CITIZENS AND PUBLIC SERVICES – A DIGITAL DIALOGUE REGARDING BUILDING PERMITS

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ABSTRACT

This paper introduces the ongoing developments in the Netherlands for the improvement of bureaucratic procedures regarding building permits. The Dutch Ministry of Housing, Spatial Planning and the Environment has initiated and supports a number of developments that aim to decrease the administrative burden for both citizens and municipalities. One of these initiatives is The Digital Dormer, which is a web site that allows citizens to design a dormer for their house and that instantly performs a range of tests to give detailed feedback about the legal and technical issues regarding the design. The paper briefly introduces the underlying technology used to build this application, a newly developed building information model. It then describes the functionality and implementation of the dormer web site itself. Finally, we look at future developments of this project, which will include its relations to other projects and to a separate site for the transparent procurement of small construction projects.

KEY WORDS

eGovernment, Building Information Model, Digital Code Checking, eCommerce, Design Support.

INTRODUCTION

This paper discusses ongoing developments in The Netherlands regarding computer support for the procedure of applying for and issuing building permits. These developments are part of a larger project, initiated by the Dutch Ministry of Housing, Spatial Planning and the Environment (Ministry of VROM 2006a), targeting also other kinds of permits related to the built environment and its usage, such as environmental permits, permits for industrial activities, permits to demolish buildings, permits for cutting trees, etc.

Following examples such as the Planningportal in the UK (www.planningportal.gov.uk) and the VIRK portal in Denmark (www.virk.dk), the Dutch government aims to not only make permit related information available in a structured way, but also to simplify and facilitate the application and issuing procedure. This paper first introduces the current policy

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and developments in this area in The Netherlands and then focuses on a specific case – the permits for dormers – for which a web application was developed using a new building information model as its basis. One of the main features of this web application is the instant building codes checking that it performs during the design process.

Research on building codes checking already has some history. Acknowledging that the main problem is not just in formalizing the building codes but mainly in unambiguous description of building information, much effort has been targeted at standardization of building models (Vanier 1995, Eastman 2002). More recently, other approaches have been developed that take advantage of more flexible technologies (Woodbury et al. 2000; Yang and Xiang 2001). Ha et al. (2002) developed a performance-based approach to check the accessibility of a building for wheelchair users.

DUTCH POLICY ON PERMITS FOR THE BUILT ENVIRONMENT

CURRENT SITUATION

In The Netherlands, circa 150,000 building permits are requested yearly. A building permit is required whenever a citizen or company wants to initiate a building project. Most of these projects are initiated by citizens for the enlargement of existing buildings, such as dormers, extensions, annexes, garages, etc. The permits requested by companies generally concern new buildings and larger renovation projects, e.g., permits for large scale housing projects or industrial buildings. Permits are requested from the local municipalities. These generally have a service dedicated to code enforcement and inspection of construction projects. This service will assess the technical qualities of the proposed construction work and will verify that the proposed building is allowed within the constraints of the local land use plans. If the activities in the proposed building are potentially harmful to the environment, additional environmental permits will be required from the local municipality, from the province, or from the national authorities. Other permits may be needed, e.g., for the cutting of trees or the demolition of existing buildings. Also, extensive and time-consuming procedures may be required, such as the modification of land use plans.

The process of requesting and issuing permits requires much effort and is often cumbersome. Many of the requests are submitted by people who will only go through this process once in their lifetime. Especially in these cases, the application process will involve much communication between applicant and issuer. The first issue to be resolved is whether or not a permit is required. Some years ago, the Ministry of VROM has simplified the regulations by expanding the categories of construction projects that do not require a permit or that can be granted a so-called *light permit*. Light permits are obtained through a simplified procedure, requiring much less paperwork and thus allowing for a faster process. When introducing this new law, the Ministry also published a website (Ministry of VROM 2006b) that informs the applicant, through a treelike structure of closed questions, what type of permit is needed.

It is regarded essential that authorities make clear which laws and regulations are in effect, both technically and procedurally. In 2002, the Dutch government has determined by law what kind of data municipalities are allowed to request before issuing building permits (i.e. the law on submission requisites for building permits). Citizens can find detailed

information on current national legislation online (Overheid 2006). Many municipal authorities also provide this type of information online, regarding local policies and regulations. Some leading municipalities offer an online application form for the more simple permits. However, digital issuing of permits is not yet practiced.

Apart from the informative websites, the communication regarding the building permits is largely non-digital. As a result, there is little structured control over the communication process. Often, the submitted information is incomplete or of insufficient quality. In such cases, municipalities should normally refuse the permission, but generally a communication process is started to obtain the correct information. The consequence of incompletion and low quality of information is that much more communication takes place than is strictly necessary, leading to high costs for both applicants and issuers of permits.

