



Data, Information and Process Integration
with Semantic Web Services

DIP

Data, Information and Process Integration with Semantic Web Services

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Deliverable

WP 9: Case Study eGovernment

D9.3

e-Government ontology

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EXECUTIVE SUMMARY

This document describes two Ontologies created for the DIP e-Government case study in DIP.

WP9 is currently involved in developing two Ontologies for SWS applications within the e-Government context, namely:

- **Change of circumstances:** An Ontology that models how several agencies should be notified of a change of address or other circumstances of any person living in a local authority area, illustrated here by a specific scenario.
- **EGovernment Ontology:** An extensive Ontology that models a wide range of e-Government and community services and information.
- It is also planned to develop a **GIS Ontology** in Months 13-30.

These Ontologies will guide the forthcoming SWS created by WP9.

The e-Government Ontology has been developed from the seamlessUK data model. This model can not be considered an Ontology at all, as it only is a Taxonomy: a description and classification of terms, with some eventual synonyms. For this reason, the OU attempted to improve and upgrade this taxonomy into an Ontology. The new seamlessUK Ontology (also called here the 'e-Government Ontology') is a more complete model than the initial taxonomy but still lacks strong relations, good groupings of concepts and appropriate semantics.

WP9 will continue this work over the next months, improving the current Ontology or beginning from scratch bringing a new global e-Government list (resulting from the Public Services Merged Vocabulary Project (PSMV)) into an Ontology. This work will be carried out by Essex County Council together with the Open University.

The Change of Circumstances Ontology models a small part of the whole government domain, specifically models the , 'Change of Circumstances' scenario where a disabled mother moves in with her daughter (described in detail in D9.2). The Ontology will help create Semantic Web Services that will simplify the notification of multiple agencies of such a change of circumstances. The aim of this scenario is that the mother only has to notify her changes of circumstances once to enable all other agencies involved to be automatically notified.

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Abstract (for dissemination)	WP9 is currently involved in the development of two Ontologies: e-Government Ontology (coming from the seamlessUK taxonomy) and the change of circumstances Ontology. Both are described in detail in this document. The WP will in also soon be involved in the development of a GIS-related Ontology.		
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GLOSSARY

- **Browse:** Navigate through the Web.
- **Conceptualisation:** To form a concept or concepts of, and especially to interpret in a conceptual way.
- **Index:** Guide, point out, or otherwise facilitate reference.
- **Instantiate:** To represent (an abstract concept) by a concrete or tangible example
- **IRS:** Internet Reasoning System
- **Keyword searching:** Search using a word as a reference point for finding related information.
- **Mark-up:** The collection of tags that describe the specifications of an electronic document, as for formatting.
- **Mock-up:** Full-sized scale model of a structure, used for demonstration, study, or testing.
- **Ontology:** Explicit and formalized specification of a conceptualisation [1]
- **Tagging:** A sequence of characters in a mark-up language used to provide information, such as formatting specifications, about a document
- **Taxonomy:** classification based on similarities

ACRONYMS

- **CEN:** European Committee for Standardization
- **DAML:** Darpa Agent Mark-up Language
- **ECC:** Essex County Council
- **eGIF:** e-governmental Interoperability Framework.
- **GIS:** Geographic Information Systems
- **GSL:** Government Category List
- **KMI:** Knowledge Media Institute. <http://kmi.open.ac.uk/>
- **LGCL:** Local Government Category List.
- **MPSV:** Merged Public Service Vocabulary
- **OCML:** Operational Conceptual Modelling Language.
- **OU:** Open University
- **PSMV:** Public Sector Merged Vocabulary
- **SOAP:** Simple Objects Access Protocol
- **SW:** Semantic Web
- **SWS:** Semantic Web Services
- **WP9:** Work package 9
- **WSDL:** Web Service Definition Language
- **WSMO:** Web Service Modelling Ontology
- **WSMX:** Web Service Execution Environment
- **XML:** Extensible Mark-up Language

1 INTRODUCTION

WP9 is currently involved in the development of two Ontologies, which will guide the forthcoming SWS created by WP9. Ontologies are essential in the Semantic Web as they state an agreement to use the vocabulary about a certain domain in a coherent and consistent manner. [2] The two Ontologies currently under development are:

e-Government Ontology: This Ontology was created from an already existing taxonomy (seamlessUK), created by Essex County Council. The seamlessUK project began in 1998 with the aim of creating a classification of all the relevant terms citizen access to ‘community information’ provided by governmental and other agencies, at national and local level. The seamlessUK taxonomy is no longer being expanded, only refined and maintained, as it will be integrated within a broader project called the ‘Public Sector Merged Vocabulary (PSMV)’. Within this framework, the seamlessUK taxonomy will be merged within two other governmental data models: GSL; a small high-level taxonomy which reflects the citizens’ point of view about high levels governmental issues, and LGCL which focuses on more local tasks.

The seamlessUK data model can not be really be considered an Ontology at all, as it only is a description and classification of terms, with some eventual synonyms. For this reason, the OU attempted to improve and upgrade this taxonomy into an Ontology. The new seamlessUK Ontology (also called the ‘eGovernment Ontology’ in this document) is a more complete model than the initial taxonomy but still lacks strong relations, good groupings of concepts and appropriate semantics.

WP9 will continue this work over the next months, improving the current Ontology or beginning a new one from scratch, in order to bring the new e-Governmental list (resulting from the Public Sector Merged Vocabulary - PSMV) into an Ontology. This work will be carried out by Essex County Council in collaboration with the Open University.

‘Change of circumstances’ Ontology: This Ontology mock-up represents a small part of the whole e-Government domain, which specifically models the , ‘Change of circumstances’ scenario where a disabled mother moves in with her single daughter (described in detail in D9.2). The Ontology will help create Semantic Web Services that will simplify the notification of multiple agencies of such a change of circumstances. The aim of this scenario is that the mother only has to notify her moving to one single local authority; then all other changes (Post Office, Treasury, National Health Service, etc) will be automatically notified.

Another **Ontology** will be created in the early future **to cover the SWS-enabled GIS** scenario, but its details are out of the scope of this deliverable.

1.1 Ontology Description

There are several definitions of the concept Ontology, one of the most descriptive ones in the knowledge management field is the following: ‘An Ontology is an explicit specification of a conceptualisation’ [3]. The basic purposes of an Ontology are:

- To describe domain knowledge in a generic way and provide an agreed understanding of a domain [2]
- To define the basic terms and relations comprising the vocabulary of a topic area, as well as the rules for combining terms and relations to define extensions to the vocabulary. [4]

An Ontology consists of different elements, namely: [2]

- **Classes:** Abstract concepts which model concepts or groups of concepts of the domain.
- **Relations:** How the classes of the Ontology interact among themselves. The main relations between classes are:
 - Subclass-of: Inheritance relation.
 - Subclass-partition: Decomposition relation.
- **Axioms:** ‘A self-evident or universally recognized truth; a maxim’. Encode meaning into an Ontology. Sentences which are always true.
- **Rules:** Two-part clauses which model facts of the domain. If the first part of the function is evaluated as true, then we can conclude the second part of the clause is also true.
- **Instances:** Last elements of the hierarchy; represent concepts of the real world. Classes can be instantiated more than once time.

An Ontology differs from the concept of taxonomy, which is only a classification of several elements (classes) and their eventual descriptions. A taxonomy does not include any knowledge description about the elements, their interactions or semantics; nevertheless taxonomies are the skeleton of Ontologies, as they provide the main classification of all the domain concepts.

2 ONTOLOGIES FOR E-GOVERNMENT

2.1 State of the art

This is still a very immature field. There are only a few isolated examples of governmental Ontologies.

In the DAML free Ontology library (<http://www.daml.org/ontologies/>), we can find two Ontologies which refer to governmental concepts:

- ‘Government R&D’ (<http://www.daml.org/projects/integration/projects-20010811>) which describes organisations and individuals participating in a government R&D program.
- ‘Government type’ (<http://reliant.teknowledge.com/DAML/Government.owl>) which describes Government Concepts Used in the CIA World Fact Book 2002

But besides these two isolated Ontologies, not many others can be found.

The initiative taken by Essex County Council within the DIP project is one of the first of its kind in the world. It aims to develop a whole governmental Ontology modelling a very wide range of concepts related to the British government and other important community agencies, their services and citizens.

2.2 Standardisation

The **e-Government Interoperability Framework** (eGIF) is a mandatory set of standards and approaches for government agencies at all levels in the UK. ‘Core’ Web Services standards were included for first time in v4 (April 2004), including UDDI, SOAP and WSDL. A growing interest in potential e-Government applications of SWS is now becoming evident, for example by eGovernment Unit of the Cabinet Office, partly as result of awareness raising efforts by Essex. It is important that DIP is able to demonstrate valid prototype applications that prove their concept and ultimately prepare the way for the adoption of WSMO/WSMX in the eGIF context.

CEN is considering the establishment of a CEN Workshop focusing on eGovernment. This Workshop will gather stakeholders across Europe and will aim to discuss the use of standards in eGovernment and to derive suitable recommendations on selected topics (e.g. strategies, Interoperability frameworks, enterprise architectures, metadata standards etc.). Essex has associated DIP with this group.

