An Information Model for Strategic Spatial Policy Documents

Henk Ottens
Urban and Regional Research Centre Utrecht URU
Faculty of Geosciences, Utrecht University, Netherlands
h.ottens@geog.uu.nl

SUMMARY

In this paper a project to convert the content of strategic spatial policy documents to a digitally exchangeable format is described and discussed. The conversion is based on a purposely-designed information model in which geo-statements – policy statements with a geographic reference - form the elementary objects. These objects have to be identified in the reports and linked to policy maps for which a new visualisation model is developed. A standard for object (sub)classes, attributes and value domains forms the basis of the information model.

The project objectives, the design principles of the model and the use of the results are related to relevant scientific and practical contexts: geographic data modelling, computer supported spatial planning, and interactive planning.

KEYWORDS: spatial planning, digital spatial plans, information model

INTRODUCTION

Data modelling in a GIS environment pertains to representing spatial objects and their characteristics in a digital format that is relevant for the research, policy or management problems and tasks under consideration and also satisfies the requirements of the computer system used (Longley et al. 2001, pp. 60-77, pp. 184-203). A data model is the heart of any GIS application.

In the field of data modelling, nearly all effort is put in modelling real world spatial objects. This may be tangible objects, representing physical space, and virtual objects representing mental human constructs of space. Geographic data models are developed in a sequence of increasing abstraction: reality → conceptual model → logical model → physical model. This approach has proven to be successful in the research and operational management domains. In research, problems are generally studied in a selective, abstracted and generalised way. In operational management, problems and objectives can often be specified relatively clearly and unambiguously.

Things become different, and in certain aspects more complicated, in the domain of strategic spatial policy making. Van Lammeren (1994), when studying knowledge and information requirements from a 'planning actor' point of view, distinguished four categories of knowledge that are relevant and needed in spatial policy and plan making: *normative* knowledge (related to planning goals, norms, priorities and cultures), *objective* knowledge (related to concrete real world phenomena), *methods* knowledge (related to data, data processing and information generation) and *process* knowledge (related to procedures for planning, decision making and plan implementation).

Therefore, planning information needs are much broader and often less concrete and predictable than can be provided by typical GIS applications based on typical GIS data models. This partly explains why GIS is still only modestly used for (strategic) decision support in spatial planning (Geertman & Stillwell, 2003, pp. 4-5). In a thorough analysis, Webster (1993) demonstrated that GIS is primarily useful for

providing *descriptive* (monitoring, visualisation) and *prescriptive* (generating and evaluating alternatives) information in planning processes, less so for prospective information.

Recent developments in spatial planning show a shift in both planning theory and practice. The traditional linear, public sector based models and practices of plan and decision making (originating in the survey-analysis-plan paradigm, often attributed to Patric Geddes, and elaborated in the planning cycle model developed by authors like Brian McLaughlin, 1969) are being replaced by flexible, interactive, participative and communicative practices of spatial planning and management (e.g. Innes, 1995). In the shift from *planning* to *governance*, the public sector takes on the role of participant and facilitator As a response, GIS is increasingly being used as a tool to facilitate discourse and participation (Nedovič-Budič, 2000). For example, efforts are being made to support argumentation practises in urban planning (Tweed, 1998). All these trends make it even more difficult to adequately support planning with elaborated and comprehensive computer-based methods and tools.

A few years ago, a new approach for GIS-based spatial planning support has been initiated in the Netherlands. It does not take planning but plans (planning documents) as a starting point for introducing and disseminating computer-supported operational procedures. The ultimate aim of this project is to produce all spatial plans in the country in a digitally exchangeable format. The project is well underway with respect to municipal land use plans. Strategic plans of an abstract and indicative nature pose particular problems for standardisation and digital conversion. In this paper the issues at hand and the solutions put forward are discussed.

