Model Setup IDM - "How to Setup Geo-referencing in a Building or Linear Infrastructure Model"

Appendix C: Process Model

Gateway to Melbourne, Australia. Source: Fender Katsalidis, Architects

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buildingSMART AUSTRALASIA

Process Model

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Version History

Version	Date	Scope	By
v 0.2a	14 Sept 2016	Table 1: The contents of Data object 9 and 10 were swapped Table 2: Contents deleted, headings kept	ONe
v 0.2b	28 Nov 2016	Table 1: Exchange scenarios renumbered from 3-10 New notes added to scenarios 2-10	ONe
v 1.0	17 May 2017	Process diagram edited: All gateways annotated, Revised logic for new or existing sites, Table 1 reference numbers corrected (include missing 3)	ONe & JMi
v 1.2	31 May 2017	Processes reduced to core tasks, updated descriptions	ONe & JMi
v 1.3	2 June 2017	Revised and simplified processes, completely revised documentation to match BLIS format.	ONe & JMi
v 1.4	27 Jun 2017	Improved *Terms and Concepts* p2, added ISO 19650 as Normative Reference, revised tasks to explicitly show large & small site activities, updated documentation to suit **Final Draft** issue.	AKo, ONe & JMi
v 1.5	26 Mar 2018	Corrected ifcBuildingStorey for *Task 1.6*; Clarified *Specification of Coordination Point Gateways: Site type?* to highlight Surveyor's role to determine the appropriate use of coordinates systems and need for transformation. Text updated to: "The project Surveyor assesses the characteristics of the site (for example geographic location, extent and elevation) to determine the need for a Helmert transformation for a BIM model. If the site type is considered Small, (less than or up to approximately 1 km square but this may vary) the Site model shall be in local coordinates and a Helmert transformation is defined for geo-referencing. If the site type is Large, (greater that 1 km in any extent) then the model shall be in Eastings/Northings coordinates. Note: Local (or small) asset models as sub-models of a Large Site Model require a Helmert transformation and the data converted to local coordinates."; *Task 1.4* text updated to: "Design Team members may/will provide design and configuration information for the chosen site setout (including local origin, rotation and elevation) and their data is integrated with the design model. This may take multiple iterations to achieve the final project configuration. The (adjusted) small site model from the Land Surveyor is integrated with the design model and a final design prepared."; *Exchange Requirement Data Objects, ER_Model_Setup*: added IFC2x3 table, updated IFC4 table **FINAL Issue**	NNe, THe, JMi, ISG feedback
v 2.0	Jan 2020	Edited and uplifted for bSI publication	JMi &JP

Process Model

Model Setup Exchange Scenarios

Overview

The primary concept detailed below is the creation of a digital BIM template or skeleton of a proposed or to be modified asset, that needs to be shared amongst the now common, many specialists in the implementation of modern facility developments. Its function is to give a precise description of the site and its location for local, GPS and geo-referencing, and a framework for the set-out and spatial configuration of the built asset.

The model setup task can occur at different stages of a project, depending on the type of owner (i.e. developer versus say a public hospital agency), or infrastructure context where the setup may be a different and more important priority.

In the Scenarios below we specify some obvious examples but recognise specific projects may be in a different sequence or priority.

Project Roles[1]

A **Client** (or *owner*, public or private) we consider has two generic choices; a common development path where the asset is speculative and intended for resale and no further interest in the built asset; or an owner who has a long term ownership of a portfolio of properties (such as a University campus, hospital complex, commercial office space provider, or a transport facility such as an airport or road network) where the agency etc has an ongoing operational or maintenance responsibility.

In this latter case a **Facility Manager** (or *Building Manager*) may perform the role, and there is the likelihood that a well documented asset (master) plan comprising full surveys and particularly in infrastructure, map referencing & geo-location have been established. A project brief issued by such client organisation may have done a significant amount of pre-planning, and in the special cases of the extension or integration of an existing asset, refurbishment or renovation may be wholly responsible for the model set-out.

