3D Geo-Information Working Group on Modelling

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The first session took a few basic questions as a starting point and the group made a variety of observations. These were summarized by the secretary and circulated during the second session, where an attempt was made to provide an agreed summary. The main points arrived at were:

1. At the current state of the art it is very difficult to arrive at a consensus on the level of complexity of the appropriate 3D data structures, or even of the conceptual data model. For many of the most immediate applications all that is needed, or desired, is an exterior 3D model of the desired structures (buildings etc.) composed of independent unconnected faces – a "polygon soup" or "triangle soup", as used as export to graphics processors. Applications here are almost exclusively exterior visualization.

However, an increasingly significant number of applications involve working models, where analysis needs to be performed. Examples include navigation, runoff modelling, finite-element analysis etc. Here it is imperative that adjacent faces are well defined – the "topology" must be specified, to give what in CAD systems is called a "B-Rep" model. While it may sometimes be possible to construct this on the fly from polygon soup, problems of speed and coordinate precision for the edge-matching process make this even less practical than in the purely two-dimensional case.

A small but growing group of applications finds even the B-Rep model insufficient, in that volumetric elements are needed. A great deal of work has been put into these models for geological modelling and for 3D engineering models, where flow through the elements of a 3D world is needed – e.g. groundwater flow, heat flow, fire and sound propagation, and escape route planning. There is an increasing desire to integrate this within a GIS framework.

From a business perspective, it does not pay to represent topology if the end user does not need it. Andreas Thomsen notes that topology is intrinsically related to space – it exists whether you like it or not. It can be either implicit or explicit in the data model. This suggests the value of specifying the level of completeness of the explicit topology for a particular application – perhaps along the lines of Gold's PAN graphs (IJGIS, 1988)

2. A 3D (or even 2D) model may include a variety of types of information:
a. Geometry (absolute or relative coordinates in two or three dimensions)
b. Topology (some form of connectedness between elements, sufficient to permit navigation)
c. Attributes (properties attached to the elements, relevant to a specific application)
d. Semantics (some specification of meaning of the element, perhaps geometric or thematic)
e. Functions (the types of operations appropriate to the element)

f. Time and Scale (at what time, and at what scale, the element is relevant)

3. A 3D (or 2D) dataset, an instance of the models suggested in 1. and 2., may be used for different purposes:
a. visualization alone
b. analysis and computation, e.g. calculation of volumes – not usually involving time
c. simulation and decision support ("what-if" modelling, including parameter change) that usually implies development over time
d. management, acquisition and storage of data, including data structure updating over time

An alternate view of function concerns time: the present (a fixed model); the past (a changing model with known results); and future (unknown change, only simulation is possible)

4. Following the ideas of Ludvig Emgard, it would be beneficial to have one or more simple 3D reference models (conceptual models) that included properties for several applications and that could be used within many application domains. This might be analogous to the CityGML approach to Levels Of Detail.