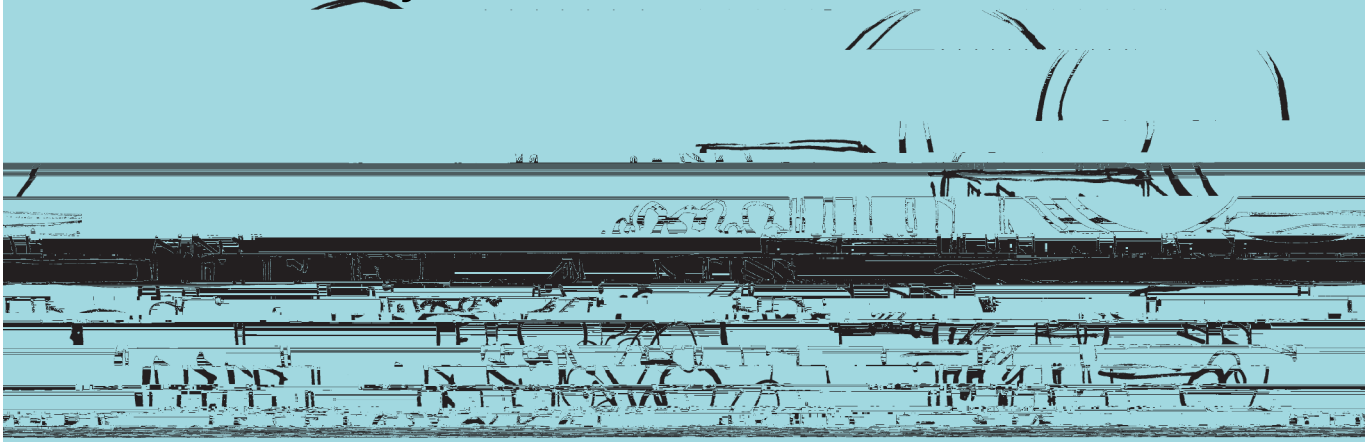
# Progressing Precinct Modelling on the UNSW Campus and Beyond: BIM/PIM and 3DGIS

## Data Inventory



# Contents

## Acronyms

| | |
|---|---|
| BIM | Building Information Modelling |
| CAD | Computer Aided Design |
| DBMS | Database Management System |
| GML | Geographical Modelling Language |
| IFC | Industry Foundation Classes |
| OGC | Open Geospatial Consortium |
| SQL | Structured Query Language |

# Executive Summary

This report presents results of inventory of the administrative structure of UNSW Estate Management (EM), software used, datasets and their content. The study was completed via interviews with employees of vnagem (o,-[(t)2

# Introduction

## Property Management

## Software packages for FM

### ARCHIBUS

ARCHIBUS is a package for management of space, planning and maintains information about space and assets, originally developed by Harvard University, USA 1980. The system was launched the first time in 1982, and later in 2008 ARCHIBUS company was founded.

ARCHIBUS has been used for space data management by many universities in Australia. The software is based on 2D floor plans and attribute information about the specified spaces. It provides opportunities of 2D space viewing, editing, extracting reports and downloading floor plans layouts.

### ArcGIS

ArcGIS is a well-known and widely used software package, developed by ESRI, for management of GIS data. ArcGIS is a de-facto industry standard and is widely used in councils and institutions dealing with geospatial information. ArcGIS maintains limited set of geometries (point, line, polygon, multipatch) but provides many tools to check the validity (e.g. self-intersection) of individual objects and topology within layers. One of the strong features of ArcGIS is the possibility to perform many spatial and semantic operations. The operations are mostly 2D but many 3D operations have been progressively offered as well. The data can be

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delivery time, cost, and quality throughout the design, construction and maintenance life cycle of buildings.