DIGITALLY EXCHANGEABLE SPATIAL PLANS (DURP)

The DURP-project is one of the initiatives of the Netherlands national government to promote e-government (Actieprogramma, 1998). The aim of this action programme is to employ modern information and communication technology for improved efficiency and effectiveness of government operations and for better services to citizens and businesses. The mid-term aim of DURP is to produce, by 2005, seventy percent of all new official spatial plans in the Netherlands in a format that makes it possible to digitally exchange and process the information contained in the plans (De toekomst, 2001). For that purpose the digital versions of the plans should be based on a common standardised information model.

In the spatial planning legislation of the Netherlands, two basic types of plans are distinguished. Municipal land use and building regulation plans ('bestemmingsplannen') have the status of a law and are legally binding for both the government and for private persons, businesses and institutions. These plans are relatively concrete and standardised documents with a direct relationship between the plan map (land use units indicated on a large scale topographic map) and the plan text (ordinances for land use categories and building regulations with added explanations). All other spatial plans are much more abstract and strategic in nature, are legally much less powerful and, as a consequence, are also far less standardised documents. They serve as indication and guidance for policy action. The most abstract and indicative of these plans are the key spatial decisions ('planologische kernbeslissingen: PKB') of the national government. A PKB is a summary of decisions embedded in integrated or sectoral spatial policy reports of ministries. The current project is aimed at designing and testing an information model for existing PKB versions that have been approved by the Netherlands cabinet.

MODELLING SPATIAL POLICY DOCUMENTS

Spatial policy documents often are a combination of texts, tables and graphics. The texts verbally describe and explain government intentions and actions, the tables provide additional conceptual and numeric specifications. Graphics can be supporting illustrations or indicative and/or descriptive thematic maps. As a consequence, a formal data model for a policy document is a hybrid construction for a combined text and map database. It is also hybrid in the sense that the plan content refers to current real world situations as well as future situations and decisions, but also to actions to attain desired

development. This type of models is generally named information models rather than data models. In our case, the aim of the information model is to structure and standardise the information content in spatial policy documents in such a way that digital conversion and exchange becomes possible. Existing PKB's were never prepared and published with digital conversion in mind. Therefore, structure and standards have to be imposed a posteriory. It is assumed that a generally accepted information model for PKB's will in future guide the PKB production process, which will make the production of digitally exchangeable versions much easier. Additional terms of reference for the construction of the PKB-information model are:

1. It should be an extension of the existing information model spatial planning (IMRO).
2. The original PKB-text should be retained in the digital version (most PKB's are already available and accessible in digital format as pdf-files from government websites).
3. The PKB-information model should be manageable for both the producers and the users of the digital PKB.

The approach taken can be characterised as bottom-up. Existing standards, policy documents and producer and user practices are the basis for constructing a formal information model for spatial policy. Ideally, it should be complemented by a theoretical approach. A good example is the work of Mennis (2003). Mennis develops an implementation for a semantic data model based on a conceptual framework of geographic cognition. Such an approach will give data/information models a sound basis and make them more sustainable and coherent. Adding a more rigorous theoretical approach was not feasible within the term of reference of the DURP-project. However, the IMRO-model is derived from a theoretical conceptualisation of geospace that is further elaborated in the DURP-project.

INFORMATION MODEL SPATIAL PLANNING (IMRO)

IMRO is based on an official Netherlands standard for property information: NEN 3610. This standard includes terms, definitions and rules for classifying and coding geo-referenced objects. IMRO is a dedicated implementation of NEN 3610 for spatial policy applications. It is an object-based model that classifies and defines spatial objects that then become entities for the model. IMRO includes a standardised listing of attributes (identification, descriptive, geometric/graphical, meta information) with their value domains for each of the entity types (Jansen, 2003). Table 1 gives an overview of the general structure of the model.

