Assessment of Different Data Collection Methods for the Creation of BIM Models for Existing Buildings

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Introduction

- To model existing buildings with BIM, it is important to have clear goals and thoughts about how to take advantage of this. The model specification defines how the modelling requirements should be performed, geometric accuracy and what level of detail it should have.
- The paper has a special focus on the combination of data acquisition with terrestrial laser scanning (TLS), inexpensive drones and Mobile BIM Measurement Systems, with the case study of one of buildings at NTNU.

DATA COLLECTION METHODS

- Terrestrial Laser Scanning (TLS)

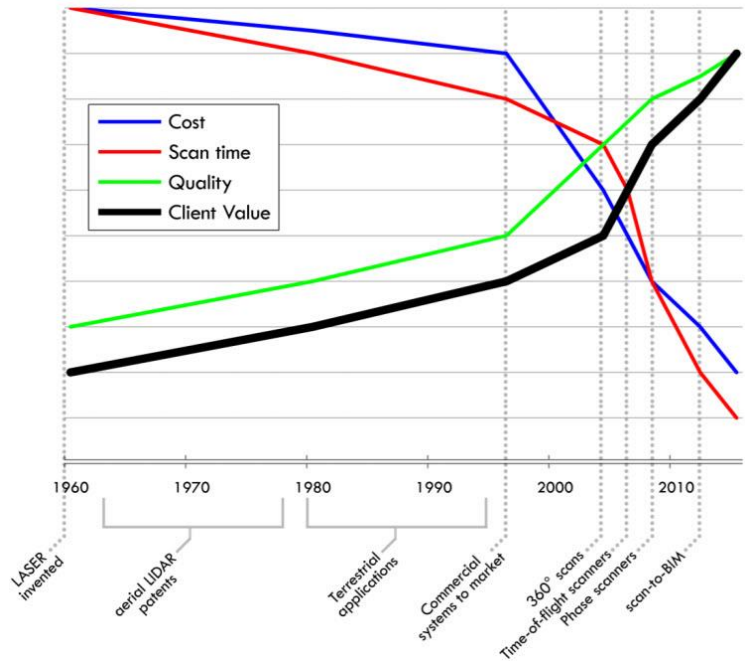


Figure 1: Timeline of 3D Scanning Development (Randall 2013, p. 3)

DATA COLLECTION METHODS

- Some of the most important accuracy factors

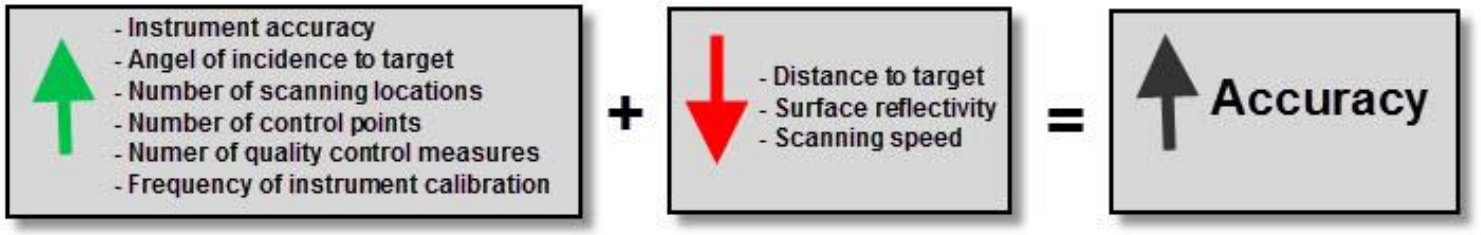


Figure 2: General Rules of Thumb for Achieving Higher Accuracy,
Designed with Inspiration from Randall (2013, p. 5))

