Toward complementary levels for Level Of Detail and Level Of Development

C-E. Tolmer[1,2], C. Castaing[2], D. Morand[3], Y. Diab[1,3]

[1]Laboratoire Eau Environnement et Systèmes Urbains (LEESU), équipe Génie Urbain, Université Paris Est Marne-La-Vallée, France
[2]Egis, France
[3]Ecole des Ingénieurs de la Ville de Paris (EIVP), France
charles-edouard.tolmer@u-pem.fr ; christophe.castaing@egis.fr
denis.morand@u-pem.fr ; youssef.diab@u-pem.fr

Bibliographie

AIA. (2013). AIA. Retrieved from http://www.aia.org/

Biljecki, F., Ledoux, H., Stoter, J., & Zhao, J. (2014). Formalisation of the level of detail in 3D city modelling. *Computers, Environment and Urban Systems*, *48*. doi:10.1016/j.compenvurbsys.2014.05.004

BIM protocol. (2013). Standard Protocol for use in projects using Building Information Models.

BIMForum. (2013). *Level of development specification*.

BuildingSMART. (2013). IFC4 Official release. Retrieved from http://www.buildingsmart-tech.org/ifc/IFC4/final/html/index.htm

Communic L1. (2010). *Livrable L1 - Modèle global* (pp. 1–160). doi:PROJET ANR-06-RGCU-002

Emgard, L., & Zlatanova, S. (2008). Design of an integrated 3D information model. In *GISt, OTB, Delft University of Technology, Delft, the Netherlands* (Delft Univ.). The Netherlands.

Gröger, G., Kolbe, T. H., Nagel, C., & Häfele, K.-H. (2012). Open Geospatial Consortium OGC City Geography Markup Language (CityGML) Encoding standard.

Isikdag, S., & Zlatanova, S. (2009). Towards defining a framework for automatic generation of buildings in CityGML using BIM. In *Lee and Zlatanova (eds.), 3D geo-information sciences, LNG&C, Springer Verlag* (pp. 79–96).

Kolbe, T. H. (2009). Representing and Exchanging 3D City Models with CityGML. In Springer (Ed.), *3rd international workshop on 3D geo-information-information*. Seoul, Korea.

MINnD. (2014). *Projet National MINnD : Modélisation des INformations INteropérables pour les INfrastructures Durables* (p. 109).

Tolmer, C.-E., Castaing, C., Morand, D., & Diab, Y. (2014). Structuration des informations pour les projets d'infrastructures : proposition de niveaux complémentaires aux Level Of Detail et Level Of Development. In *SCAN'14, Séminaire de Conception Architecturale Numérique*. Luxembourg.

Introduction

A city should be considered as a whole more complicated than the sum of its parts (systemic analysis). How is it possible to ensure the urban resilience and efficiency if the modeling, the structure and the management of these information systems can't be afforded? How do the conception, the construction and the operating of an infrastructure, which form the heart of an urban environment, should be managed?

IFC CityGML approcehs conceptuelles et structuration des données différentes, communautés différentes comme on le voit au travers de leur manière de structurer l'information (point particulier des LOD et LODt) mais qui tendent à se rapprocher.

CityGML: developpement about Level Of Detail (LOD)

CityGML is still focused on buildings and still not effective enough for infrastructures. The most important concept in CityGML, the Level Of Detail (LOD) both manage geometrical details and semantic precision. With CityGML three kind of information are assigned to LOD: a display scale (or a range of scales), objects from the breakdown of previous LOD's objects and attributes related to the displayed objects (in addition to the representation).

A number of LOD's extensions are currently proposed: intern and extern LOD for buildings, semantic and geometric LOD, or even LOD for road asset management. But it is only supplements and they remain inadequate. Due to the lack of precise and standardized definition, a question arises: is the concept actual definition adequate? Furthermore, the keeping of the coherence of feature representations trough different LOD is still a delicate topic.

IFC: details about Level Of Development (LODt)

IFC data model provide a strong semantic approach for features and products. A LODt corresponds to a project stage, a working scale and accuracy of deliverables. Consequently, homogeneity of features LODt is required. It is possible in a building project but much less in infrastructure project.

LODt are being used increasingly in practice in BIM projects but there is no consensus about their definition (no standardization compared to IFC standard or CityGML LOD). Thus, LODt are usable only with specifications and not really through IFC standard itself.

Discussion

LOD follow a top-down approach for feature decomposition. In addition, they mix scale, project stages, geometric and semantic precision… This is not efficient to manage project information.

LODt are too much focusing on elementary feature, on components. They facilitate the monitoring of design, construction and operation but the need a higher hierarchy, based on decisions and contractual phases that punctuate the lifecycle of the infrastructure.

Finally, LOD and LODt do not organize features in the same way because of their primary function. LOD are more about spatial analyses (noise, thermal, flooding) and LODt are more defined to manage design and construction. See Table 1 below about working scales.

Working scales for infrastructure project	Regional, landscape	City, region	City, city districts, projects	City districts, architectural model (exterior)	Architectural model (interior), landmark	Construction arrangements	Implementation
LOD for CityGML	LOD0	LOD1	LOD2	LOD3	LOD4	-	-
Possibilities for IFC	-	-	-	?	?	?	?

Table 1: *conformity between the working scales for infrastructure projects for CityGML and IFC ("-" means a lack of conformity - "?" means a possible conformity but not standardized).*

A new approach to solve BIM uses requirements: Levels Of Decision

A more global concept has to be defined. We call it Level Of Decision (LODec). They manage, through ontologies, the objects structuration and LOD and LODt specifications (LOD and LODt has also to be defined more precisely, according to LODec, to separate their uses). It is also a way organize objects in several manners: spatial decomposition or systems decomposition for example. LODec allow responding to BIM Uses requirements. All the LODec specify the data model for all the life cycle of the project elements.