	Entity Categories	Entity Types
Spatial Entity	linear/areal development (real)	road, railway, water body, terrain
	artefacts (real)	building, transportation artefact, water control artefact, pipe/wire, other artefacts
	subdivisions (virtual)	cadastral division, service area, spatial policy area, environmental policy area
	networks (virtual)	(connections and flows)
	geometric references	

Table 1: General Structure of IMRO

For modelling information in municipal land use plans only the entity type spatial policy area is used. All land use units in a plan are considered policy areas. For this entity 17 attributes are identified, most of them to be specified with standard codes.

Next to the IMRO model, practical guidelines for implementation, a cartographic visualisation model and technical converters between software systems have been produced. Many municipalities have started making digital plans based on IMRO, often supported by specialised consultants

STRATEGIC SPATIAL PLANS

The first years of the DURP-project priority has been given to municipal land use plans, of which there are many thousands. Strategic spatial plans are made by municipalities (structure outlines and structure plans), provinces (integrated regional plans and sectoral spatial plans for water management, transportation etc.) and the national government (the series of comprehensive reports on national spatial policy and sectoral reports on traffic and transportation, green spaces, military terrains etc.). A few hundred of such plans exist. There are about ten operational national strategic spatial plans. Preparation and decision making follows a specific procedure. For each plan, a textual and map summary is produced that contains the key concepts and decisions. This is the PKB (planologische kernbeslissing), often the last chapter of the policy report. Parliamentary decision making is based on these PKB's.

The development of an information model for PKB's was split up into three phases:

1. Exploration: essays on the legal, cartographic, planning and design issues for the digital conversion of PKB's.
2. Prototyping: a proposal for an information model for PKB's.
3. Testing and improving the prototype model.

The exploration of the context and of the possibilities and limitations of the digital conversion of PKB's was carried out by the NETHUR research school (Ottens & Geertman, 2003). The main conclusions of this exercise are:

1. A PKB is generally primarily a policy mission statement, aimed at influencing relevant public and private actors.
2. PKB's take shape in a process of interactive and communicative policy and decision-making, where the gradual decision-making process is often considered more important than the final plan.
3. A substantial diversity of policy statements and maps can be found in PKB's, making them much less standard than could be expected.
4. Most policy statements and maps in a PKB are abstract, conceptual and indicative in nature, where maps are mainly used to illustrate policy concepts and decisions.
5. Many policy statements and maps in PKB's have a low level of geographical precision.
6. PKB's do play an important role in policy coordination among ministries, have an after-effect in spatial plans of provinces and municipalities, are used for the implementation of national spatial projects (e.g. new towns, transportation infrastructure, high level services) and are important in the hierarchical approval process of spatial plans.

Based on these insights, an extension of the IMRO-model was developed to guide digital conversion of PKB's.

AN EXTENDED IMRO-INFORMATION MODEL

The initial proposal for the PKB-specific extension of the IMRO-model was tested and adapted in a few rounds (Ottens, 2003). This has resulted in a first operational model and in two digitally converted PKB's: the PKB of the Fifth Report on Physical Planning and the PKB of the Second Structure Plan for Rural Areas (Wessels & Bulens, 2003).

The building blocks of the model are geographically referenced policy statements (so called *geo-statements*). The text and maps of a PKB are jointly used to decompose the information content into separate statements. These statements form the objects of the PKB to populate the entity 'spatial policy area' in the information model. The table of contents and the map symbols are used as starting points for identifying the statements. Next, the statements are classified according to a number of aspects. Finally values (often codes) for attributes of the geo-statements are generated from the original document text and maps. Partly existing attributes in the IMRO-model can be used, but a number of new attributes and new domain specifications for attributes have to be added to IMRO to make the model applicable for PKB's.
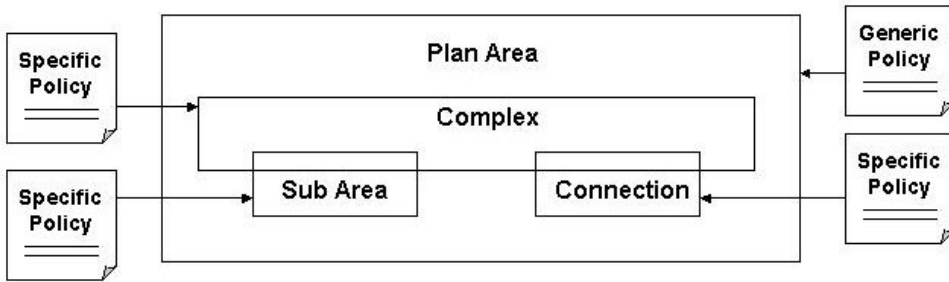
Figure 1: Object classes of the information model