Data Capture with TLS

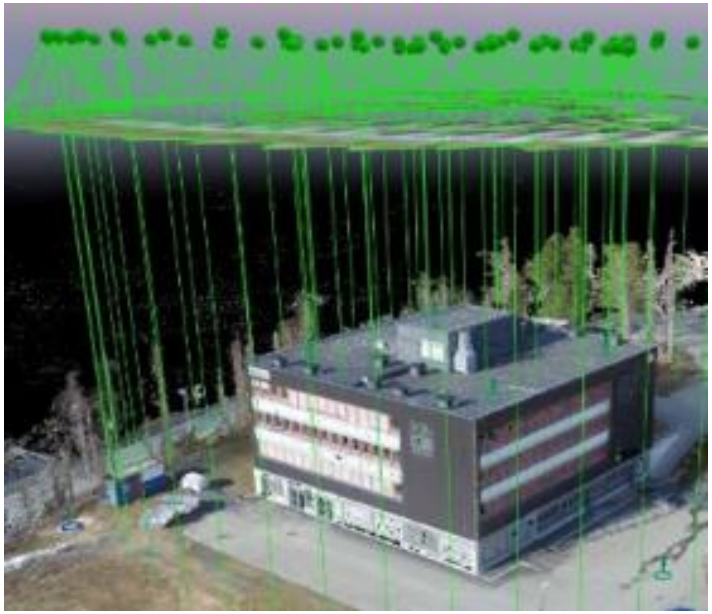
- After completing the scanning of the building, unwanted point clouds were deleted, the stored images were draped into the 3D model, and measures from each position were linked to the model, first by storey, afterwards collected.
- It generated a TrueView, allowing the user to move freely around the model. The finished X, Y and Z data was imported into 3D software (Leica Cyclone), displayed as a point cloud and modelled. The model was exported from Leica Cyclone and linked to two programs with more BIM functionality (Autodesk Revit Structure and ArchiCad).

Data Capture with Drone

- In the study the external TLS data for the building was merged with the point clouds taken from the drone, to produce a complete point cloud of the exterior building.

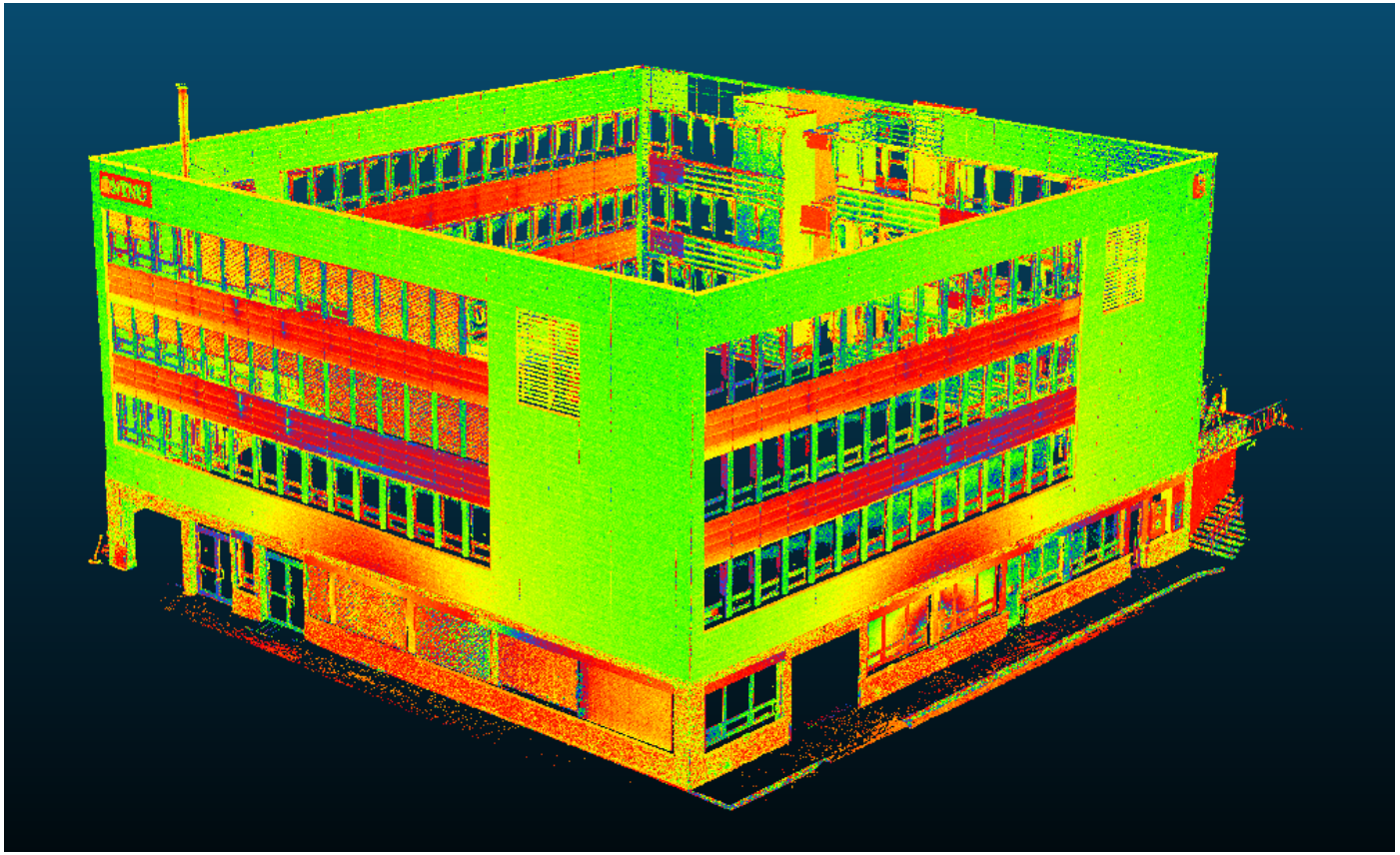
- The next five slides show the different steps of the merging process with drones and TLS.

