

# PSL : an ontology based language for the representation of multi-lingual urban permitting systems

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**Abstract** : The paper proposes an expression using the Process Specification Language (PSL) of the administrative process of planning permissions in four different countries (Belgium, France, UK). Besides eliciting differences and convergences between different legal approaches as regard with planning permission, the PSL expression is intended to be used as an exchange support between project planning software, permitting systems and geographical information systems used by the construction industry and local authorities.

## Introduction

Municipalities and town councils are the public bodies politically responsible for the long-term regulation of large urban civil engineering projects. The instruments to support this activity typically include management procedures, standards, legal norms and a diversity of computer tools ranging from 3D GIS to Web-based interfaces. This set of instruments has expanded in a dramatic way over the last decade and it will most probably keep so for the next years, pushed as it is by the demands of citizens, the development of international frameworks (especially in the domain of urban sustainability) and technical innovation.

Good urban governance urgently require an improved integration between these instruments: computer tools fit to the evolution of the legal context, data sharing between different systems in order to streamline decision-making processes, integrated management at a municipal level that allows quick and efficient resolution of conflicts between different stakeholders. So the point of developing ontologies that may be shared by these different instruments in the view of improving their interoperability.

As far as now most efforts in the domain of urban ontologies focused on objects and their relationships, may these objects be physical (infrastructure networks, transport systems and the like) or abstract ones (planning objects, urban limits etc.). The purpose of this paper is to examine the applicability of ontologies for the expression of processes, whose role in an improved urban governance has long been stressed in the literature. The next section will briefly state the context in which this research takes place. We will then describe a specific urban regulation process, namely the urban permitting system as it is designed in three European Member States (UK, France and Belgium). The permitting processes in these three countries has been modelled in PSL language. This model serves two uses: it allows a formalised comparison of the process in three different contexts and it is designed to serve as an interoperability format for exchanges between GIS, project planning and permitting softwares.

### **Context of the work : the COST C21 Towntology action**

The COST Action C21, « Urban Ontologies for an improved communication in urban civil engineering projects » started in February 2005, with a 48 months duration. Ten countries participate in the work. The web site of the project is : <http://www.towntology.net/>.

The main objective of the Action is to increase the knowledge and promote the use of ontologies in the domain of Urban Civil Engineering (UCE) projects, in the view of facilitating the communications between information systems, stakeholders and UCE specialists at a European level (Groupware). Secondary objectives are : producing a taxonomy of ontologies in the UCE field, contrasting existing design methodologies, techniques, glossaries and production standards ; developing an urban civil engineering ontology both in textual and visual (graph) presentation and a visual editor to integrate and update concepts, definition, photos, etc. into the ontology (software tool) ; developing a set of guidelines for the construction of multi-lingual UCE ontologies, based on practical examples (cases) ; analysing the role of ontologies as a tool to foster an improved communication between UCE stakeholders.

Three working groups have been established : WG 1 - Methodologies for developing UCE ontologies ; WG 2 - Construction of multi-lingual UCE ontologies ; WG 3 - Impact of ontologies upon organisational structures. The present work has been developed in the context of WG1.

### **Urban permitting system : main features and specificities across European countries**

In this section, we recall main specificities of urban permitting systems in three European countries : UK, France and Belgium. Some features are common to the different documents, but there are also strong differences which are mainly due to differences in the legal and political culture in these three countries.

### **Role of permitting systems**

Generally speaking, the permitting systems aim at ensuring environmentally sound operations. Also, they provide reference levels to calculate charges and taxes to be paid. The permits (licences) are believed to potentially fulfil a number of functions, such as: secure that private and public interests are respected, guarantee that incentives to protect the environment in an effective and cost-efficient way are provided to the regulated community, stipulate the kind of non-compliance responses to be taken in the case of a breach of permit requirements, contribute to a favourable investment climate, stimulate technical innovation and adoption of cleaner production, provide a mechanism to identify the regulated community and keep track of its environmental performance, and play the role of an asset that can be transferred to another owner (EAP TF, 2003).

### **General features**

*Planning permission* or *planning consent* or else *permit licence* is the permission required by property developers and private individuals in order to be allowed to build on, or change the use of, a plot of land or to redevelop an existing building. In certain circumstances (in the UK), planning permission is not required before work can commence and this is known as permitted development.