Work is now underway (Merged Public Service Vocabulary – MPSV) project, led by the e-Government Unit (UK Cabinet Office) to merge the seamlessUK taxonomy with the GCL, LGCL to form a single terminology list for e-government applications in all levels of government in the United Kingdom. During this process, uncertainties are emerging regarding the potential functionalities of such a merged vocabulary (e.g. whether it can be constructed to function both as a keyword index to support online searching - and possibly through derivation of a subset- whether it can act as a ‘category list’ to support navigational ‘browsing’

In this context, attention should also be paid to The LGSL (also known as ‘The PID List’), which describes every service that a council might provide directly to citizens (residents, businesses and other people it serves) and is accepted as the standard for defining local authority outputs and measuring electronic service delivery.

3 SCENARIO-BASED ONTOLOGY FOR CHANGE OF CIRCUMSTANCES USE CASE

3.1 Background

This scenario aims to provide homogeneous online interfaces to governmental services for the citizens of Essex.

Current governmental policy is to use a web services based architecture. There are three tiers of government organizations in Essex: national, county and local council. This tier partition makes more difficult to find the appropriate service that fulfils the citizen's necessity. Nowadays, services are provided to the citizens through several web pages, which are locally managed by these different organizations. Some examples of the current situation are shown in the following snapshots:

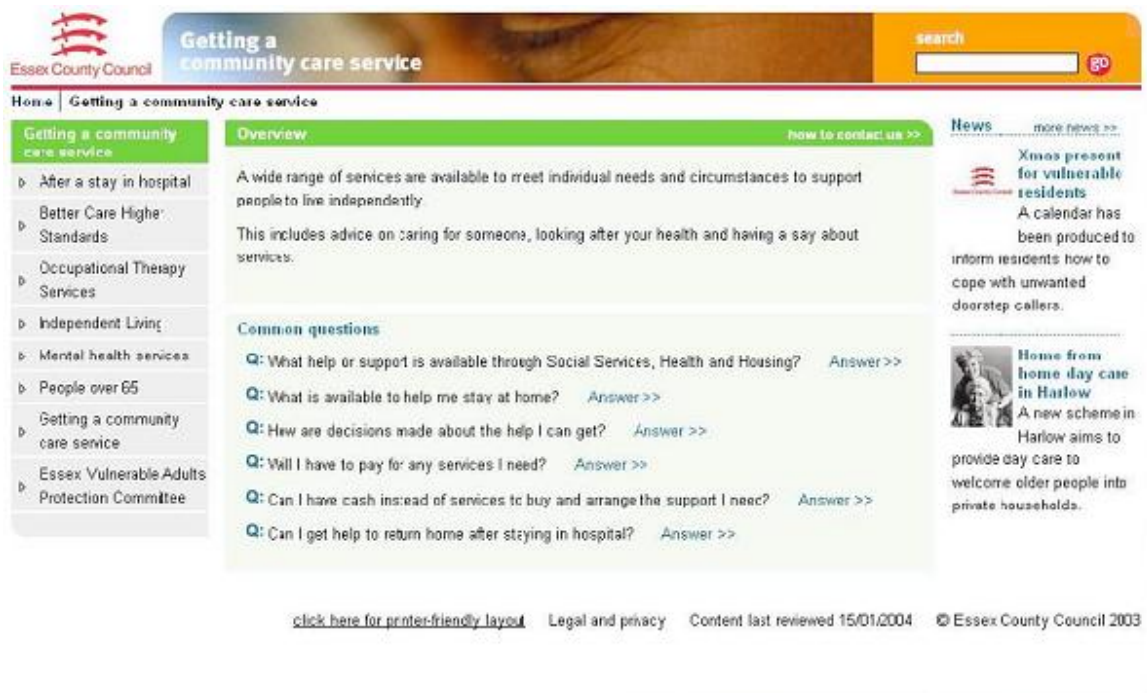


Figure 1 Essex County Council Community care service

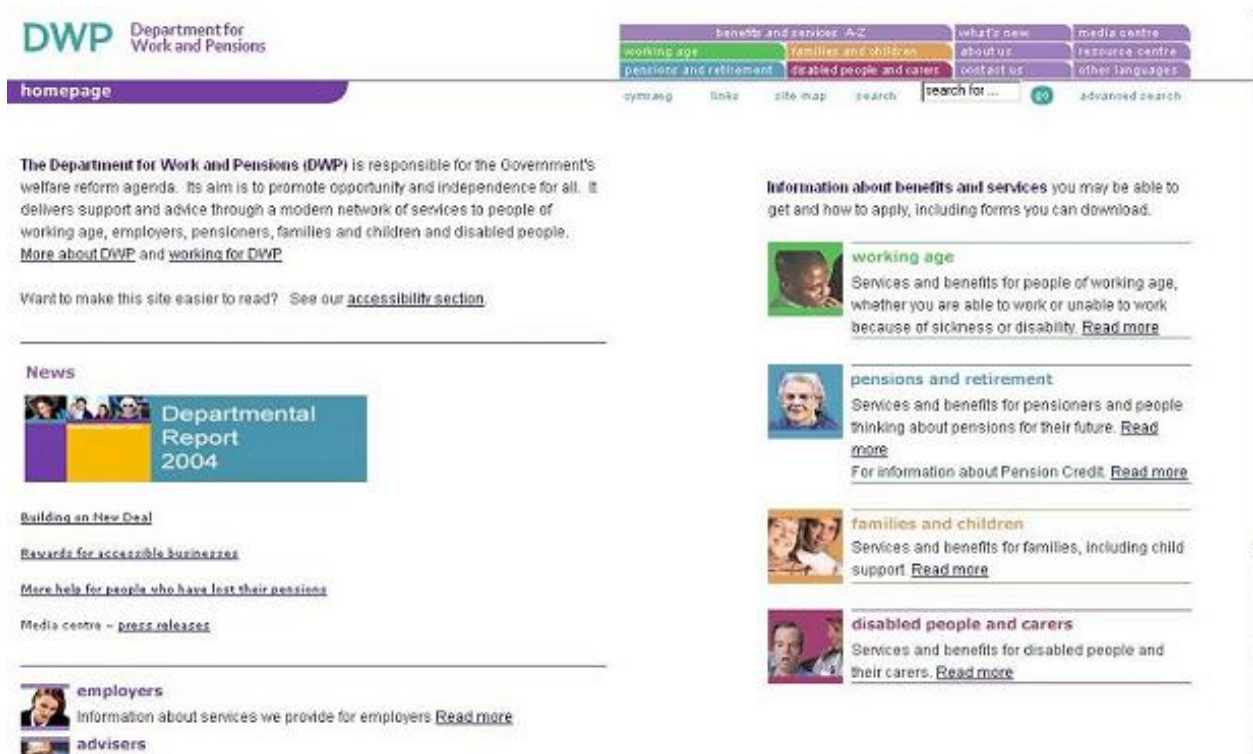


Figure 2 Department of work and Pensions public services

This gets more complicated when different agencies have to collaborate to provide a service to the user (as it happens in the ‘Change of circumstances scenario’, detailed in next chapter). They have to work together and notify any changes to partner agencies. The Essex County Council has a coordination role in all this process.

Next chapter describes in detail the ‘Change of circumstances scenario’ and how WP9 has solved its drawbacks thanks to the SW and the use of SWS.

3.2 Change of circumstances scenario description

The change of circumstances scenario can be defined by means of the following example: ‘A *part-time employed single woman moving into a new rented house, in the same local authority area as their previous address, in order to look after her disabled 86 year old mother, whose previous address was also in the same local authority area.*’

The prototype created by WP9 is a portal for Essex County Council within this ‘Change of circumstances’ use case. The end user of this portal is the caseworker which is helping the citizen (daughter that moves out, in the example) to report her change of circumstances to the different agencies involved in that process. This way the citizen only has to inform once about her change of address, and the County Council automatically notifies all the agencies involved.

3.3 Change of circumstances portal prototype

The objective of the mockup is to illustrate the use of Semantic Web Services within the Change of Circumstance scenario. The semantic web service provided by the mockup is the 'notification of change of address'. The semantic description of this and other services used in the mockup uses the ontology (change of circumstance) presented. More services will be provided through the implemented prototype.

The change of circumstances mock-up has been created in IRS-II (Internet Reasoning Service, version 2), which is an infrastructure for publishing, locating, executing and composing semantic web services, organized according to the WSMO framework . This approach was chosen because this was an already WSMO compliant existing infrastructure (created by the OU).