IFC is a very complex model, which requires a thorough consideration during the design and construction process. In IFC, a building is modelled as a collection of objects (with properties and relationships) that represent parts of the building. In contrast to GIS topology, the relationships within IFC are hierarchical, i.e. the IFC model is a tree structure. The 3D geometry is one of the properties, at the same level as the name of the vendor, cost, etc. IFC objects may represent any building

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As mentioned before only a few BIM models are currently in the possession of the FM department. Most of the models listed below are created with the help of students within previous CRC LCL projects (e.g. CRC LCL project RP2011). Unfortunately, many of them are very simple and do not contain indoor information. Currently many Revit BIM models are available for the newly renovated buildings and they will be made available to FM by the construction company Multiplex. These models are now accessible to FM either as a simplified Revit file or via a viewer, which makes connection to the hosting Oracle DBMS (Figure 10). The BIM models, we have examined, are all available as IFC files.

The BIM model of Red Centre was built by researchers at GRID lab from existing pdfs of floor plans (Figure 11). These were digitised, augmented with sematic information about walls, slabs, doors, windows and stairs and updated to represent the present situation.

Figure10 BIM model in a BIM viewer extracted from ORACLE

Figure11 Red Centre Building, 4th floor

For the scope of this project, BIMs of the following buildings were collected and examined: Red Centre and UNSW main library (Figure 12), Electrical Engineering building and Block house (Figure 13), Chemical Science and Dalton Building (Figure 14). Figure 15 displays an example of an indoor object in the Roundhouse BIM model. Figure 16 illustrates modelling of outdoor building elements. Some buildings undergoing renovation by Multiplex can be accessed for viewing.

The models of the Library, Electrical Engineering and Roundhouse building are more comprehensive. In some buildings semi-indoor objects attached to the buildings are modelled as well, such as two types of structural elements providing two covere,3 (i)-0.6 (v)10.6 (j0.004 y)19.3 ((v)10.6 ()-2.7 ( an)136 (n )13.4 (t)24 Tw [a)13.4 (n)6 (ou)124 Tw2d[4)-8.7

Figure13 Electrical Engineering BIM model up

campus located in buildings. The data is attributed to the buildings and therefore there is no possibility to specify the level of energy consumption per room or as part of the building.

Table6 Categories of objects in Universe app

| Objects |
| --- |

## Discussion

We conducted this data inventory to understand the structure of EM, the software packages in use and the

visual inspection, it poses challenges to the editing and update of information.

- Many of the objects are drawn with individual disconnected lines and do not form closed geometries. A typical example are roads and gardens. Besides maintenance, this disturbs spatial analyses such as area, length computation or overlays.
- The attributes of objects are organised with respect to the options provided by the software package, which makes it difficult and even impossible to exchange between software packages. A typical example is management of attributes in a separate text file in AutoCAD.
- Validity of object (intersections and gaps) is not maintained, which may complicate or even make impossible to compute lengths, distances, areas

## Integrated 3D Data Model

The continuous development and maintenance of assets, infrastructure, facilities and logistics at the UNSW campus requires management of a broad spectrum of heterogeneous information. EM departments and stakeholders inside/outside the campus such as companies, councils, institutions, researchers and citizens are constantly involved in the use and exchange of critical information. Much of this information concerns infrastructural components that are embedded in a constantly changing environment. They are spatially distributed above ground (topography, cadastral parcels), underground (cables and pipes, soil, water and geological/geotechnical data) and indoor (buildings)

BIM can be left for specialised use only. Some parts might be included in the generic model (e.g. walls, slabs, stairs, doors, windows, roofs), but many might be left only as a reference (e.g. furniture).

A suitable 3D data structure should be designed in such a way to follow some generic rules for data harmonisation: one object definition per physical entity and re-use of definitions and concepts already available in international standards such as IFC, CityGML, IndoorGML, LADM, etc. In this step a model-driven approach mus Tm( ) wo f d 2- A T c (

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are given separately with an indication as

Zlatanova, S., T.P.M. Tijssen, P.J.M. van Oosterom and W. C. Quak, 2003, Research on usability of Oracle Spatial within RWS Organisation, GISt No. 21, ISSN: 1569-0245, ISBN: 90-77029-07-9, AGI-GAG-2003-21, Delft, The Netherlands, 75 p. (pdf)