In the policy of the current Dutch government, reduction of the administrative burden is an important item. The Ministry of VROM has calculated the yearly costs of the administrative burden caused by sector-specific regulations. These are costs that are made by citizens and companies to demonstrate that they meet the requirements in these regulations. Examples of such requirements are construction drawings, structural calculations, environmental reports, obligatory tests or inspections, etc. In 2002, companies spent a total of 1700 million Euros on these requirements; private citizens spent 43 million Euros and 56 million hours filling out forms and producing the required documents.

The present government aims to reduce this burden with 25% in all national regulations before the next elections in 2007. The Ministry of VROM has determined that in the construction sector a reduction of 29% should be possible, partly through an amendment of the laws regarding the required permits and the requisites for these permits. This amendment will lead to a new type of permit, the *Spatial Permit*, which is to replace a number of separate permits that are currently required (see below). The introduction of this new Spatial Permit and the simplified procedure that comes with it, partly through the application of ICT means, will lead to a considerable annual reduction of costs.

FUTURE SITUATION

Recently, the government has accepted a bill titled 'General regulations environmental law' (in Dutch: Wet algemene bepalingen omgevingsrecht). In this bill, the application procedure for building and environment related permits is simplified and the time needed for issuing these permits reduced. The new law proposes a uniform regulation that defines the so-called *Spatial Permit*. The law is expected to become effective January 1, 2008. The new Spatial Permit will replace the collection of permits that are currently needed when a citizen or company wants to demolish, construct, or use a facility on a particular location. Circa 25 permits, exemptions and other permissions are replaced by this single permit. This does not only include national regulations, such as the environmental permit, building permit, and monumental permit, but also provincial and municipal regulations. The new law also reduces and normalizes the procedural terms that are much differentiated in the current procedures. In most cases, a regular procedure of maximum fourteen weeks will be followed. After this maximum term, the regular procedure will lead to automatic granting of the permit, the so-called fatal term. More complex cases will require an extensive procedure of maximum 32 weeks that does not have a fatal term.

An explicit objective of the introduction of the Spatial Permit is to support the process of requesting and issuing the permits with digital means. This includes the application procedure and the efficient handling by the authorities. The most important objective is that each municipality offers a single digital desk that guides the applicant through all issues of the Spatial Permit: the applicant will be dealing with only one authority.

CURRENT DEVELOPMENTS

Currently, the following developments are ongoing.

Electronic application form and the e-Form facility

To enable the digital application for permits, a digital application form for the Spatial Permit is being developed. Its precursor, the digital construction permit, is now in test phase. Related to this digital form, a tree-structured set of questions is developed and made available online that guides the applicant through the application procedure. The digital form is defined in XML format, in collaboration with third parties that are expected to develop applications and tools facilitating the procedure.

The Dutch government has initiated the so-called 'e-Forms' program that, comparable to the Danish VIRK public services portal for businesses (www.virk.dk), develops online forms for all (semi) public services. The digital construction permit and, eventually, the digital spatial permit are developed within this program.

Digital Construction Desk

The Digital Construction Desk facilitates the online submission of applications for construction permits, including the accompanying drawings and calculations. All documents involved in the procedure can be submitted digitally and the application forms are completed online. This leads to a complete record of the application that is accessible to various parties involved in the procedure (municipality, fire department, aesthetics committee, etc.). The system includes automatic checking of the legal terms.

This new system makes it possible to reduce the time needed for the application procedure, thus reducing costs for both applicant and issuer. The system is being developed in a commission by nine municipalities, with financial support from the Ministry of VROM. At the time of writing, the first version has been completed and is undergoing tests. Future developments will include support for workflow management for the municipal services.

The Digital Dormer

Of the applications for permits submitted by citizens, a considerable part is for the construction of dormers. For example, in the city of Rotterdam 300 applications for dormers are filed yearly. These form 20% of the permits requested for smaller projects and close to 15% of the total number of applications. The construction costs of dormers are relatively low (varying between € 2,500 and € 35,000) which makes a complex application procedure relatively expensive. Although the actual procedure is relatively simple and the list of requisites to obtain the permit limited, the procedure is still experienced as quite a burden, mainly because of occurrence of mistakes and incompleteness of the requisites.

The remainder of this paper presents *The Digital Dormer*, a recently completed project that has resulted in a web application that allows citizens to 'design' a dormer for their house, to check the design against all effective regulations, and to submit a digital form and all requisites online to initiate the application procedure for the construction permit. This project is part of the range of projects supported by the Ministry of VROM in the context of the above described development of online tools for the Spatial Permit procedure.