### **Planning permission (UK)**

In the UK, the concept was introduced in the *Town and Country Planning Act (1947)*. The planning permission system is administered by the Local Planning Authority. A number of different types of planning permission can be applied for : Full planning permission, Outline Permission, Reserved matters (seeking permission for those aspects that were not dealt with in the outline permission), Renewal of full planning permission and Removal or alteration of a planning condition. Planning permissions are usually granted for 3 years and typically contain a number of planning conditions that need to be complied with (eg. built as per the approved drawings, trees planted as per the landscape scheme and replaced if they die in the first few year. materials should be approved by the Local Authority etc.) Some of these need to be complied with before any work starts on site others may not. It can be difficult to sell a property that does not have fully discharged planning conditions. It should be noted that once granted, Planning permissions (with very few exceptions) relate to the *Land* and not the person who applied - *The Applicant*. This is important because it means that land can be sold 'With the benefit of planning permission'. All applications must include copies of a location plan based on an up-to-date map. The plans of the proposed development should accurately show the proposed development in relation to the site boundaries and other existing buildings on the site. The local authority checks the plans and consults their Statutory consultees and the general public who must comment within three weeks. The authority must complete the procedure by issuing a decision within eight weeks or, for major applications 13 weeks. If agreed with the applicant, extensions of time are permissible.

### **Permitting system in France (Permis de Construire)**

In France, the application form to be filled in to get a "permis de construire" needs several documents, among which layouts and maps close to those

required by the UK system. The building permit license is in France an administrative authorisation given on strong conditions coming from third parties or covenants. Those are very important since they can drive, in some cases, architectural features of the construction project (e.g. windows opening onto a garden of the neighbour). It is up to the Applicant to check out that his construction project fulfils the rules applicable, in terms of sun lighting, neighbourhood constraints, passageway and others. Usually, within two weeks, the applicant receives a letter notifying the decision about the construction project. Taxation properties are also an important feature of the permitting system in France, since different surface assessments of the property need to be mentioned in the document, notably dwelling surface and overall surface. As in the UK, layout plans and overall plans have to be provided with the form. The documents must be sent to the Town Hall of the construction site (Ministère de l'Urbanisme, 2006).

### **Permitting system in Walloon Region (Permis d'urbanisme)**

Legislation concerning land planning has been entirely regionalised in Belgium since 1980. Regions are hence competent to edict and enforce laws concerning planning permissions. In the Walloon Region, this issue is regulated by the CWATUP (Code Wallon de l'Aménagement du Territoire, de l'Urbanisme et du Patrimoine), which defines the permitting procedure following to the nature of development (small buildings, usual ones, large infrastructures that require and environmental impact assessment beforehand), the area where the development is located (delineated zones, planning secteurs etc.), the entity that applies for a permit (public administrations or private).

Generally speaking a permit is delivered to a person or an organisation in the Walloon Region. It is not transferable nor sellable. Furthermore, since the last reforms of the CWATUP, most the permitting procedure is under the control and supervision of local authorities (Belgian communes). The agreement of regional authorities is not required to grant a planning permission except in special cases, as when a planning zone or a local regulation has to be derogated or when the project is of major interest. The procedure further defines the possibilities for the developer, the commune or the Regional authorities to appeal against planning decisions. In the Walloon Region there is no possibility for third parties to introduce an administrative appeal against a planning permission, unless on a procedural basis via the Conseil d'Etat that will solely judge on the legality of the administrative process.

The planning application is introduced by the developer at the municipal hall which then has to manage the entire procedure: dispatch the documents to the different authorities/administrative bodies that have to be consulted, ask for more information, organise the public consultation if requested etc. This can prove a very arduous task, especially for smaller local authorities (less than 20.000 inhabitants) and for planning applications that require some derogations which is often the case for larger development. It has still to be acknowledged that, despite these difficulties, the best management of this process is essential to attract investment in cities and to maintain good standards of environmental quality.

### **Problems encountered**

If we try to make a synthesis of the permitting system across the three countries mentioned in this section, we can notice that, whatever the country, the documents to be filled in look similar (application form). Differences appear in the content of the layouts, the degree of precision of the plans, but also in the representation and the interpretation of property limits and property neighbourhood. According to the country, property limits can impose constraints and covenants to the Applicant – given the regulation applicable to the country, or to the construction area.