The graphic below illustrates how SWS are can be published by the providers and consumed by the users trough IRS-II

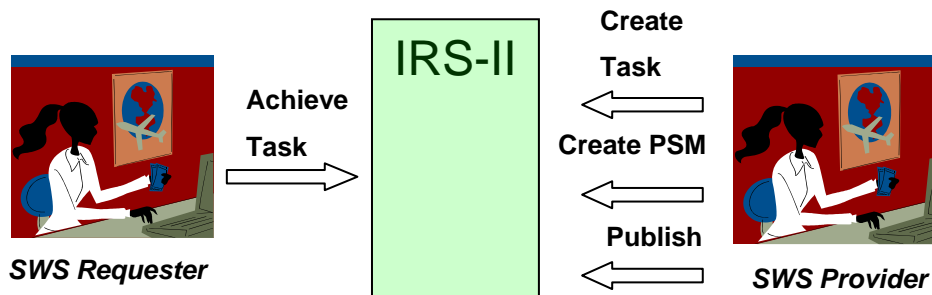


Figure 3 IRS-III functionality

The mock-up ontology was created in IRS-II. It was written in OCML but it can be currently exported to RDF(S) and OWL. In the future IRS will have the functionality to export it to WSML. There is now a new version of the internet reasoning system: IRS-III. The e-government ontology will be translated into it within the next months.

The prototype portal administers a network of registered agencies (service/benefit providers). Every registered agency publishes one or more Semantic Web Services (SWS), which have to be based on the agreed e-government Ontology (explained in detail below). There are a number of fixed SWS tasks (change of circumstance) to which agencies have to subscribe (publish services). Agencies can make their own SWS Tasks available through the portal (URL)

Next pictures illustrate how ‘change of circumstances’ is notified to all the different involved agencies, through the ECC portal prototype. A running prototype can be found visiting the URL http://ibrow.open.ac.uk:8080/essex_mockup/

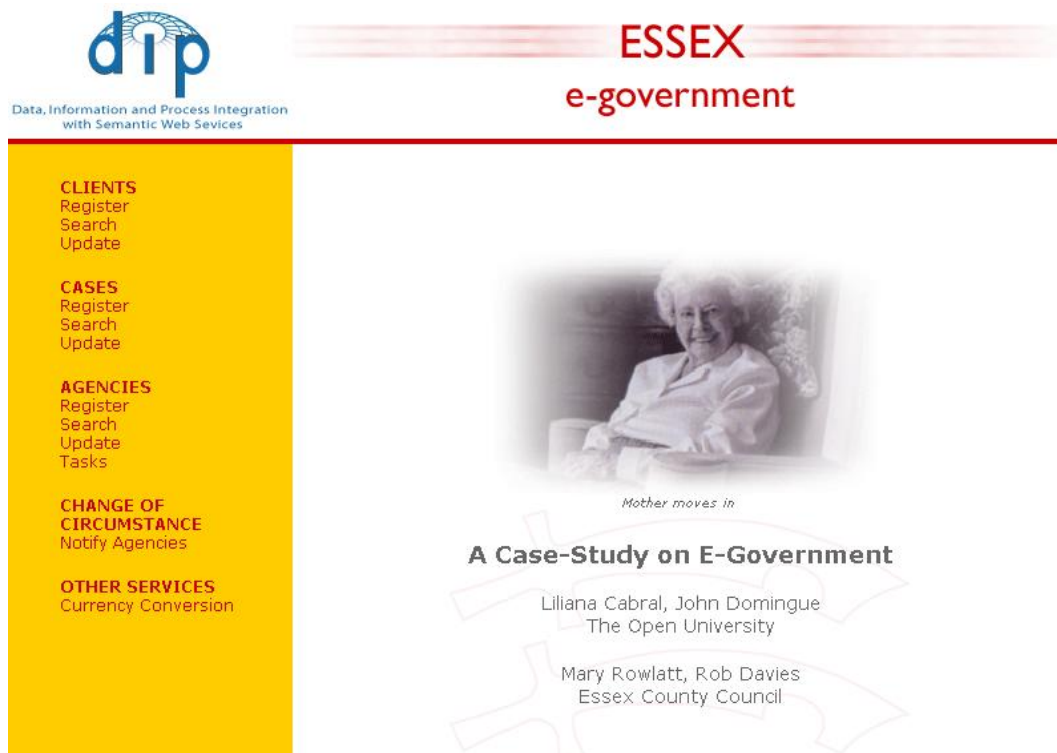
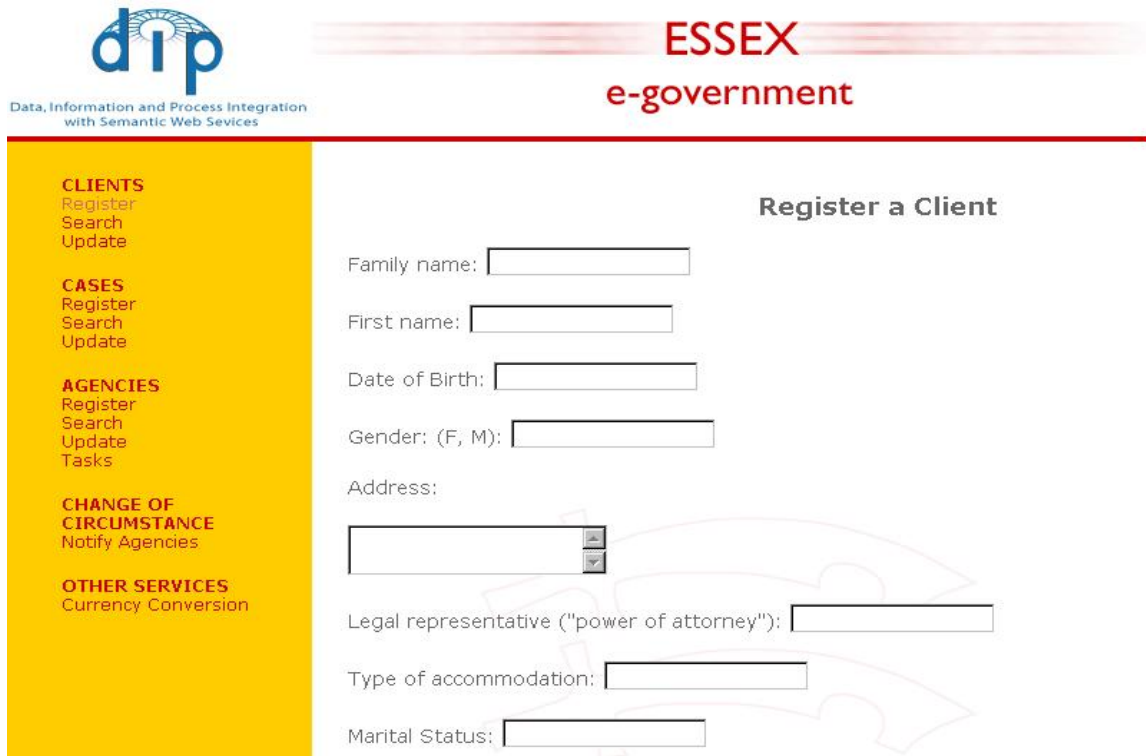


Figure 4 Home page of the portal prototype.

On the left menu the caseworker can choose among several options, which are grouped under several fields: clients, cases, agencies, change of circumstance and other services. This sections shows an example of the previously described example ‘*Mother moves in*’ scenario. When the mother moves to the new house, she (or a legal representative) notifies this change to the caseworker. Next pictures simulate what steps the caseworker has to follow to easily notify this change to all the involved authorities through the ECC portal.



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ESSEX
e-government

Register a Client

CLIENTS
Register
Search
Update

CASES
Register
Search
Update

AGENCIES
Register
Search
Update
Tasks

CHANGE OF CIRCUMSTANCE
Notify Agencies

OTHER SERVICES
Currency Conversion

Family name:

First name:

Date of Birth:

Gender: (F, M):

Address:

Legal representative ("power of attorney"):

Type of accommodation:

Marital Status:

Figure 5 Web page to ‘register a new Client’

The caseworker can register a new client, search or update the information of an existing one through the portal. The picture above shows how the caseworker can introduce information of a new client in the system. He has to fill in several fields about the citizen’s information: Name, date of birth, gender, address, marital status, etc. This information will be stored and related in the underlying Ontology, as a new instance of the class ‘Client’. Once the caseworker submits this information is stored in the IRS system



ESSEX
e-government

Register an Agency

Agency Name:

Organization:

Contact Person:

Partner Agencies:

Services/Benefits available:

Name	URL
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>

Figure 6 ‘Register and agency’ web page

The same procedure is followed to register a new agency. This time is not the caseworker, but the agency, the one that registers itself. The fields it has to fulfil are: the name of the agency, the organization it belongs to, the name of the contact person, and the agencies working in partnership with it. It also has to fill in the name of the services/benefits it provides to the citizens (in the form of SWS), accompanied with the URL where that SWS is published.

Once the button ‘Add’ is pushed, this information is submitted and a new instance of the Ontology term ‘Agency’ is created.

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Change of Circumstance

Notify Agencies

Client ID:

What's the circumstance:

- Change of address
- Getting married
- Going into hospital
- Someone moved in
- Going to residential/nursing home
- Being left money in a will
- Winning lottery
- Retiring
- Death

Figure 7 'Change of circumstance' web page

In this page the caseworker relates a selected client (mother that moves in in this example) with its change of circumstance case. The circumstance can be of different nature: change of address, marriage, hospitalisation, moving in, winning lottery...etc.

