many desktop tools are used in FC? All connected to the same database?
6. Are they open source or Proprietary?
7. Are tools (ESC, forester) dataset specific or can use other data formats?

Overall

1. What is the estimated percentage of data:
2. Created within the organization?
3. Acquired from other organizations?
4. Are they all license/contract protected?
5. Is data exchange done more frequently with Public offices or Private organizations or Private Citizens? Who are your clients?
6. Do you foresee major differences in existing spatial data practices in the devolved countries?
7. Do you think inter-regional web-base data infrastructure will conflict with FC Data Policy?
8. How does FC Data policy related to European data Policies? Which ones?
9. Any other issues that you would like to point out?

Intellectual Property Rights	**Inter and Intra-organisation**
1. How do you enforce copyright, license, custodianship, charging?? 2. Have you ever had a case of infringement regarding the above Policy elements? 3. What is the minimum and/or maximum punishment if breach of contract happen? 4. To whom does the these regulations apply?(individuals, organizations, public offices) 5. Is there any exception in regard to academic and non-profitable institutions? According to FC Data Licensing: You must not modify, alter, decompile, reverse engineer, or disassemble the Data beyond that which is necessary to allow the use of the Data within your system. 1. Which data is protected, raw data? Finished products? (E.g. I obtain shape files and I create maps myself or do further analysis) 2. How do you ensure that there is no breach of contracts? Within your organization and by your clients?	1. How many departments/Divisions within the organization directly use spatial datasets (business process depended on spatial datasets)? 2. Are all departments or divisions having separate data policies or license? 3. If one does not create spatial datasets, are they obliged to the departmental data policy? 4. Which software or database packages are being used? 1. Which organization you exchange data with? 2. Do you pay to get data from other organization? 3. Do you charge to distribute/exchange data with other organizations? Private individual?

Appendix B: Follow-up, interview appointment email

Subject: Interview Appointment

Dear *Name of person*

Many thanks for indicating your willingness to take part in my data policy study. I am studying for an MSc degree at ITC (http://www.itc.nl/)in the Netherlands. My work is related to the European Interreg 4b project Forestclim (http://www.forestclim.eu/index.php?id=2) for which Forest Research is a partner (http://www.forestresearch.gov.uk/forestclim).

A main objective of Forestclim is to develop a common framework for decision support within partner countries for assessing the impacts and adaptation response to climate change in the forestry sector. My project is concerned with the availability, accessibility and feasibility of data for these tools, in particular forest inventory data. The work will provide meta-information to help assess the tractability of data sharing in partner countries.

So, as promised, I am writing to ask if I may arrange a meeting to have an interview to discuss 'Data availability and access Policies'. This will take less than 1 hour.

Date: xx October 2009

Time: 10h00

Venue: Your Office

Please, feel free to change if details are not convenient.

Looking forward to meeting you,

Regards,

Celina.

Appendix C: Cover Page for Imagery Contractor Licence of Ordnance Survey Data

Schedule to Framework Terms
Contractor Licence of Ordnance Survey Data

This **Contractor Licence** is made this .. day of ..... 200.. .

Between: (1) .....

of ..... (the **Sub-licensor**); and (2) .....

of ..... (the **Contractor**).

Background

A The Sub-licensor has acquired a licence from Ordnance Survey to use certain Ordnance Survey Data for its own Licensed Use.

B The Sub-licensor wishes to provide such Ordnance Survey Data to the Contractor to enable the Contractor to provide a Tender or to carry out the Works.

