A BIM-Driven Approach to Managing Common Properties within Multi-Owned Developments

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A complex combination of different types of residential and commercial uses of urban spaces

In AU, multiple groups of lot owners (Owners Corporations (OCs)) are responsible for managing and maintaining common property areas.

Growing Trend in High-rise & Multi-owned Development

Background (2)

**Limitation in Disambiguating The 3D Spatial Extents of CPs, using 2d-based Subdivision Plans**

- Limited delineation of building lines by using the building lines on the ground
- Challenges in identifying the physical structure of CPs which is defined by referencing a physical structure
- Difficulties in determining the physical structure that is spatially referenced within a specific CP among multiple common property areas
- OC managers’ limited understanding of the full spatial extent of the CP area

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Better approach to manage CP in a more visual way & the digital data management methods for CP is required

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Building Information Modeling (BIM)

A feasible approach to digitizing 3D spatial structures of CP in multi-owned developments
Related Works (1)

Subdivision Act (1988)
Subdivision Regulations (2011)

Section 30 of the Subdivision Act (1988)
- CP: the co-ownership of common areas by the lot owners as ‘tenants in common’ in shares proportional to their lot entitlements
- 3D situations of common properties are not explicitly described in the Subdivision Act,

Subdivision Regulations (2011)
- Provides Specific examples of registering CPs in 3D situations

Owners Corporation Act (2006)
Owners Corporation Regulations (2007)

- Provides the legal instruments for managing CPs after its registration

The owners Corporation Regulations (2007)
- Provides A set of predefined model rules for managing CPs
  - The matters related to health, safety, security, administration
  - Use of common property
  - Use of lots
  - Behaviour of owners, residents and visitors,
  - Dispute resolution

Two dimensions for common property management in multi-owned developments

- Governance structure
  - It has been extensively studied in the property research domain

- Spatial arrangement
  - There are limited studies about the spatial arrangements of common properties and how 3D digital environments (such as BIM) can support the spatial structure of CPs in complex developments
Related Works (2)

Governance Structure

1. Legislative Mechanisms & Terminologies
   - The mechanisms for CP management may not vary from one jurisdiction to another
   - The adopted terminologies would be significantly different among Australian states and territories

2. Owner Corporations (OCs) \(^1\)
   - OCs are formed by individual lot owners whose communal ownership are defined within the CP areas
   - Four main elements
     - Communal ownership of the CPs and amenities
     - Formation of behaviour governing rules in a multi-owned development
     - Establishment of a governing body to administer
     - Monitor the CP and behaviour rules

Related Works (3)

Spatial Arrangement of CP

- It is mainly defined by 2D subdivision or strata plans in current practices.
- R&D in the domain of 3D digital cadastre have mainly studied the 3D spatial arrangement of CPs implicitly along with other types of legal interests.
- Possible 3D spatial information models in terms modelling legal interests and boundaries defined in the Victorian jurisdiction

<table>
<thead>
<tr>
<th>3D Spatial Information Model</th>
<th>Individual Spatial Parts</th>
<th>The Entire Spatial Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>LADM (ISO19152, 2012)</td>
<td>LA_SpatialUnit, LA_LegalSpaceBuildingUnit</td>
<td>LA_BAUnit</td>
</tr>
<tr>
<td>ePlan (Cumerford, 2010)</td>
<td>VolumetricLot, Parcel</td>
<td>Parcel</td>
</tr>
<tr>
<td>CityGML (Groger, Kolbe, Nagel, &amp; Hafele, 2012)</td>
<td>LandUse, BuildingPart, BuildingInstallation, IntBuildingInstallation, Room</td>
<td>CityObjectGroup</td>
</tr>
<tr>
<td>IndoorGML (Lee et al., 2014)</td>
<td>CellSpace</td>
<td>PrimalSpaceFeatures</td>
</tr>
<tr>
<td>LandInfra/InfraGML (Scarponcini, Gruler, Stubkjær, Axelsson, &amp; Wikstrom, 2016)</td>
<td>LandParcel, BuildingPart</td>
<td>LandPropertyUnit, PropertyUnit</td>
</tr>
</tbody>
</table>

# Modelling Common Properties in BIM (1)

## Data Elements of CPs

### Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Property Type</td>
<td><strong>Two types of CP</strong>&lt;br&gt;▪ Unlimited CP: commonly owned properties are for the use and benefit of all owners&lt;br&gt;▪ Limited CP: must be used by a specific group of owners.</td>
</tr>
<tr>
<td>Land Affected</td>
<td>▪ Includes a list of those lots that are affected by the owners corporation being responsible for managing the CP</td>
</tr>
<tr>
<td>Limitation Details</td>
<td>▪ Optional&lt;br&gt;▪ Should be used to provide limitation details for limited common properties.</td>
</tr>
</tbody>
</table>

### Spatial Structure

- Includes a combination of a wide range of functional spaces, physical built structures and geographic features
  - spaces between and separating each lot
  - gardens, gymnasiaums, stairs, elevators, parking areas, driveways, security and air conditioning systems, as well as water, sewerage, electrical and fire connection systems
  - roads, golf courses, parkland, and marinas (in master planned developments)
Modelling Common Properties in BIM (2)

Mapping the Data Elements onto the IFC Standard

- Suitable IFC Entity for modelling CPs: **IfcSpatialZone**
  - It can include various types of internal and external spaces as well as built structures and geographical features
- Relation between IfcSpatialZone and its related spatial structure: **IfcRelReferencedInSpatialStructure** relationship entity
  - **RelatingStructure**: refers to the IfcSpatialZone entity to define the entire structure of the spatial zone
  - **RelatedElements**: refers to a set of products (any spatial and physical element) which are referenced within the spatial zone

<table>
<thead>
<tr>
<th>Property Set Name</th>
<th>Pset_CommonProperty</th>
<th>Name</th>
<th>Property Type</th>
<th>Data Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>CommonPropertyType</td>
<td></td>
<td></td>
<td>IfcPropertyEnumeratedValue</td>
<td>IfcLabel</td>
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<tr>
<td>LandAffected</td>
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<td></td>
<td>IfcPropertySingleValue</td>
<td>IfcText</td>
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<tr>
<td>LimitationDetails</td>
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<td>IfcPropertySingleValue</td>
<td>IfcText</td>
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</tbody>
</table>
Implementation of Prototype BIM Model

- BIM model for 3-storey complex development located in Melbourne
  - BIM model based on plans finalised after the registration phase
  - 1 unlimited CP and 4 limited CPs
  - Transformation of the coordinates from the project coordinate system into the geospatial reference system
Discussion and Conclusion

- The full extent of the legal spaces defining CPs can be visually communicated in the BIM environment
- The physical elements deemed to be part of a CP are not abstracted in the BIM environment
- Developing a new BIM-based tool for supporting CP management in complex structures is required

From a Technical Point of View, BIM-driven Approach Can:

- Provide the possibility to define organisational relationships in managing multiple CPs.
- Have a significant impact on the interactions among various OCs in a multi-owned development.
- Facilitate their collaboration during the building lifecycle by providing more transparent and integrated representation of the complex spatial structure of CPs.

From a Legal Point of View, BIM-driven Approach:

- Need to be considered in the Subdivision Act, Subdivision Regulations, the Owners Corporation act and regulations

Future Studies

- Appropriate amendments in the legal frameworks adopted for CP registration and management should be proposed
- New guidelines for adopting a BIM-based approach for managing CPs should be developed
THANK YOU

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