A **Lead Designer** may be an *Architect*, *Engineer*, *Landscape planner*, *Project Manager* or an *Advisor*. They have the role to define the specific location of the asset on a site, to define its spatial nature and extent of the asset(s) and to provide an overall asset concept. For the model set-out the naming and broad spatial geometrical framework are the essence of the exchanged data. Often this information may be adjusted or refined during the Inception and Feasibility life-cycle phases. The model set-out may change during early project stages, but will be frozen once detailed design, documentation or construction phases commence.

A **Land Surveyor** is responsible for undertaking the detailed site survey, accessing and confirming cadastral and title particulars, and for developing a site model. Traditionally these data would be in a 2D drawing; in the Model Setup IDM this information is a component of the asset digital model, focussing on the description of the site, nature of the terrain, geology, natural features, climate zone, and often government Planning aspects such as land use types, development controls, easements etc. as well as adjoining site and existing or proposed built asset relationships.

A **Land Registry** is responsible for the description of Cadastre and Land Title (ownership) its key activities. This defines the boundaries of lots or parcels of land under private, Crown

[1] See the following ISO Standards as a normative reference for terminology:
ISO/DIS 19650-1:2017 (E) Organization of information about construction works — Information management using building information modelling — Part 1: Concepts and principles,
ISO/DIS 19650-2:2017 (E) Organization of information about construction works — Information management using building information modelling — Part 2: Delivery phase of assets

or government ownership. Cadastral data is currently a 2D description (with varying national standards) but is moving to a 3D description firstly to describe strata title (where an owner has multiple parts of a generally multi-storey building (eg a car space, apartment space(s) and an access space). However this 3D spatial context is also present in subterranean developments and also transport systems (roads, railways…) which overlap in the airspace.

A **Council** (or *Local Government* or *Authority*, *Borough*, *Commune*, *Planning Department* etc) has the role of controlling the types of development within its boundaries. Such Zoning and Development controls limit the types and scope of built assets or activities that can be provided.

Terms and Concepts

A project **Site** is defined as one or more contiguous land parcels. In this context, a site is mapped directly to the `ifcSite` entity, and represents the legal land boundary.

A **Lot** is a type of land parcel, and the term used to describe the boundaries of legal ownership of land, often described as the **Cadastral** data. Lot types apply to roads, standard lots, strata[2], railways.

A land **improvement** is any type of alteration to the land to make it more usable (and enhance its value.

An **Easement** is a section of land registered on your property title, which gives someone the right to use the land for a specific purpose even though they are not the land owner, such as a route for an underground water main (preventing coverage, etc) or the right of other individuals to pass through the site for access etc.

A **Project** is initiated by a client to construct (or modify) an *Asset* using collaborative federated discipline BIM models. An **Asset** model is any of a building, railway, road, waterway, tunnel, open space, or utility type.

A **large** site is typically the context for infrastructure or linear assets (such as roads or railways) and will be in the order of tens to hundreds of km in length, and about 1 km or less in width. A **small** site is common for buildings or vertical assets, where the geographic extent is up to approximately 1km square.

Above this “small” limit requires geo-referencing transformation for measurement accuracy, and mapping and GPS compatibility.

A **benchmark** is a surveyor's mark made on a stationary object of previously determined position and elevation and used as a reference point, as in geologic surveys or tidal observations.

[2] Buildings such as apartment blocks with multiple ownerships in the one building.