After selecting the client, the caseworker selects what the circumstance is ('change of address' in this example), and afterwards the agency which has to be notified about this change; this is done by pressing the button 'Select an Agency', which leads to another form (showed in the next picture)

Figure 8 ‘Change of circumstance’ web page – part 2

This is the second and last step of the change of circumstances notification. In this form the caseworker chooses the agency he wants to notify the change of address to. Fills in the old and the new address of the pre-selected client and then notifies it just clicking ‘Notify’. With this simple form the Case Worker shares change of address details with relevant partner organisations (Housing, Pensions Service) and suppliers of external commissioned services (meals on wheels and nursing support, e.g.)

When doing this, a goal is created in IRS-III (WSMO compliant reasoning server). IRS then tries to matches all the published SWS with this goal, finally invoking the one that satisfies this goal. All this reasoning is guided by the ‘change of circumstances mock-up’

Finally, the woman and her mother can apply for several services and benefits, such as: housing benefit and/or Council tax benefit (Housing and ECC), attendance allowance (JobCentre plus), carer’s allowance (Disability and Carers), building regulation permission to adapt the house for her mother’s disability (Planning Department), additional discount on Council Tax Benefit (Housing Department), etc.

3.4 Change of circumstances Ontology mock-up description

All the process related above is guided by the semantics provided by the ‘Change of circumstances’ mock-up Ontology. This Ontology models tangible and abstract concepts concerning all the governmental issues about a change of circumstances, and the persons, which are involved in it. It defines 95 classes, 1 axiom, 3 rules and 64 instances (concepts already described in this document in section 1.1). Some of these concepts and their purpose are deeply described below.

The "change of circumstance" ontology allows a large number of inferences in respect to the use case scenario. It is possible to assert, for example, which benefits are provided by different agencies (organizations) or which benefits and services are provided to a citizen. All the relations of the ontology (attributes of classes in OCML) can be used in logical expressions when describing constraints for Semantic Web Services (e.g. preconditions, post conditions, assumptions and effects of WSMO descriptions).

Classes

The next pictures show the main classes of the ontology modelled in UML language:

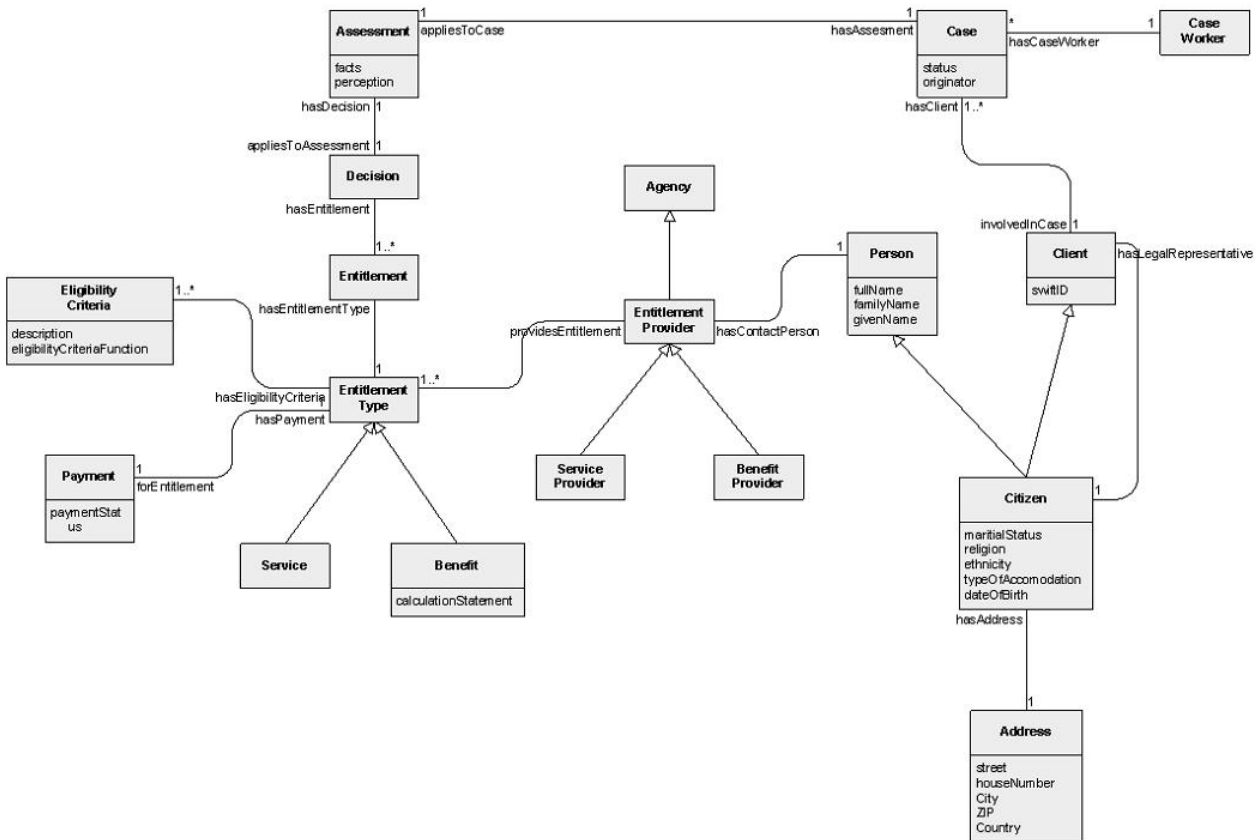


Figure 9 UML diagram of the main classes of the Ontology

The main classes in the ontology are: **CASE** (e.g. mother-case), **CITIZEN** (e.g. mother), **ASSESSMENT** (e.g. of change of circumstance), **DECISION** (e.g. mother-case-decision), **CASE-WORKER** (e.g. mother-case-worker), **benefit-provider** (e.g. housing-department), **service-provider** (e.g. disability-and-carers), **ENTITLEMENT-TYPE** (e.g. housing-benefit).

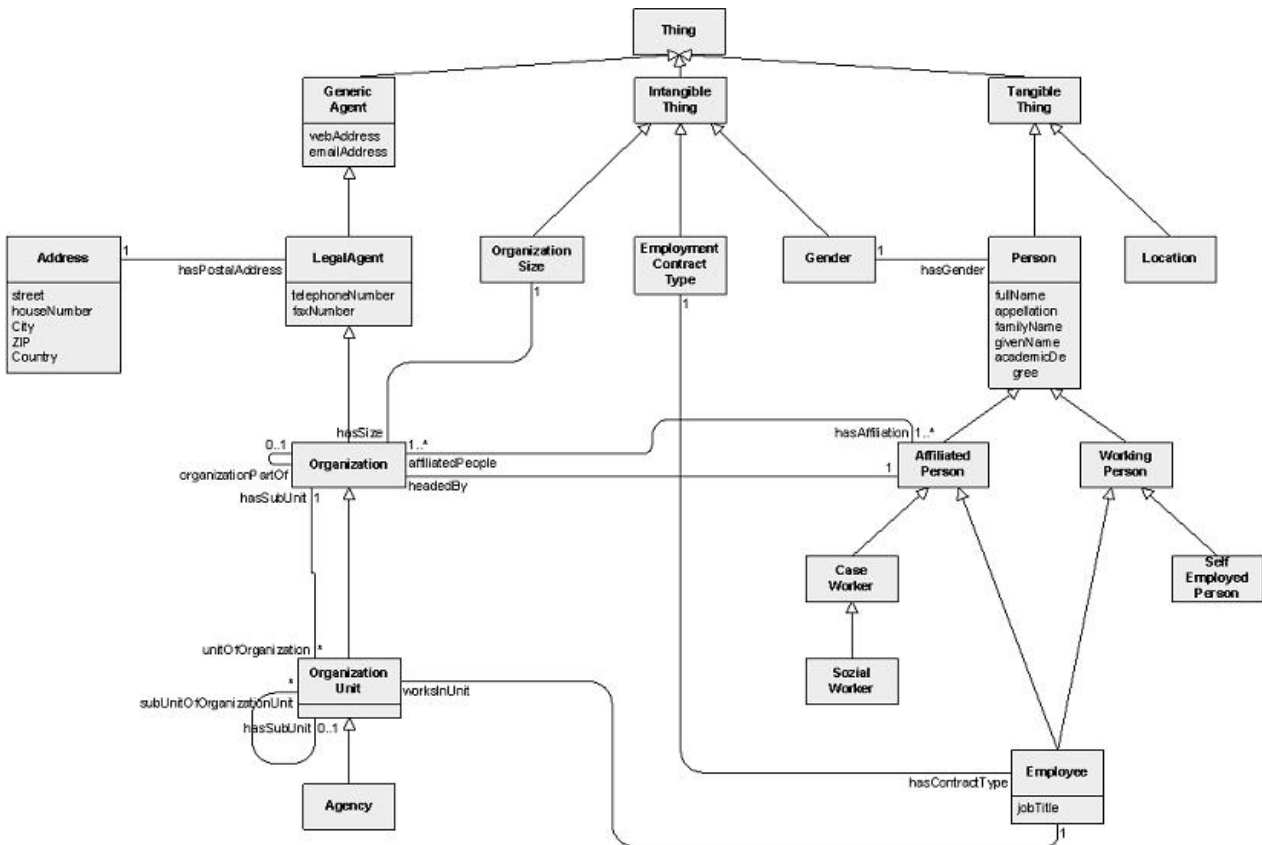


Figure 10 UML diagram – level 2

The diagram above shows a higher level of abstraction of the ‘change of circumstances’ domain Ontology. In fact all these classes are interrelated among them, but the picture is split in two for a better understanding. The most important class here is **GOVERNMENT-ORGANIZATION** (e.g. Essex-county-council). All the classes in the Ontology inherit from the generic class ‘thing’ which is created as the top-class for inference reasons.