A few aspects of the model will be discussed here. A main principle for classifying objects is the geographic articulation of the policy statement (Fig. 1). In the text, quite some generic policy statements pertain to the plan area, often the Netherlands as a whole. For example, the aim to promote spatial quality. Other geo-statements are more specific and only relevant for a sub area (e.g. the northern part of the country or the coastal regions), for a connection (e.g. the high speed rail network) or for overarching spatial concepts like the Randstad metropolitan area and the Main Ecological Structure of the Netherlands.
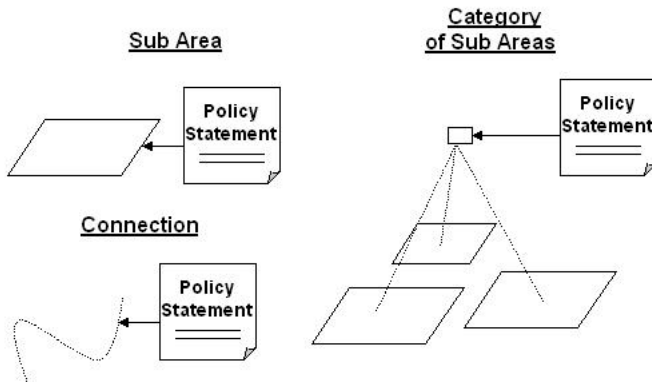

Figure 2: Object classes: Sub Area and Connection

Elaborating this first classification of geo-objects (Fig. 2 and 3), it proved to be necessary to further differentiate between geo-statements relevant for one sub area (e.g. Amsterdam) or connection (e.g. the Rotterdam-Ruhr railway link) and those relevant for categories of areas (e.g. all large cities) or connections (all major rivers). A complex was defined as an overarching geo-statement with both policy defined for the concept as a whole and additionally for spatial components of the concept.

Finally, the existing IMRO tables with attributes and domains were extended to be able to deal with specific characteristics of PKB geo-objects. One of the attributes added is a hyperlink to the original text in the printed PKB-document.
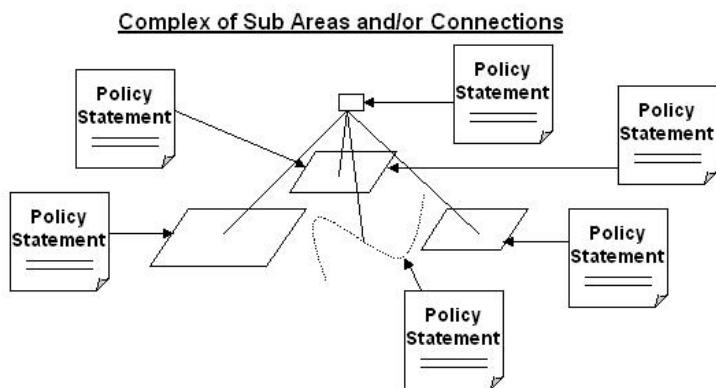
Figure 3: Object class: Complex

Table 3 gives an impression of the kind of table that has been produced and used in the experimental conversion of two PKB's. After further tests and tuning with comparable exercises by the Dutch provinces to develop an information model for regional plans, a proposal for an extension of IMRO will be made to the organisation that manages IMRO.