COMMUNICATION ON BUILDING PERMITS

CASE: DORMER PERMITS

Current practice of the application procedure for a building permit for a dormer is that the applicant must submit the following documents/drawings, on paper:

- Completed generic application form with questions about personal details, location of the building, usage of the building, measures, materials, costs, execution of the project, etc. In total, these are 5 pages of questions; not all of these questions are actually considered necessary for dormers, but this is not indicated on the form.
- Drawing from the land register
- Plans of the existing and new situation
- Vertical sections (existing and new) for the complete building
- Elevation drawings (existing and new) of front and side views
- Detailed technical drawings
- Structural calculations
- List of materials used

Currently, these documents are required on paper. Apart from the application form, no specific document format is prescribed. Generally, the required documents are technically too complicated to allow citizens to produce these themselves. The projects are normally too small and limited in budget to prompt citizens to hire an architect. So, generally, it will be a pre-selected contractor or specialized company in dormers and like extensions, who will be preparing the documents. Some of these contractors offer paid services to manage the complete application procedure. The costs of these services can amount up to 10% of the actual construction costs.

Ambiguity, incorrect information, missing documents, and in particular incomplete parts of information are the main causes for elaborate and tedious communication, by letter or phone, after the first application has been submitted. Although the procedure is relatively simple, the required information quite clearly stated, and the variety of designs submitted rather limited, the fact that citizens are inexperienced with the process leads to an inefficient procedure. The efficiency of this procedure can be improved considerably through the development a support tool that guides the citizen through the decision-making process, performs many checks instantly, and helps gather the necessary information to produce the required documents in a correct and complete format. The objective of the project described in this paper is to develop such a support tool, which we have dubbed *The Digital Dormer*.

THE DIGITAL DORMER

This project started with the observation that citizens have a need to find out what kind of extensions to their homes are possible and are likely to be permitted. Also, they would like to know what such extensions would cost. Then, they would like to have access to an online application procedure, making it easy and cheap to obtain the permit. Finally, they would be helped if a transparent procurement procedure could be supported.

Municipalities have an interest in improving the quality of the information submitted by citizens and in automating the feedback that can be given to questions on the basis of the regulations that are in effect. However, municipalities are not interested in any commercial activities surrounding the design and construction of dormers. On the contrary, they have a need to remain distant from commercial interests.

This amounts to a system that helps citizens in the decision-taking process by:
- Providing accurate information about the citizen's local situation;
- Offering knowledge-based feedback regarding the applicable regulations;
- Helping to check the design against these regulations;
- Preparing all documents to be submitted to the municipality;
- Offering a link to a procurement portal that provides a transparent bidding procedure.

The main technological challenges for developing the required functionality of The Digital Dormer were (van Leeuwen et al. 2004):
- To offer a simple 'graphic design' tool for use by lay persons, with a good balance between the realism of the representation and the level of user-interaction required;
- To provide an informative feedback system that acquires all information from the user that is necessary to evaluate the design using criteria from land use plans as well as from the local policy on architectural aesthetics;
- To perform the checking of both geometrical and non-geometrical criteria regarding the position, size, materials, and other characteristics of the dormers with respect to the specific context of the house, its location, and the national and local regulations.
- To minimize the requirements of client-side software to what can be expected at people's homes: just a web browser;
- To have a flexible software-architecture, regarding the type of houses and dormers, the test criteria, and other specific requirements that will vary per municipality.

The validation and code checking that the system needs to perform has a number of sources:
- Technical and logical limitations (e.g., the top of the dormer cannot exceed the ridge of the house);
- National regulations for the type of permit required (i.e. full permit, light permit, or no permit at all);
- Local regulations regarding the aesthetics of the design (e.g., size, position of the roof, colors, materials, …);
- National building codes (applicable parts concern daylight admission, ventilation, thermal insulation, structural safety, etc.);
- Technical aspects, such as the sound insulation. Even when these are not legally enforced, advice can be offered to citizens to ensure high quality.

The web application that has been developed in this project acquires all necessary information from its users, giving graphical feedback to the users for direct control. It performs the above listed checks instantly and provides immediate feedback regarding the correctness of the design, the consequences of the decisions for the type of permit that will be needed, and the expectation whether or not it will be issued. The actual issuing of the permit remains a formal decision to be taken by officials from the municipality.