Some other classes not shown in these diagrams, but important for the Ontology purpose are: **affiliated-person**, **working-person**, **case-worker**, **self-employed-person**, etc. (persons are modelled and classified within the view of their working status), **political-organization**, **small-or-medium-sized-organization**, **non-profit-organization** [government-organization, charitable-organization], **profit-organization** [company, industrial organization], **learning-centred-organization**,

publishing-house (detailed classification of several kinds of organizations. These are the ones that need to be notified of the change of circumstances), **year-in-time**, **month-in-time**, **hour-in-time**, **second-in-time** and **minute-in-time** (auxiliary classes, with a constrained value. Assure correctness and consistency about data types)

As an illustration, the following scenario can be represented (by the instances in the ontology): A citizen is involved in a case for entitlement of benefits and services. The case is opened by a social worker and described via an assesment (which has facts and perceptions) and a decision. The decision shows which benefits the citizen is entitled to. Benefits are provided by benefit or service (entitlement) providers, which are agencies (organization units). The Ontology aims to model the real world. All citizens' data concerning this change of circumstances is stored in the 'Person-centred care information system' (SWIFT), described in section 3.4.3

Axioms

The ontology also states one axiom, which will be always true and can be used to check the consistency of the model, this axiom states that: "A city is the capital of a country if and only if this country has that city as its capital", which expressed in OCML looks like the following:

Consistency axiom of the 'change of circumstances' Ontology
(def-axiom CONSISTENCY-BETWEEN-COUNTRIES-AND-CAPITAL-CITIES (↔ (is-capital-of ?city ?country) (has-capital ?country ?city)))

Table 1: Axiom which states a symmetrical property between capital cities their countries

Rules

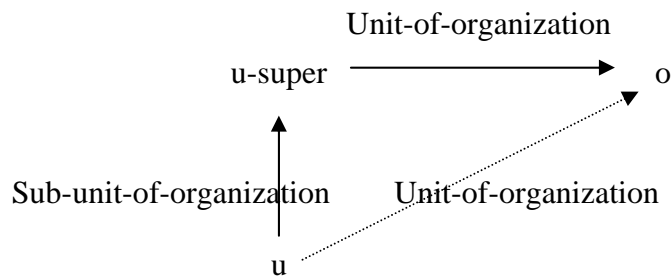
There are also three rules defined in the Ontology:

Rule 1
(def-rule UNIT-OF-ORGANIZATION-IS-TRANSITIVE ((unit-of-organization ?u ?o) if (sub-unit-of-organization-unit ?u ?u-super) (unit-of-organization ?u-super ?o)))

Table 2: government Ontology rule1

Which in natural language means: ?u is a unit of the organisation ?o if ?u is a sub-unit or a unit ?u-super and ?u-super is a unit of an organisation. For example: If the chemistry department is a unit of the science faculty and the science faculty is a unit of

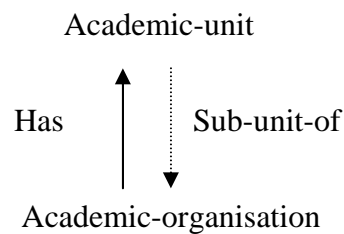
the open university then the chemistry department is a unit of the open university. The drawing below shows the relations of this rule:



Rule2
<pre>(def-rule HAS-ACADEMIC-UNIT-IMPLIES-HAS-ORGANIZATION-UNIT ((has-sub-unit ?x ?y) if (has-academic-unit ?x ?y)))</pre>

Table 3: eGovernment Ontology rule2

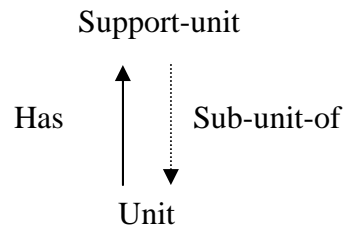
If an (academic) organisation has an academic unit then that unit is a sub unit of the organisation. E.g. has-academic-unit open-university knowledge-media-institute implies has-sub-unit open-university knowledge-media-institute



Rule3
<pre>(def-rule HAS-SUPPORT-UNIT-IMPLIES-HAS-ORGANIZATION-UNIT ((has-sub-unit ?x ?y) if (has-support-unit ?x ?y)))</pre>

Table 4: eGovernment Ontology rule3

Which in natural language means: If a unit has a support-unit then that unit is a subunit



If the conditions of these rules are satisfied (the ‘if’ clause) then the rule is triggered (dotted line) and the second part of the rules becomes true.

Instances

Instances are the final elements of an Ontology. They have all the properties of the class their instantiate, and also inherit all the properties from the upper classes in the taxonomy.

This mock-up consists of 64 instances, although more can be added. The instantiation of a class is easily made defining specific values to each of its attributes and characteristics. Once an Ontology is populated with instances it is known as a ‘Knowledge base’ (*A collection of knowledge expressed using some formal knowledge representation language*). Some examples of instances are:

Mother (Instance of class ‘CITIZEN-client’)
Swift id: 001
Legal representative: daughter
Involved in case: mother-case
Full name: Mother Scott
Family name: Scott
Gender: female
Address: mother-address
Marital status: Widow

Daughter (Instance of class ‘CITIZEN-client’)
Swift id: 002
Involved in case: daughter-case
Full name: Daughter Scott
Family name: Scott
Gender: female
Address: daughter-address
Marital status: Single

<p>Department-of-work-and-pensions (Instance of class ‘national-government-organization’)</p>
<p>Web address: http://www.dwp.gov.uk</p>
<p>Size: large</p>
<p>Sub-units: the-pensions- service job-centre-plus disability-units</p>

Note that people’s related instances have been created with fictitious data in order to protect citizens’ privacy rights. WP9 has not been able to access data stored in SWIFT system due to security and privacy reasons. The prototype that will be developed to model the change of circumstances scenario will simulate (within a narrower domain) the data stored SWIFT system and its structure, aiming to be as accurate as possible with the real world.

3.4.3 SWIFT database

SWIFT is a *social care system* designed to help social care practitioners to cope with the emerging operational practice and constantly changing legislation.

Before SWIFT was implemented, governmental data about citizens was scattered among several information systems. This project hooked up all these data facilitating its management and preventing inconsistencies and data loss.

SWIFT provides social care departments with the tools to deliver joined-up services (allowing the collaboration between public and private organizations).

SWIFT is designed to support e-Government initiatives subject to security and confidentiality. Selective information held by SWIFT is accessible via a Web browser, allowing collaborating with bodies such as the police, caring homes and hospitals to keep themselves properly informed and participate as necessary.

SWIFT can be integrated with other systems as required, and is compliant with the electronic Government Interoperability Framework (eGIF).

4 THE TRANSFORMATION OF THE SEAMLESSUK TAXONOMY

4.1 Background

The seamlessUK taxonomy is a public sector project that has been developed since 1998. This taxonomy, which currently has 2621 preferred terms (Version 12), was created to enable easy access for the citizen to ‘community information’, by indexing and categorising their services and other relevant concepts or topics.

Several people at the Information Services department in Essex County Council are currently working on its maintenance. But this project will no longer continue, as the

seamlessUK taxonomy will be merged with two other lists which are used by national and local government bodies to index and categorise their information: GCL and LGCL. These lists, together with seamlessUK, describe the information resources of the governmental organizations and other agencies providing community information. Until now organisations have been able to use any of the three term lists as source files for subject terms, which has led to confusion and difficulties in finding information.

Now however the list owners are working together to create a single unified list of categories and keywords that the public sector can use to describe their information resources. This standardisation should result in information resources being described more consistently across organisations, which should in turn make it easier for organisations to share information and for user searches to be more effective. This project (named the Public Sector Merged Vocabulary - PSMV) is being carried out by an independent taxonomy expert Stella Dextre Clarke on behalf of the eGovernment Unit (eGU) of the Cabinet Office and is expected to be completed by end March 2005

4.2 Introduction

The seamlessUK taxonomy is the basis for the e-Government Ontology which WP9 is attempting to create. SeamlessUK is only a taxonomy, which means it reflects the terms and their hierarchy (occasionally some synonyms are also defined), but does not have the relations and semantics an Ontology provides.

The purpose of the WP9 is to upgrade this taxonomy to a real complete (and maybe also complex) Ontology. This taxonomic knowledge is at the heart of our future Ontology conceptualisation.

4.3 Transformation process

The Essex information community has been developing the seamlessUK taxonomy for 6 years. It covers local community information (e.g. health, clubs, hobbies, recreations, environment, transport etc).

