# Integration of multiple data sources for 3D Land Administration through the lifecycle of 3D objects

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## SUMMARY

This extended abstract focuses on the significance of data sources from design processes and various data collection approaches, ranging from the use of drones, high-resolution satellite images, sensors and laser scanning to the participatory crowdsourcing methods using smartphones and tablets with GPS for (3D) LA. On the other hand, ownership boundaries also influence the architectural designs and spatial plans. However, the integration of multiple data sources presents challenges in terms of establishment of interoperability, harmonizing standards and licensing. To address this, the ISO 19152 Land Administration Domain Model (LADM) is currently under revision, to provide a standardised framework at a conceptual level, for reusing such data sources in 3D land administration.

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## 1. INTRODUCTION

The current societal demand for sustainability in a collaborative environment and a lifecycle-thinking, is driving the need to integrate independent systems with standalone databases and methodologies, associated with different aspects of the Spatial Development Lifecycle (SDL). Land Administration (LA) plays an essential role in ensuring secure land tenure, efficient land markets, and can provide support for effective spatial planning, thereby promoting economic development and good governance. Therefore, Land Administration Systems (LASs) are an important component of the SDL.

For that reason, accurate, semantically rich and up-to-date data is needed to facilitate the determination, recoding and dissemination of information about ownership, value and use of land. In the context of 3D LA current research explores the reuse of information from diverse sources and phases of the SDL of a (cadastral) object, including data from design processes, surveying methods, participatory crowdsourcing approaches, spatial and architectural planning. This extended abstract focuses on the significance of data sources from design processes and various data collection approaches, ranging from the use of drones, high-resolution satellite images, sensors and laser scanning to the participatory crowdsourcing methods using smartphones and tablets with GPS for (3D) LA. On the other hand, ownership boundaries also influence the architectural designs and spatial plans. However, the integration of multiple data sources presents challenges in terms of establishment of interoperability, harmonizing standards and licensing. To address this, the ISO 19152 Land Administration Domain Model (LADM) is currently under revision, to provide a standardised framework at a conceptual level, for reusing such data sources in 3D land administration.

## 2. MULTIPLE DATA SOURCES FOR 3D LAND ADMINISTRATION

At the structure of the second edition of LADM, which is being developed as multipart with six new parts, and the definition of the (operational) capabilities of this new edition, particular attention is given to the requirements and the design-related decisions taken in the revision process. The reuse of information from different data sources for 3D LA can be achieved through the proposed refined survey model of the LADM Edition II - Part 2: Land Registration. Therefore, the developed UML diagrams include the description of information deriving from multiple data sources and can be (re) used for 3D LA in a standardised way.

Starting from the need to support the description of a wide range of spatial unit types, the categories of the (legal spaces of) cadastral objects supported in Edition I (LA_LegalSpaceBuildingUnit and LA_LegalSpaceUtilityNetworkElement) are further

specified, with two newly subclasses introduced, the LA_LegalSpaceCivilEngineeringElement and the LA_LegalSpaceParcel to explicitly described the legal spaces of infrastructure elements (bridges, tunnels, etc.), as well as traditional land parcels, accordingly.
Moreover, as illustrated in Figure 1, the LA_SpatialSource class as defined in LADM Edition I, is being updated and extended with new attributes, while the concept of "Integrated Source" is introduced, modelled as an association between LA_AdministrativeSource and the LA_SpatialSource classes. What is more, there are two subclasses of LA_SpatialSource being proposed; a_SurveySource and LA_DesignSource, to provide more insights at the spatial source registered at the system.

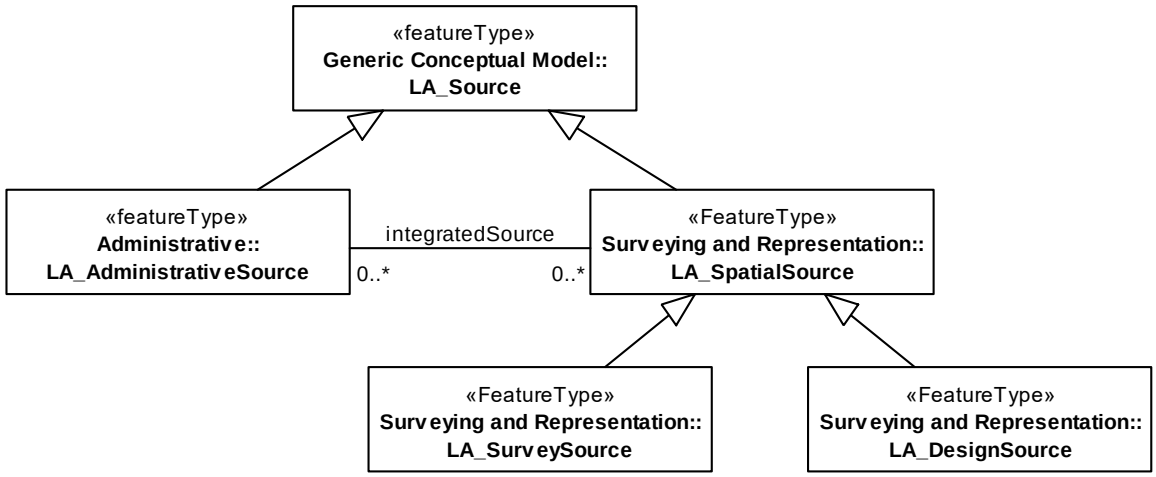


***Figure 1.*** *Suggested Class LA_Source and sub-classes for LADM Edition II – Part 2, as submitted in CD of ISO19152-2*

A survey is documented with survey sources, instances from class LA_SurveySource, while there are subclasses of the LA_SurveySource developed that relate to the various survey acquisition methods, specifically (Figure 2): distance observations, angular observations, level observations, image-based, GPS GNSS and/or using Galileo High Accuracy Services, classic total station and point-clouds observations. At the LA_GNSSObservation class, a subclass LA_GalileoHAS is introduced to explicitly model the corrections from Galileo HAS.
The second subclass of class LA_SpatialSource is the class LA_DesignSource and refers to a source from the design phase of the lifecycle that enables information reuse. A design document (e.g., BIM/IFC, DXF) is documented with design sources, instances from class LA_DesignSource, providing the option to store information for (apartment) buildings based on BIM formats in a standardised way.