An important feature is that this information can be implicit : it is up to the applicant to check the local regulation applicable (e.g. in France) and to propose a project in conformance with the local rules : e.g. roofing system whose slope depends on the region, overall shape of the house, use of solar energy, use of construction materials (timber, ... ) depending on the region and depending on the style of the houses.

According to the countries, the surfaces may or may not be calculated on the same bases : ground surface, dwelling surface, vacant land. According to the rules of the local authorities, the authorised construction surface may differ.

From the previous comments, it is obvious that, to consider a European approach of the permitting system, we need a common representation of the corresponding information : ontology based representations have been analysed within the framework on the COST C21 TOWNTOLLOGY project. We present in this paper the PSL language, as a possible key-enabler for representing multi-lingual urban permitting system information.

### **Overview of the PSL language**

The Process Specification Language (PSL) project, whose development started at the National Institute of Standards and Technology (NIST, US), is a formal language aimed at creating a neutral, standard language for process specification to serve as a neutral representation to integrate multiple process-related applications throughout the manufacturing life cycle. The language is based on first-order logic. The scope is limited to the realm of discrete processes related to manufacturing, including all processes in the design/manufacturing life cycle.

As a formal language, PSL is a lexicon (set of logical and non-logical symbols) and a grammar (specification of how these symbols can be combined to make well-formed formulae). All are chosen to represent the basic concepts in the PSL ontology. The underlying grammar used for PSL is roughly based on KIF (Knowledge Interchange Format) (KIF, 1999), formal language based on first-order logic developed for the exchange of knowledge among computer programs with disparate representations. To date, PSL contains more than 330 concepts and 46 definitional extensions. The foundation of the process specification language is the PSL ontology, which provides rigorous and unambiguous definitions of the concepts necessary for specifying manufacturing processes to enable the exchange of process information. The PSL ontology is essentially two-tiered. The foundation of the ontology is a set of process-related concepts that are common to ALL manufacturing applications. These concepts constitute the core of the PSL ontology (see Fig. 1). Since these concepts, alone, only allow for the exchange of very simple process specifications, the ontology includes a

mechanism to allow for extensions to these core concepts (the second tier) to ensure the robustness of the ontology.

PSL Core Primitives	Type	Informal definitions and axioms
activity	relation	Everything is either an activity, an activity occurrence, a timepoint, or an object. Objects, activities, activity occurrences, and timepoints are all distinct kinds of things (disjoint classes).
activity_occurrence	relation	An activity occurrence is associated with a unique activity. But there are activities without occurrences.
timepoint	relation	Given any timepoint t other than inf-, there is a timepoint between inf- and t. Given any timepoint t other than inf+, there is a timepoint between t and inf+.
object	relation	An object participates in an activity at a given timepoint and only at those timepoints when both the object exists and the activity is occurring.
before	relation	The before relation only holds between timepoints. It is a total ordering, irreflexive, and transitive relation.
occurrence_of	relation	Every activity occurrence is the occurrence of some activity and associated with a unique activity.
participates_in	relation	The participates_in relation only holds between objects, activities, and timepoints, respectively.
beginof	function	The beginning of an activity occurrence or of an object are timepoints.
endof	function	The ending of an activity occurrence or of an object are timepoints.
inf+	constant	Every other timepoint is before inf+.
inf-	constant	The timepoint inf- is before all other timepoints.

Fig. 1 : Concepts in PSL Core (part 11)

The extensions are the third component of PSL : they provide the resources to express information involving concepts that are not part of PSL Core. To define an extension, new constants and/or predicates are added to the basic PSL language, and, for each new linguistic item, one or more axioms are given that constrain its interpretation. In this way one provides a semantics for the new linguistic items. The current extensions deal with Activity, Temporal and state, Activity ordering and duration, Resource roles, Resource sets, Processor activities (IFAC 2005). The language is being standardised at the international level, under the reference ISO 18629 PSL (Part 1). The language has initially been developed for manufacturing purposes, but several applications in other domains, such as construction (construction projects), have been developed (Pouchard, 2004), (Grüniger, 2003).

### Use of PSL for the representation of multi lingual urban permitting systems

The main purpose of PSL is to establish a computer language for exchanging process information between software applications, such as CAD, project design, GIS software, estimating software tools. As a specification language, PSL can be considered as a specification tool of the information and knowledge to be exchanged : this information has to be formalised through verbs (processes, activities, actions) to be dealt with by PSL.