WP9 has made a first attempt at transforming SeamlessUK taxonomy into a real Ontology over the first months of the project. This is still an initial draft of what the e-Government Ontology should look like. The relations among the entities are still a bit weak. This weaknesses of semantics is due to it is being created straight from the seamlessUK taxonomy, which has a particular term classification. It is very efficient in supporting tagging and keyword searching (people can look for keywords and use the structured list for searching), but not so good for web browsing, it is too big for web navigation purposes. For this or other purposes another kind of terminology and classification may be needed.

4.4 Results

4.4.1 SeamlessUK taxonomy

SeamlessUK is developed in Essex. Several implementations in different formats are available: plain text, Microsoft Word version, XML etc. In the following sections the XML format will be used to explain its structure.

The seamlessUK taxonomy was created to manage governmental information. It is currently used to index and facilitate keyword searching of the Essex web page

The taxonomy, which has 2621 terms, it is showed in its complete form in chapter 7.2 (Appendix). This chapter only focuses on the main relevant groups of terms:

seamlessUK taxonomy's main groups of terms
<pre> <?xml version="1.0" encoding="iso-8859-1" ?> <thesaurus name="Subject" database="Seamless" version="12" termcount="2621"> ± <term value="ARTS, CRAFTS, MEDIA"> ± <term value="BELIEFS and FAITHS"> ± <term value="BUSINESS and EMPLOYMENT"> ± <term value="CHILDREN and FAMILIES"> ± <term value="DISABILITY"> ± <term value="EDUCATION, CAREERS and TRAINING"> ± <term value="ENVIRONMENT and TRANSPORT"> ± <term value="ETHNIC ORIGIN and LANGUAGE"> ± <term value="GOVERNMENT and POLITICS"> ± <term value="HEALTH"> ± <term value="LAW"> ± <term value="LEISURE"> ± <term value="SCIENCE and TECHNOLOGY"> ± <term value="SOCIAL ISSUES, ADVICE and SUPPORT"> ± <term value="SPORT"> </thesaurus> </pre>

Table 4: seamlessUK taxonomy's main groups in plain text

Table 4 shows the main classification of the Ontology concepts. These terms are the most general terms in the classification; also known as broader terms or BT.

The taxonomy experts have classified the concepts in this way after gathering a lot of relevant information in these areas. They have acquired information from experts and users of each of these fields. We have to bear in mind the purpose of this classification: to ease web indexing and keyword searching. Other purposes may not benefit from this classification.

seamlessUK taxonomy's second level classification
<pre> <term value="ARTS, CRAFTS, MEDIA"> ± <term value="Arts"> <related_term>LEISURE</related_term> <related_term>Entertainment</related_term> <related_term>Culture</related_term> <related_term>Heritage Services</related_term> <attribute>ECC A-Z</attribute> ± <term value="Architecture"> ± <term value="Arts Administration"> ± <term value="Arts Venues"> ± <term value="Community Arts"> ± <term value="Culture"> ± <term value="Design"> ± <term value="Fine Arts"> ± <term value="Literature"> ± <term value="Music"> ± <term value="Performing Arts"> ± <term value="Visual Arts"> </term> </pre>

Table 5: Second level of hierarchy in the seamlessUK taxonomy

Table 5 shows a more detailed classification of the term Arts, which belongs to the group: *arts, crafts and media*.

It has several **related terms**: *leisure, entertainment, culture* and *heritage services*, which represent closely associated terms but not equivalents or terms closely related hierarchically to the term *craft*. When used for indexing the Essex web page, these related terms refer to the term *Arts*, so if the user looks for any of these, he/she will be suggested to also have a look at the others, as they contain similar information.

The term *Arts* also has several ‘**child**’ concepts; this means concepts that directly inherit from it (have all its characteristics but are narrower in scope). The hierarchical relationship is based on levels of superordination and subordination where the superordinate term represents a class or a whole and subordinate terms refer to its members or parts [5] *Arts* subordinate terms are: *Architecture, Arts administrator, Arts venues, Community arts, Culture, Design, Fine arts, Literature, Music, Performing Arts* and *Visual Arts*. Going deeper in the classification we will find each of these terms’ children and so on. When we reach the leaves of the classification, the more specific terms are known as narrower terms or NT (the ones that not have any children)

A graphical description taken from the Ontology editor WebOnto can be seen in the figures below. They model partial views of some of these subsets and their relations



Figure 11. WebOnto snapshot – fine arts class and its sub-classes

In the previous picture we can see a partial view of the fine-arts subset. This class has six children subclasses; one of those (painting) has two children as well (oil-painting and watercolour-painting), which are related to it within an inheritance relation.



Figure 12. WebOnto snapshot – arts venues subtree

This picture shows the taxonomy of the arts-venues classes. All the classes: arts-centres, cinemas, concert-halls, galleries, rehearsal-space and theatres are kinds of arts-venues, so they are linked to the main class within inheritance relations. The term theatre-licenses, however, is related to its upper class (theatres) within another kind of relation (theatres *'have'* theatre-licenses)

Leave terms
<pre> : <term value="Literature"> <term value="English Literature" /> : <term value="Literature Development"> <related_term>Arts Development</related_term> <use_for>Writers' Groups</use_for> <attribute>ECC A-Z</attribute> </term> <term value="Poetry" /> <term value="Reading" /> : <term value="Writing"> <use_for>Creative Writing</use_for> : <term value="Play writing"> <use_for>Playwriting</use_for> </term> : <term value="Screen writing"> <use_for>Screenwriting</use_for> </term> </term> </pre>

Table 6: Third and last level of hierarchy in the seamlessUK taxonomy

Table 6 shows the last level of hierarchy in a specific branch of the taxonomy. The term *Literature Development*, for example, introduces two new concepts:

Use for: Includes synonyms, variant spellings or singular forms. *Writers' Groups* is a synonym for *Literature Development*

Attribute: the field *attribute* express a characteristic of the element it belongs to. In this taxonomy it only displays that the term is referenced in the Essex County Council web page, in the A-Z section.

4.4.2 e-Government Ontology first version

The first version of the WP9 e-Government Ontology was developed from the seamlessUK taxonomy. It is almost a direct translation from the XML seamlessUK taxonomy into OCML, with small additions. The entire code of the e-Government Ontology can be found in chapter 7.3 (Appendix)

The following table show the same concepts already explained in the seamlessUK taxonomy, but expressed in OCML.

OCML class definition
<pre>(def-class seamless-uk-top-class () ((related_term :type seamless-uk-top-class-type) (has_ecc_a-z :type boolean) (use_for :type seamless-uk-top-class-type) (scope_note :type string) (misspell :type seamless-uk-top-class-type) (has-definition :type string) (has-useful-info :type string)))</pre>

Table 7: OCML class definition

The elements of a concept definition in the e-Goverment Ontology are the following:

Related_term: Defines similar or partially equivalent areas.

Has_ecc_a-z: Boolean field which indicates if the term is described in the A-Z section of the Essex County Council web page.

Use_for: States which are the term’s synonyms

Scope_note: States in which other terms the one referred to is used.

Misspell: is used to define common misspellings of certain words, for example: *ophthalmology* instead of *ophthalmology*, *crohns-disease* instead of *chrhn-s-disease*, *archaeology* instead of *archaeology*, etc.

All these terms are taken from the seamlessUK taxonomy. Nevertheless, two new fields are introduced within the Ontology:

Has_definition: Describes the term in natural language

Has_useful_info: Describes any useful info about the term

Partial view of the main classes of the OCML Ontology
def-class arts-crafts-media (seamless-uk-top-class)
def-class beliefs-and-faiths (seamless-uk-top-class)
def-class business-and-employment (seamless-uk-top-class)
def-class children-and-families (seamless-uk-top-class)
def-class disability (seamless-uk-top-class)
def-class education-careers-and-training (seamless-uk-top-class)
...
def-class sport (seamless-uk-top-class)

Table 8: Broader terms of the eGovernment Ontology

Table 8 shows a partial view of the top-class terms of the eGovernment Ontology. These are the broader terms of the classification (that is, they do not inherit from any other one). This classification is exactly the as that in seamlessUK.

Last level of the OCML hierarchy
<pre>(def-class arts-crafts-media (seamless-uk-top-class)) (def-class arts (arts-crafts-media) ((related_term :value leisure :value entertainment :value culture :value heritage-services) (has_ecc_a-z :value true))) (def-class architecture (arts) ((related_term :value planning)))</pre>

Table 9: Narrower terms of the e-Government Ontology

Table 9 describes the last level of the hierarchy; terms without any children. These are the leaves of the Ontology, inherit all the properties from their ancestors and are the ones which will be instantiated.

- **Differences between the taxonomy and the Ontology**

This section attempts to capture any changes and improvements that were made when the seamlessUK taxonomy was transformed into an OCML Ontology.

The Ontology defines as classes some terms that appear in the taxonomy without any definition (none of the synonyms in the taxonomy are described anywhere)

The Ontology has more descriptive power than the taxonomy as it adds two new fields for each class: `has_definition`, and `has_useful_info`; both defined as strings.

4.5 Future work

The current eGovernment Ontology needs to be reviewed in depth in order to improve its relations and semantics and provide it with better term descriptions and classifications within the eGovernment domain.