IMPLEMENTATION OF THE DIGITAL DORMER

The Digital Dormer system is a web application that makes use of a newly developed building information model, called *The Digital House*. This model is the result of a joint effort of three Dutch CAD-software developing companies that focus on the architectural design market. In concurrence with other developers of building information models, mostly developed by internationally operating CAD developers such as IEZ, Nemetcheck, Graphisoft, Bentley, and Autodesk, this development also aims to provide a semantically rich model that will form the basis for the interoperability of a range of software applications, of which CAAD is only one. This national initiative, however, is unique in that it focuses on Dutch specifics, such as Dutch construction law, local construction practices, regional suppliers of construction products, national de-facto standards for design specification writing, cost estimation, etc. The model aims to support as much as possible the existing practices of the various disciplines, not just by using terms that are known by professionals from these disciplines, but also by providing an information structure that is easy to understand and that follows the traditional design process.
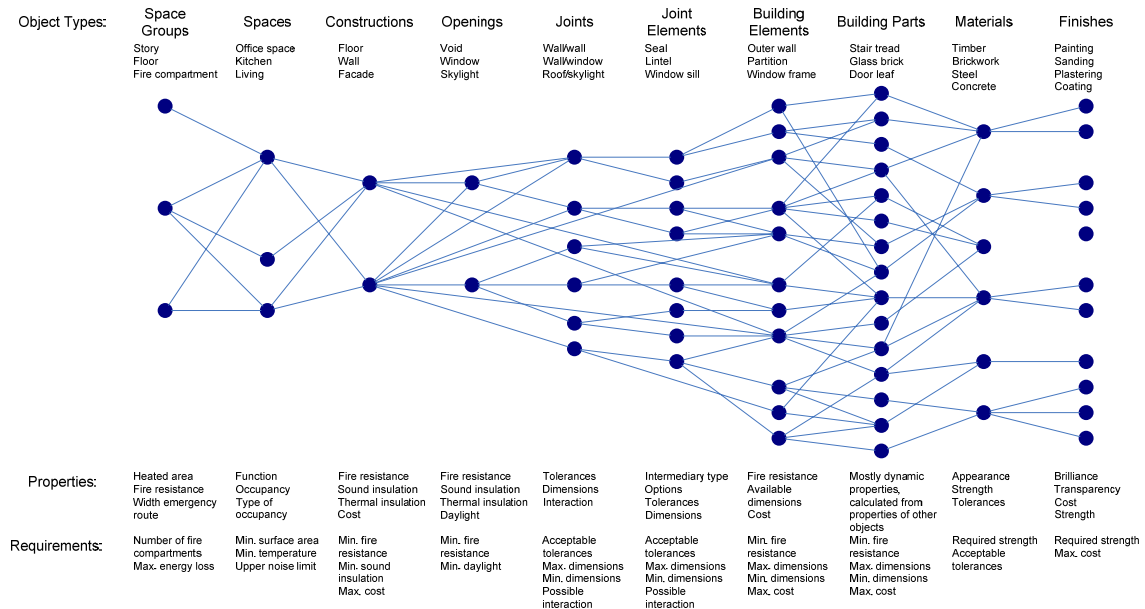

Figure 1: 'The Digital House' with examples of object types, properties, and requirements. The picture illustrates the relationships between the 10 groups of object types.

The basic structure of the information model is shown in Figure 1. It consists of 10 related object types that represent 10 levels of increasing detail of a building. Each of these object types is specialized into subtypes that are defined as parametric objects with collections of properties and are constraint by requirements, which are implemented as so-called *recipes*. Recipes contain knowledge about the relationships between the parameters of various objects. For example, recipes implement the geometrical constraints that are needed to relate doors and frames. Recipes are also used to implement the, sometimes very complex, technical constraints and interrelationships of regulations and design heuristics.

The building information model is implemented as an API that, in this project, forms the core for The Digital Dormer web application, offering a basis for modeling geometric and non-geometric data and a framework for implementing the building codes checking. This approach is similar to that proposed by Satti and Krawczyk (2004) whose framework for building code checking provides a strong interaction between formalized building codes and a semantic building model.