Attribute	Domain			Relevant Entity Type			
	Code	Description	Value Range	Pln	Sub	Con	Com
Identification Attributes							
ID-code (idn)		serial number	32 pos. alfanumeric	x			
			32 pos. numeric		x	x	x
Location-code (loc)	06	location name	name in report	x	x	x	x
Descriptive Attributes							
type of virtual area (tvg)	31	policy area		x	x	x	x
	320403	PKB	name PKB	x			
	3101	policy sub area	plan area, sub area, connection, complex	x	x	x	x
	31010101	single policy sub area	name sub area		x	x	x

Entity Type: Pln: Plan Area; Sub: Sub Area; Con: Connection; Com: Complex

Table 2: First rows of the Attribute Table

610

DISCUSSION

It proved to be possible to develop an information model that makes it possible to digitally convert and exchange strategic spatial policy documents. The prototype needs to be tested more thoroughly and further adapted according to experiences of producers and users of this type of information. Further, a standard visualisation model will be developed that will serve as a guideline for plan makers. New maps will have to be designed in a way that all geo-referenced policy statements in the text can be linked to objects in the map. These new maps also are key to geographically combining PKB-information with information in regional and municipal plans, a prerequisite for useful digital exchange of spatial policy information.

In the DURP-project it has already become apparent that apart from exchanging plan information between government agencies, information provision to citizens and businesses will become another useful application of digital spatial plans. Special viewers are being developed to support this application.

Digital planning information can also support flexible planning practices. The already discussed changing emphasis in urban and regional planning from restrictive planning and planning control to development planning based on flexible programmes and implementation projects will be easier with digital planning documents.

The legal status of digital plans is still a problem that has to be solved. For the time being, spatial plans have to be produced as paper documents alongside with a digital version.

BIBLIOGRAPHY

Actieprogramma Electronische Overheid, 1998. Ministerie van Binnenlandse Zaken.

De toekomst in kaart: digitaal uitwisselbare ruimtelijke plannen, 2001. Ministerie van VROM.

Geertman, S. & J. Stillwell, Planning Support Systems: An Introduction. In: S. Geertman & J. Stillwell (eds.) Planning Support Systems in Practice. Springer Verlag: 3-22, 2003.

Innes, J., 1995 Planning theory's emerging paradigm: communicative action and interactive practice. Journal of Planning Education and Research, 14, 183-90.

Jansen, P.A.L.M., 2003 Informatiemodel Ruimtelijke Ordening. Amersfoort: RAVI.

Lammeren, R., 1994 Computergebruik in de ruimtelijke planning. Wageningen: Landbouwuniversiteit Wageningen.

Longly, P.A., M.F. Goodchild, D.J. Maguire & D.W. Rhind, 2001 Geographic Information: Systems and Science. Chicester: Wiley.

McLoughlin, J. B., 1969 Urban and Regional Planning: A Systems Approach. London: Faber.

Mennis, J.L., 2003, Derivation and Implementation of a Semantic GIS Data Model informed by principles of cognition. Computers, Environment and Urban Systems, 27, 455-479.

Nedovič-Budič, Z. , 2000 Geographic Information Science Implications for Urban and Regional Planning. URISA Journal, 12, 81-93.

Ottens, H.F.L. & S. Geertman (eds.), 2003 PKB's digitaal?: Verkenningen rond digitale uitwisselbaarheid van PKB-inhouden. Den Haag: VROM.

Ottens, H.F.L. (ed.), 2003 Aanzet voor een Informatiemodel voor Planologische Kernbeslissingen. Den Haag: VROM.

Tweed, C., 1998 Supporting Argumentation Practices in Urban Planning and Design. Computers, Environment and Urban Systems, 22, 351-363.

Webster, C.J., 1993 GIS and the Scientific Inputs to Planning. Environment and Planning B: Planning and Design, 20, 709-728.

Wessels, C. & J-D. Bulens, 2003 Informatiemodel IMRO-PKB, Versie 5. Utrecht/Wageningen: NexpRI/Alterra.