The new eGovernment Ontology will be either based on the current one or possibly

another new one will be developed from scratch, based on the seamlessUK taxonomy or as a result of the PSMV (a broader and more complete taxonomy covering a wide range of governmental terms).

Developing an Ontology from an already existent taxonomy is a very risky task. The structure and relationships among the terms might not be the most adequate to model a complete Ontology. An Ontology about a complex domain may well need to represent the domain classes within multi-hierarchical relationships, and some of these taxonomies are created as mono-hierarchical lists of terms (seamlessUK for example). In the early near future a decision about whether or not to follow (totally or partially) the existing taxonomies to create the final government Ontology will be need to be taken with care.

Finally, it should be noted that the current Ontology has a semi-formal grade of description, as it is described in an artificial formally defined language [6]. The aim of the final eGovernment Ontology is to be defined in a rigorously formal way (formal semantics, theorems, proofs)

5 CONCLUSIONS

Ontologies are beginning to play an important role within the new Semantic Web era. Although it is a very immature field, much progress has been made in recent years.

5.1 Perspectives for deployment of e-Government ontologies

WP9 is leading a new way of Ontology development within the governmental field. There is still a lot of work to do in the government area, as not so many governmental institutions are ready to implement this kind of system, because of their immaturity.

We believe in the potential of the SW, the great opportunities and advantages that can be obtained when applied to peoples' daily lives.

5.2 Influence on development of Semantic Web Services

WP9 will be focused over the next months on the development of the e-Government Ontology, and the GIS related Ontology. These Ontologies will be the basis of a common scenario on top of which SWS can be created. Ontologies state the vocabulary and the rules that model the piece of the world we are concerned with. Thereby SWS can interoperate over this common domain.

6 REFERENCES

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APPENDIX

Mock-up Ontology code (OCML)

```

;;; Mode: Lisp; Package: ocml

;;; The Open University

(in-package "OCML")

(in-ontology egovernment2)

(def-class SOCIAL-WORKER (CASE-WORKER ))

(def-class WORKING-PERSON (person)
  ((has-work-status :type work-status)))

(def-class AFFILIATED-PERSON (person)
  "A person which has an affiliation with some organization.
  For instance employees are affiliated to the organization they work for,
  students to the institution where they are studying, etc..
  A person can have multiple affiliations, which means that there is no
  constraint relating the values of slot has-affiliation-to-unit to the values
  of slot has-affiliation"
  ((has-affiliation-to-unit :type organization-unit)
   (has-affiliation :type organization :min-cardinality 1)))

(def-class E-GOV-TOP ())

(def-class thing (E-GOV-TOP))

(def-class GENERIC-AGENT (E-GOV-TOP)      ;;(temporal-thing)
  "This is a generic notion, an agent can be an organization, a person
  an animal, a software agent, etc"
  ((has-web-address :type URL)
   (has-email-address :type email-address)))

(def-class SELF-EMPLOYED-PERSON (working-person))

(def-class EMPLOYEE (affiliated-person working-person) ?x
  ((works-for :type organization)
   (works-in-unit :type organization-unit)
   (has-job-title :type string)
   (has-contract-type :type employment-contract-type)
  )
  :slot-renaming ((works-for has-affiliation)
                  (works-in-unit has-affiliation-to-unit)))

(def-class CLIENT (E-GOV-TOP)
  "A client is a generic notion. It can be a citizen, a couple or an asset"
  ((has-swift-id :type string :cardinality 1)
   (has-legal-representative :type citizen :cardinality 1)
   (involved-in-case :type case :min-cardinality 1)
  ))

```

```

(def-class ENTITLEMENT (E-GOV-TOP)
  ((has-entitlement-type :type entitlement-type :cardinality 1)
   (has-entitlement-provider :type entitlement-provider :cardinality 1)
   (has-payment :type payment :cardinality 1)
  ))

(def-class ENTITLEMENT-TYPE (E-GOV-TOP)
  ((has-eligibility-criteria :type eligibility-criteria)
  ))

(def-class ELIGIBILITY-CRITERIA (E-GOV-TOP)
  ((has-description :type string)
   (has-eligibility-criteria-function :type kappa-expression)
  ))

(def-class PAYMENT (E-GOV-TOP)
  ((for-entitlement :type entitlement :cardinality 1)
   (payment-status :type string :cardinality 1)
  ))

(def-class CASE-WORKER (AFFILIATED-PERSON))

(def-class CASE (E-GOV-TOP)
  ((has-status :type string)
   (has-originator :type string)
   (has-case-worker :type case-worker :cardinality 1)
   (has-client :type client :cardinality 1)
   (has-assessment :type assessment:cardinality 1)
   (has-decision :type decision :cardinality 1)
  ))

(def-class ASSESSMENT (E-GOV-TOP)
  ((applies-to-case :type case :cardinality 1)
   (has-facts :type string)
   (has-perceptions :type string)
   (has-decision :type decision :cardinality 1)
  ))

(def-class DECISION (E-GOV-TOP)
  ((applies-to-assessment :type assessment:cardinality 1)
   (has-entitlement :type entitlement)
  ))

(def-class couple (e-gov-top)
  ((has-citizen1 :type citizen)
   (has-citizen2 :type citizen)))

(def-class asset (e-gov-top)
  ((has-asset-owner :type citizen)))

(def-class BENEFIT (ENTITLEMENT)
  ((has-calculation-statement :type string :cardinality 1)
  ))

(def-class SERVICE (ENTITLEMENT))

(def-class asset-client (asset CLIENT))

```

```

(def-class couple-client (couple CLIENT))

(def-class AMOUNT-OF-MONEY (thing) ;; (Physical-Quantity)
  ((has-unit-of-measure :type currency)
   (has-amount :type number)
   :slot-renaming ((has-amount has-magnitude)))

(def-class CURRENCY (thing) ;;(information-bearing-object)
  ((issued-by :type government)))

(def-class ORGANIZATION-UNIT (generic-agent)
  "An organization may have a number of units. Units may themselves have sub-units"
  (
   (has-telephone-number :type string)
   (has-fax-number :type string)
   (has-postal-address :type postal-address)
   (has-size :type organization-size)
   (affiliated-people :type affiliated-person)
   (unit-of-organization :type organization)
   (sub-unit-of-organization-unit :type organization-unit)
   (has-sub-unit :type organization-unit)
   (headed-by :type affiliated-person)))

(def-class LEGAL-AGENT (generic-agent)
  "Some agents have legal status: definitely organizations and people,
  anybody else?"
  ((has-telephone-number :type string)
   (has-fax-number :type string)
   (has-postal-address :type postal-address)))

(def-class intangible-thing (thing)

(def-class tangible-thing (thing)

(def-class ORGANIZATION (legal-agent)
  "An organization is a type of legal agent"
  (
   (affiliated-people :type affiliated-person)
   (organization-part-of :type organization)
   (has-sub-unit :type organization-unit)
   (headed-by :type affiliated-person)
   (has-size :cardinality 1 :type organization-size)
  ))

(def-class ORGANIZATION-SIZE (intangible-thing)
  "We use EU guidelines to distinguish between different organization sizes")

(def-class EDUCATIONAL-ORGANIZATION-UNIT (organization-unit)
  ((unit-of-organization :type educational-organization)
  ))

(def-class LOCATION (tangible-thing)
  "A generic class for locations. It includes both real and
  fantastic places")

(def-class PERSON ( tangible-thing)
  ((full-name :type string)

```

```

(family-name :type string)
(given-name :type string)
(has-gender :type gender)
(has-academic-degree :type academic-degree)
(has-appellation :type appellation)
:slot-renaming ((full-name has-pretty-name)))

(def-class APPELLATION (Intangible-thing))

(def-class GENDER (Intangible-thing) ?x
  "HPKB says that genders are intangible..Uhm..."
  :iff-def (element-of ?x (set-of male-gender female-gender)))

(def-class WORK-STATUS (Intangible-thing))

(def-class EMPLOYMENT-CONTRACT-TYPE (Intangible-thing))

(def-class AGENCY (E-GOV-TOP ORGANIZATION-UNIT ))

(def-class citizen (person CLIENT )
  ((full-name :type string)
  (family-name :type string)
  (given-name :type string)
  (has-gender :type gender)
  (has-address :type address)
  (has-marital-status :type string)
  (has-religion :type string)
  (has-ethnicity :type string)
  (has-type-of-accomodation :type string)
  (has-date-of-birth :type string)

  ))

(def-class ENTITLEMENT-PROVIDER (agency )
  ((has-contact-person :type string :cardinality 1)
  (provides-entitlement :type entitlement-type :min-cardinality 1)
  ))

(def-class GEOGRAPHICAL-REGION (tangible-thing location)
  "Real' geographical regions")

(def-class PUBLISHING-HOUSE (organization))

(def-class LEARNING-CENTRED-ORGANIZATION (organization))

(def-class PROFIT-ORGANIZATION (organization)
  ((subsidiary-of :type profit-organization)))

(def-class NON-PROFIT-ORGANIZATION (organization))

(def-class SMALL-OR-MEDIUM-SIZED-ORGANIZATION (organization) ?x
  "SME are important, so we define a class to represent them explicitly.
  In some case we might not know or we do not want to bother specifying
  exactly whether something is a small-organization or a medium-organization.
  Hence, we can just say 'x is a SME' without going into further detail."
  :iff-def (and (organization ?x)
    (has-size ?x ?size))
  )