Figure 2 shows the general system architecture, with the geometric engine of The Digital House library at the base, part of which is a parametric engine. This forms the basis for the geometric data of the 10 semantic object types as shown in Figure 1. The rule engine forms the connection between the parametric engine and the object types; it is used to maintain constraints and execute tests. Test, in this project this mainly concerns the building codes, are defined in an XML format, making the system open for further extension and customization per municipality.
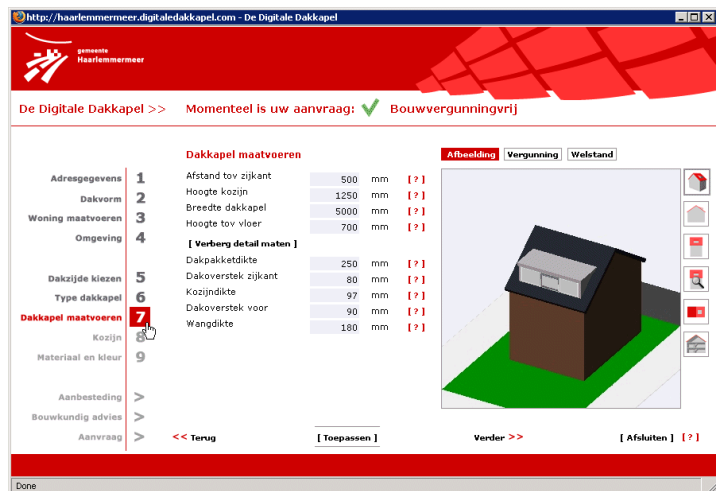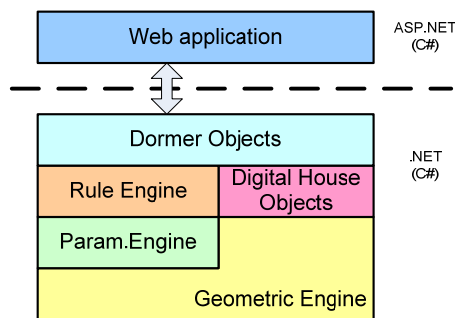

Figure 2: Left: Implementation of The Digital Dormer web application on top of The Digital House API library; Right: sample screenshot of the web application.

For the dormer application, a layer was built on top of the generic object types, containing object types for the application form and the dormer and its components. These special object types were necessary to store the dormer specific design knowledge that was deduced from, on the one hand, the municipal criteria used to check the designs and, on the other hand, available expertise and best practices regarding dormer design.

The Digital Dormer's web interface, shown on the right in Figure 2, offers a step-by-step procedure for the user to fill in all information needed to generate and visualize a simplified

model of the house, its direct surroundings (neighboring houses and outdoor space), and the actual dormer. This process involves nine steps:

1. Personal data and address of applicant;
2. Selection of the existing roof shape: this step simplifies the procedure to a limited number of roof shapes, covering close to 90% of existing house stock;
3. Dimensions of the existing house: this is limited to the main shape, the roof dimensions, and the level of the floor where the dormer is planned;
4. The direct surroundings of the house: neighboring houses and public spaces;
5. Selection of the surface of the roof where the dormer is planned;
6. Selection of the type of dormer: currently the four most common dormer shapes are available in the application;
7. Dimensions of the dormer: this can be limited to the main dimensions of the shape or extended to more detailed dimensions for more accurate output;
8. Window frame for the dormer front: the user can indicate the subdivision, materials, and various parts of the frame, such as windows, fixed panels, ventilation units, etc.;
9. Materials and colors for the remaining parts of the dormer.

This information has sufficient detail to generate technical drawings that are acceptable for issuing the permit. While the user enters the required data, the server instantly generates a visualization of the house and dormer, which can be enhanced by uploading digital photographs of the house. Using the functionality of the building information model, the server performs all code checking and produces detailed feedback on the status of the procedure, regarding the expected outcome of the application and regarding the technical issues. At the end of this process, the complete application forms are generated as well as all drawings and other documents needed for submitting the application. The actual submission can be done online or via a printout, depending on the user's preferences and the capabilities of the municipality's back office.

FUTURE WORK

The Digital Dormer is currently in beta test in a limited number of Dutch municipalities. The application is implemented as a central server that is used by all subscribing municipalities. In the near future, these municipalities will also be making use of the other developments surrounding the new Spatial Permit. The Digital Dormer project aims to integrate seamlessly with these new services and work is planned to develop a standard software interface between these various server applications, which will most likely be based on Web Services technology. The next steps in the development of the dormer application itself are:

1. The integration of so-called 'trends,' which are existing dormers in the applicant's direct neighborhood that are permitted as is by the municipality;
2. Additional tests and advices regarding the technical qualities of the dormer, such as structural stability;
3. Improved level of detail of the dormer design, based on a best practices study in collaboration with the Dutch Architects Association (BNA).
4. A link, at the end of the procedure, to a website for transparent procurement of the user's dormer project. This site sends the user's data anonymously to regionally

located contractors who can respond with a complete and detailed bid. The site will be developed in collaboration with the Dutch Contractors Association (Bouwend Nederland).

ACKNOWLEDGMENTS

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