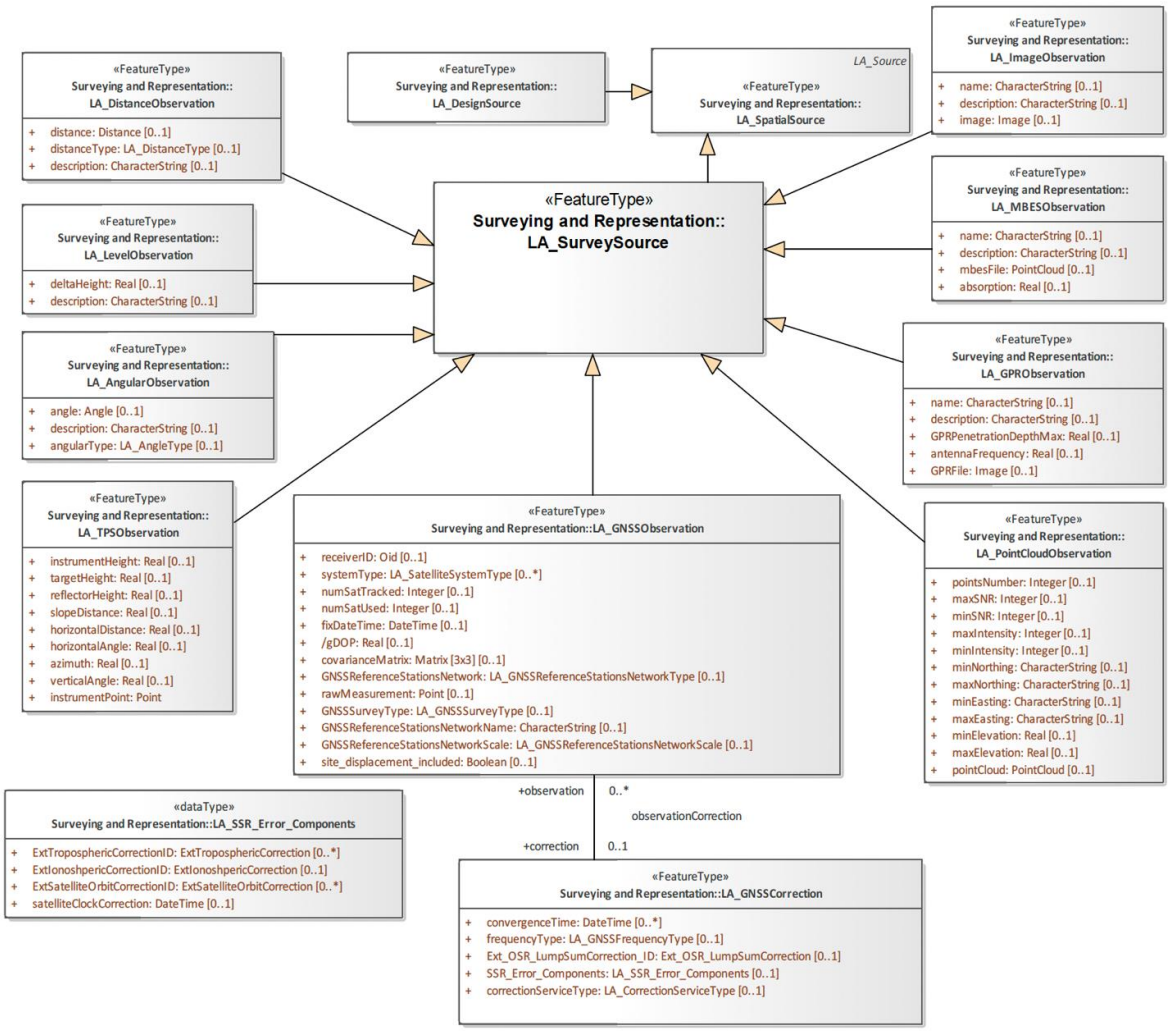


***Figure 2.*** *The sub-classes of LA_SurveySource of the Surveying and Representation Sub-package of ISO19152-2, as submitted in CD of ISO19152-2.*

## 3. CONCLUSIONS AND FUTURE WORK

It is expected that effective (3D) data collaboration, sharing, and reuse across the sectors and disciplines in the SDL of (cadastral) objects will enable new ways of data harmonisation and use in the current complex environment; will improve efficiency of design and data acquisition, as well as data quality (in relation to specific regulations); and will minimise inconsistencies and data loss within information flows. In this scene, this extended aims to document in a standardised way the components of the refined survey part of the Part 2 of LADM Edition II that support data (re)use for 3D LA. This is presented at conceptual level, through UML diagrams that have currently be submitted in ISO TC 211 at the stage of Committee Draft (CD), while it is expected that will be published as ISO standard in January 2025.

Future work refers to the implementation of the conceptual model through various encodings, in the context of the development of LADM Edition II Part 6.