Process Model

1. Specification of Process

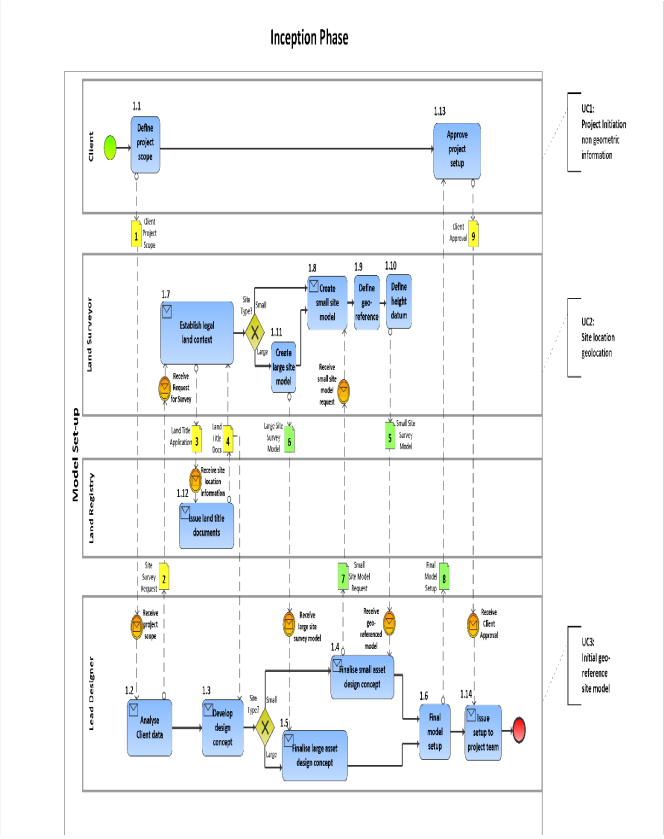

Figure 1: Model Setup Process Model, version 1.4, 23 Jun 2017

1.1 Define Project Scope

Type	Task
Document	The Client specifies the type of asset to be developed, the design brief and the site information on which the asset is located.

1.2 Analyse Client Data

Type	Task
Documentation	Following an analysis of the brief for the new asset, the Lead Consultant requests from the Land Surveyor a survey be undertaken of the project site.

1.3 Develop Design Concept

Type	Task
Documentation	The Lead Consultant develops a design concept for the chosen site in accordance with the Client Brief, and authoritative site information.

1.4 Finalise Small Asset Design Concept

Type	Task
Documentation	In the case of a project with a master design (linear infrastructure, large asset development) model in Eastings/Northings coordinates, a small site model in Cartesian coordinates and appropriate Helmert transformation for a *local Asset design model* is requested from the Land Surveyor. Design Team members may/will provide design and configuration information for the chosen site setout (including local origin, rotation and elevation) and their data is integrated with the design model. *This may take multiple iterations to achieve the final project configuration.* The (adjusted) small site model from the Land Surveyor is integrated with the design model and a final design prepared.

1.5 Finalise Large Asset Design Concept

Type	Task
Documentation	The Lead Consultant receives from the Land Surveyor a large site model in Eastings/Northings coordinates and develops a final design collaborating with other design Team members who may/will provide design and configuration information for the chosen site setout.

1.6 Final Model Setup

Type	Task
Documentation	The Lead consultant finalises the asset model setup integrating the surveyor's model of the site, and sets a framework for the setout and spatial configuration of the proposed asset design. This comprises: • defining the cadastre, urban context, terrain, and site elements • setting the project local origin & grids and/or alignment • defining paper North for documentation • defining model orientation/location for export • defining vertical (e.g. storeys) and/or horizontal zoning (e.g. infra-structure segments, project sub-zones) • creating IFC high level entity structure (ifcProject, ifcSite, ifcBuilding, ifcBuildingStorey, ifcSpace) & GUIDs for collaboration synchronisation For a *small* site, the Lead Consultant will validate the geo-reference.

1.7 Establish Legal Land Context

Type	Task
Documentation	The Land Surveyor reviews the Client brief and submits an application to the Land Registry to obtain a copy of the Land Title(s) and cadastral data for the Lot(s).

1.8 Create Small Site model

Type	Task
Documentation	Based on the Title and cadastral information, the Surveyor undertakes an on-site survey, proving the Lot boundaries, an as-built survey to capture existing buildings, terrain, site features, identification of easements, existing improvements, utilities, structures and other features of the property and it's surrounds. Identifiable points, such as the corners of the property will assume **local coordinates** based on the site model.

1.9 Define Geo-reference

Type	Task
Documentation	The Land Surveyor conducts a control survey to connect the site to survey marks with known coordinates in the Eastings/Northings grid coordinate system. The Surveyor uses the coordinates of the identifiable points to compute a Helmert transformation for the local site model and inserts the geo-referencing data.

1.10 Define Height Datum

Type	Task
Documentation	The Land Surveyor adds the reference to the National Height Datum to be used and adds the height shift relative to the model's origin point (benchmark) and local height.