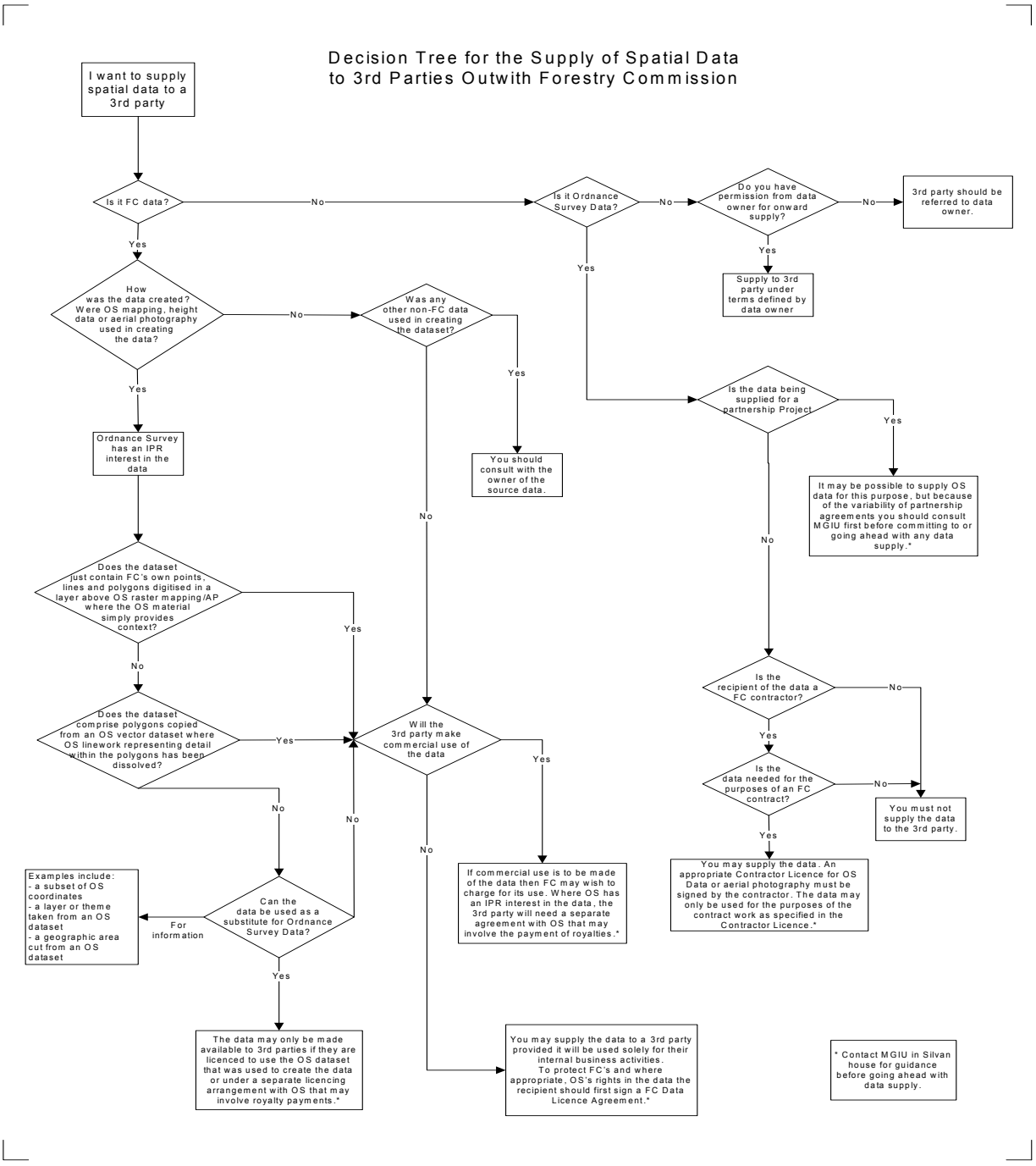
C The Sub-licensor has authority from Ordnance Survey to grant a licence to the Contractor in respect of any Ordnance Survey Data provided to the Contractor on the limited terms of this Contractor Licence.

Operative Terms:

1 Definitions and interpretations

1.1 Expression	**Meaning**
Confidential Information	means any information that relates to the affairs of the Sub-licensor and Ordnance Survey and that is acquired by the Contractor in anticipation of or as a result of this Contractor Licence. This excludes information which is in the public domain other than through the breach of any duty of confidentiality;
Data	means any text, graphics, audio, visual (including still visual images) and/or audio-visual material, software, applications, data, database content or other multimedia content, information and material;
Intellectual Property Rights	means copyright, patent, trade mark, design right, database rights, trade secrets, know-how, rights of confidence, broadcast rights and all other similar rights anywhere in the world whether or not registered and including applications for registration of any of them;
Licensed Use	means such use which has been licensed to the Sub-licensor by Ordnance Survey;

Appendix D: Procedures for the supply of spatial data to 3rd Parties



Appendix E:Database distribustion