```

```

      (member ?size '(micro-size small-size medium-size)))
:avoid-infinite-loop t)

(def-class POLITICAL-ORGANIZATION (organization)
  "An organization which has a political connotation")

(def-class PARTNERSHIP (profit-organization)
  "A partnership is not necessarily a company, e.g. a consultancy firm is
  not a company")

(def-class COMPANY (profit-organization))

(def-class INDUSTRIAL-ORGANIZATION (profit-organization))

(def-class GOVERNMENT-ORGANIZATION (non-profit-organization))

(def-class CHARITABLE-ORGANIZATION (non-profit-organization))

(def-class R&D-INSTITUTE (learning-centred-organization))

(def-class EDUCATIONAL-ORGANIZATION (learning-centred-organization))

(def-class UNIVERSITY-FACULTY (academic-unit))

(def-class GEOPOLITICAL-ENTITY (Geographical-Region Generic-Agent)
  "A geopolitical entity is a geographical area which is associated with some sort of
  political structure. For instance, Russia, Italy, The-city-of-Messina, etc..
  A geopolitical entity can be also seen as an agent - e.g., France declared
  war to Spain")

(def-class SERVICE-PROVIDER (ENTITLEMENT-PROVIDER))

(def-class BENEFIT-PROVIDER (ENTITLEMENT-PROVIDER))

(def-class local-council-organization (government-organization))

(def-class national-government-organization (government-organization))

(def-class LOCAL-DISTRICT (geopolitical-entity))

(def-class MUNICIPAL-UNIT (geopolitical-entity))

(def-class COUNTRY (Geopolitical-Entity)
  ((has-capital :type capital-city)
   (has-currency :type currency)
   (has-government :type government)))

(def-class HIGHER-EDUCATIONAL-ORGANIZATION (educational-organization)
  ((has-academic-unit :type academic-unit)
   (has-support-unit :type academic-support-unit)))

(def-class R&D-INSTITUTE-WITHIN-LARGER-ORGANIZATION (r&d-institute organization-unit))

(def-class GOVERNMENT (GOVERNMENT-ORGANIZATION)
  ((government-of-country :type country)))

(def-class CIVIL-SERVICE (GOVERNMENT-ORGANIZATION))

```

```

(def-class PUBLIC-COMPANY (company)

(def-class PRIVATE-COMPANY (company)

(def-class UNIVERSITY (higher-educational-organization)
  ((has-faculty :type university-faculty)
   (has-vice-chancellor :type educational-employee)
   :slot-renaming ((has-vice-chancellor headed-by)))

(def-class CITY (municipal-unit)

(def-class TOWN (municipal-unit)

(def-class VILLAGE (municipal-unit)

(def-class county-council-organization (local-council-organization )

(def-class district-council-organization (local-council-organization )

(def-class borough-council-organization (local-council-organization )

(def-class parish-council-organization (local-council-organization )

(def-class CAPITAL-CITY (city)
  ((is-capital-of :type country)))

(def-class DISTANCE-TEACHING-UNIVERSITY (university)

(def-axiom CONSISTENCY-BETWEEN-COUNTRIES-AND-CAPITAL-CITIES
  (<=> (is-capital-of ?city ?country)
        (has-capital ?country ?city)))

(def-rule UNIT-OF-ORGANIZATION-IS-TRANSITIVE
  ((unit-of-organization ?u ?o)
   if
   (sub-unit-of-organization-unit ?u ?u-super)
   (unit-of-organization ?u-super ?o)))

(def-rule HAS-ACADEMIC-UNIT-IMPLIES-HAS-ORGANIZATION-UNIT
  ((has-sub-unit ?x ?y)
   if
   (has-academic-unit ?x ?y)))

(def-rule HAS-SUPPORT-UNIT-IMPLIES-HAS-ORGANIZATION-UNIT
  ((has-sub-unit ?x ?y)
   if
   (has-support-unit ?x ?y)))

(def-instance essex-county-council GOVERNMENT-ORGANIZATION )

(def-instance a-private-company PRIVATE-COMPANY )

(def-instance community-care service-provider
  ((has-contact-person "someone")
   (provides-entitlement meals-on-wheels nursing-support)
   (unit-of-organization a-private-company))

```

```

))

(def-instance housing-department benefit-provider
  ((has-contact-person "someone")
   (provides-entitlement housing-benefit council-tax-benefit)
   (unit-of-organization essex-county-council)
  ))

(def-instance disability-and-carers service-provider
  ((has-contact-person "someone")
   (provides-entitlement carers-allowance)
   (unit-of-organization essex-county-council)
  ))

(def-instance planning-department entitlement-provider
  ((has-contact-person "someone")
   (provides-entitlement building-regulations-permission)
   (unit-of-organization essex-county-council)
  ))

(def-instance jobCentre-plus service-provider
  ((has-contact-person "someone")
   (provides-entitlement attendance-allowance pension-credit)
   (unit-of-organization some-private-organization)
  ))

(def-instance housing-benefit ENTITLEMENT-TYPE
  ((has-eligibility-criteria eligibility-criteria1)
  ))

(def-instance council-tax-benefit ENTITLEMENT-TYPE )

(def-instance attendance-allowance ENTITLEMENT-TYPE )

(def-instance pension-credit ENTITLEMENT-TYPE )

(def-instance meals-on-wheels ENTITLEMENT-TYPE )

(def-instance nursing-support ENTITLEMENT-TYPE )

(def-instance carers-allowance ENTITLEMENT-TYPE )

(def-instance building-regulations-permission ENTITLEMENT-TYPE )

(def-instance mother CITIZEN
  ((has-swift-id "001")
   (has-legal-representative daughter)
   (involved-in-case mother-case)
   (full-name "mother Scott")
   (family-name "Scott")
   (has-gender female)
   (has-address mother-address)
   (has-marital-status "widow")
  ))

(def-instance daughter CITIZEN
  ((has-swift-id "002")
   (involved-in-case daughter-case)
  ))

```

```
(full-name "daughter Scott")
(family-name "Scott")
(has-gender female)
(has-address daughter-address)
(has-marital-status "single")
))
```

```
(def-instance mother-case-worker CASE-WORKER
  ((has-affiliation-to-unit :type housing-department)
   (full-name "worker full name")
   (has-gender female)
   (has-academic-degree social-sciences)
   (has-appellation MISS))
)
```

```
(def-instance mother-case CASE
  ((has-status "active" )
   (has-originator "Mother's GP")
   (has-case-worker mother-case-worker)
   (has-client mother)
   (has-assessment mother-case-assessment)
   (has-decision mother-case-decision)
  ))
```

```
(def-instance daughter-case CASE
  ((has-status "active" )
   (has-originator "herself")
   (has-case-worker daughter-case-worker)
   (has-client daughter)
   (has-assessment daughter-case-assessment)
   (has-decision daughter-case-decision)
  ))
```

```
(def-instance mother-case-assessment ASSESSMENT
  ((applies-to-case mother-case)
   (has-facts "change of circumstance: moves to daughter's house" "is disabled")
   (has-perceptions "eligible for benefits " )
   (has-decision mother-case-decision)
  ))
```

```
(def-instance daughter-case-assessment ASSESSMENT
  ((applies-to-case daughter-case)
   (has-facts "disabled mother moves in")
   (has-perceptions "eligible for services" "permission to adapt the house " )
   (has-decision daughter-case-decision)
  ))
```

```
(def-instance mother-case-decision DECISION
  ((applies-to-assessment mother-case-assessment)
   (has-entitlement mother-housing-benefit
                   mother-council-tax-benefit
                   mother-pension-credit
                   mother-meals-on-wheels
                   mother-nursing-support )
  ))
```

```
(def-instance daughter-case-decision DECISION
  ((applies-to-assessment mother-case-assessment)
```

```

(has-entitlement daughter-attendance-service
daughter-carer-service
daughter-building-permission)
))

(def-instance daughter-attendance-service SERVICE
((has-entitlement-type attendance-allowance)
(has-entitlement-provider jobCentre-plus)
(has-payment daughter-payment-for-attendance-service)
))

(def-instance daughter-carer-service SERVICE
((has-entitlement-type carers-allowance)
(has-entitlement-provider disability-and-carers)
(has-payment daughter-payment-for-carers-allowance)
))

(def-instance daughter-payment-for-carers-allowance PAYMENT
((for-entitlement daughter-carer-service)
(payment-status "exempt")
))

(def-instance mother-housing-benefit BENEFIT
((has-entitlement-type housing-benefit)
(has-entitlement-provider housing-department)
(has-payment mother-payment-for-housing-benefit)
))

(def-instance mother-council-tax-benefit BENEFIT
((has-entitlement-type council-tax-benefit)
(has-entitlement-provider housing-department)
(has-payment mother-payment-for-council-tax-benefit)
))

```