1.11 Create Large Site model

Type	Task
Documentation	Based on the Title and cadastral information, the Surveyor creates a site model for the linear or large asset based on **Eastings/Northings** coordinates. As needed the Surveyor undertakes lot surveys, identifies benchmarks, proving boundaries, identifying site features, identification of easements, existing improvements, utilities, structures and related matters.

1.12 Issue Land Title Documents

Type	Task
Documentation	The Land Registry issues the Land Title documents, with Lot identification, cadastral boundaries, ownership and easement & related data.

1.13 Approve Project Setup

Type	Task
Documentation	The Client approves the project model setup and work can commence for the next project phase to build a federated model

1.14 Issue Setup to Project Team

Type	Task
Documentation	The Lead Consultant distributes the approved Model Setup for the project team to create the required discipline specific project models.

2. Specification of Data Objects

2.1 Client Project Scope

Type	Data Object
Name	**1. Client Project Scope**
Documentation	The scope of the project specifying the asset type, an initial design brief and site selection.

2.2 Site Survey Request

Type	Data Object
Name	**2. Site Survey Request**

Documentation	A request to the Land Surveyor to establish the specific land ownership (one or more Lots) for the asset development based on the Client project scope.

2.3 Land Title Application

Type	Data Object
Name	**3. Land Title Application**
Documentation	A formal application to the Land authority requesting Land Title data for the specified Lot(s).

2.4 Land Title Documents

Type	Data Object
Name	**4. Land Title Documents**
Documentation	The Land Title data for the requested Lots.

2.5 Small Site Survey Model

Type	Data Object
Name	**5. Small Site Survey Model**
Documentation	The site *model* in Local Coordinates with a defined Helmert transformation for map compatibility.

2.6 Large Site Survey Model

Type	Data Object
Name	**6. Large Site Survey Model**
Documentation	The site *model* in Eastings/Northings Coordinates.

2.7 Small Site Model Request

Type	Data Object
Name	**7. Send Small Site Model Request**
Documentation	The Lead consultant requests from the Land Surveyor a small site model transformed in the context of a sub-project which is part of a master Eastings/Northings based large asset model

2.8 Final Model Setup

Type	Data Object
Name	**8. Final Model Setup**
Documentation	The project *model setup* to be used by the Project Team for collaborative modelling.

2.9 Client Approval

Type	Data Object
Name	**9. Client Approval**
Documentation	Approval by the Client for the Lead Designer to commence adoption by the project of the Model Setup template

3. Specification of Coordination Point Gateways

3.1 Site type?

Type	Coordination Point
Name	**Site type?**
Documentation	The project Surveyor assesses the characteristics of the site (for example geographic location, extent and elevation) to determine the need for a Helmert transformation for a BIM model. If the site type is considered **Small**, (less than or up to approximately 1 km square but this may vary) the Site *model* shall be in local coordinates and a Helmert transformation is defined for geo-referencing. If the site type is **Large**, (greater that 1 km in any extent) then the model shall be in Eastings/Northings coordinates. **Note**: *Local* (or small) asset models as sub-models of a Large Site Model require a Helmert transformation and the data converted to local coordinates.

4. Exchange Requirement Data Objects

4.1 ER_Model_Setup

Mapping to IFC2x3 Entities	Mapping to IFC4 Entities
IfcProject	IfcProject
IfcSite	IfcSite
	IfcMapConversion
IfcCoordinateReferenceSystem	IfcCoordinateReferenceSystem IfcProjectedCRS
IfcBuilding	IfcBuilding
IfcBuildingStorey	IfcBuildingStorey
IfcBuildingElement	IfcBuildingElement
IfcBuildingElementProxy	IfcBuildingElementProxy
IfcClassification	IfcClassification
IfcPropertySet **ePSet_ProjectedCRS**: Name, GeodeticDatum, VerticalDatum **ePSet_MapConversion**: Eastings, Northings, OrthogonalHeight, XAxisAbscissa XAxisOrdinate, Scale	IfcPropertySet
ifcGrid	ifcGrid
	IfcGeographicElement