#### Main principles of the PSL translation

Those principles are described on the example of two applications (namely A and B), that do not necessarily exchange all their processes for

interoperability : only one or a set of processes may be translated. After identifying the concepts to be exchanged, the translation is performed in three steps (Pouchard, 2000) :

- **Syntactic translation** : the native syntax of an application is parsed to PSL syntax (KIF). This parser keeps the terminology of the application.

- **Semantic translation to PSL** : keeping the KIF syntax for the terminology of the application of interest, KIF definitions are written for that application using PSL definitions. These definitions are found within the concepts of the PSL extensions. The question wizard (PSL wizard, 2006) facilitates the attribution of definitions to the terminology and concepts of an application to PSL definitions. Translation definitions between an application and PSL ontology can be derived from the ontological definitions and axioms provided in the different parts of ISO 18629.

- **Semantic translation from one application to another** : At this point, the processes of the source and target applications have been expressed using PSL terms and KIF syntax. Each should have a one-to-one correspondence between each process definition and a PSL definition. The concepts of the source application are mapped to concepts of the target application using PSL as the intermediate language. On this basis, data for the relevant process can be exchanged.

### The PSL Wizard

The PSL Wizard has been developed through several forms intended to help map process characteristics into PSL Ontology concepts. Each form contains a questionnaire aimed at defining the concept from the ontology the most suited to the needs of the user. The Fig. 2 shows an example of the form for the class of complex activities.

To date, the wizard has been developed for the following concepts : classes of Atomic Activities and classes of Complex Activities



Fig. 2 : PSL Wizard

### Potential benefits of the approach

The PSL approach applied to the representation of multi-lingual permitting systems needs to express the knowledge related to permitting systems in terms of processes, in terms of the set of actions the permitting system is made of : those actions appear in the different sections of the form to be filled in. As such, it can be considered as an important tool to clarify the full process and the different stages the process is made of : an example of a UML activity diagram is proposed in the Fig. 3 :

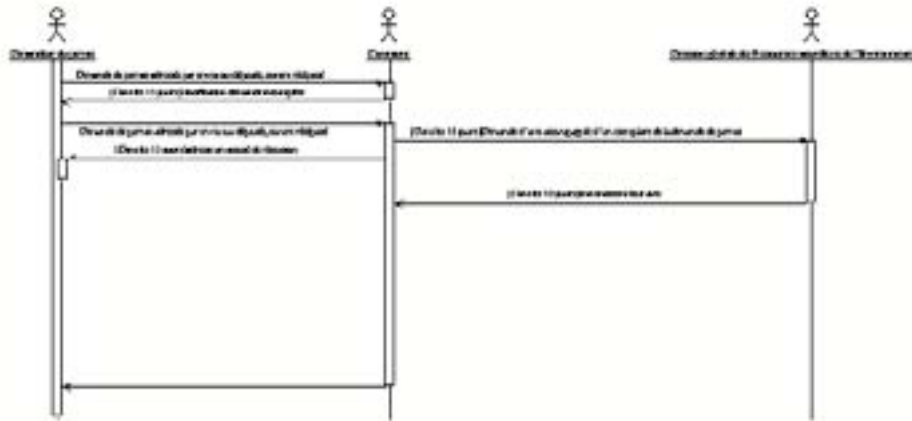


Fig. 3 : UML activity diagram of the initial procedure of demand of a permit system in Belgium

### Conclusion – summary, issues

Urban permitting systems witnessed a series of evolutions over the last ten years in most European countries. This certainly explains by the fact that this process plays an essential role in the sustainable development and attractiveness of European towns and cities. Hence most recent changes in permitting procedures intended to further improve the efficiency and accountability of the overall process, as well as to cope with the decentralisation of planning competences from States and Regions towards cities and municipalities.

An ontology based on the PSL language has been designed to model this process. This research work, although it is still at its earlier stage, highlights the lack of communication between different instruments mobilised in the management of the process as well as significant divergences between EU Member States in the formulation of requirements to applicants. These divergences are unavoidable and somehow positive in that they refer to a diversity of urban context and cultures in the Union. Still they should not constitute a barrier for the present integration of the European construction and development market.

A better formulation of urban permitting requests and process is hence required from both a technical and conceptual point of view. Further work now has to be achieved in order to implement a running PSL expression of the



process in the three countries, so as to make applicable for the interoperability of GIS, project planning and permitting software.

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