Photo/ Data Capture Positions from Drone

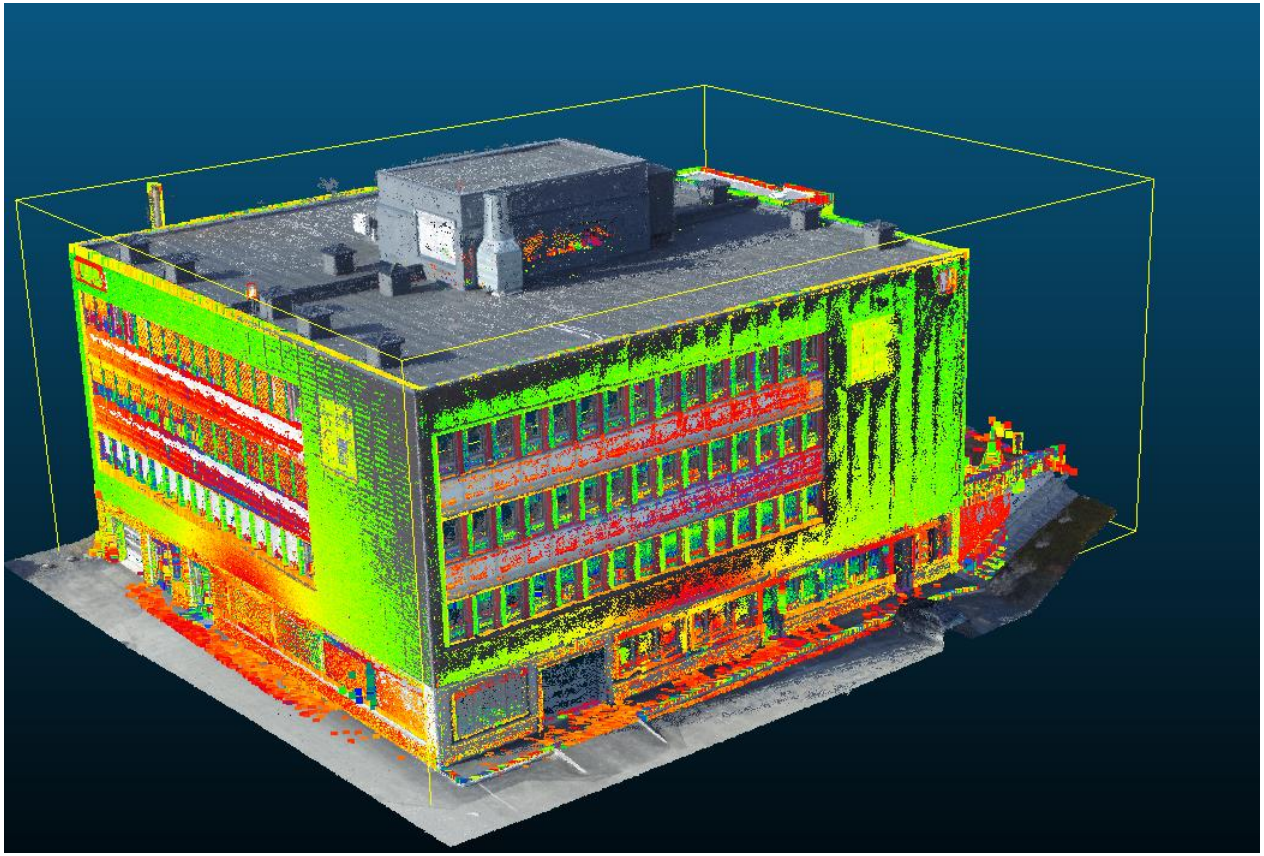


Triangulated Model from Drone

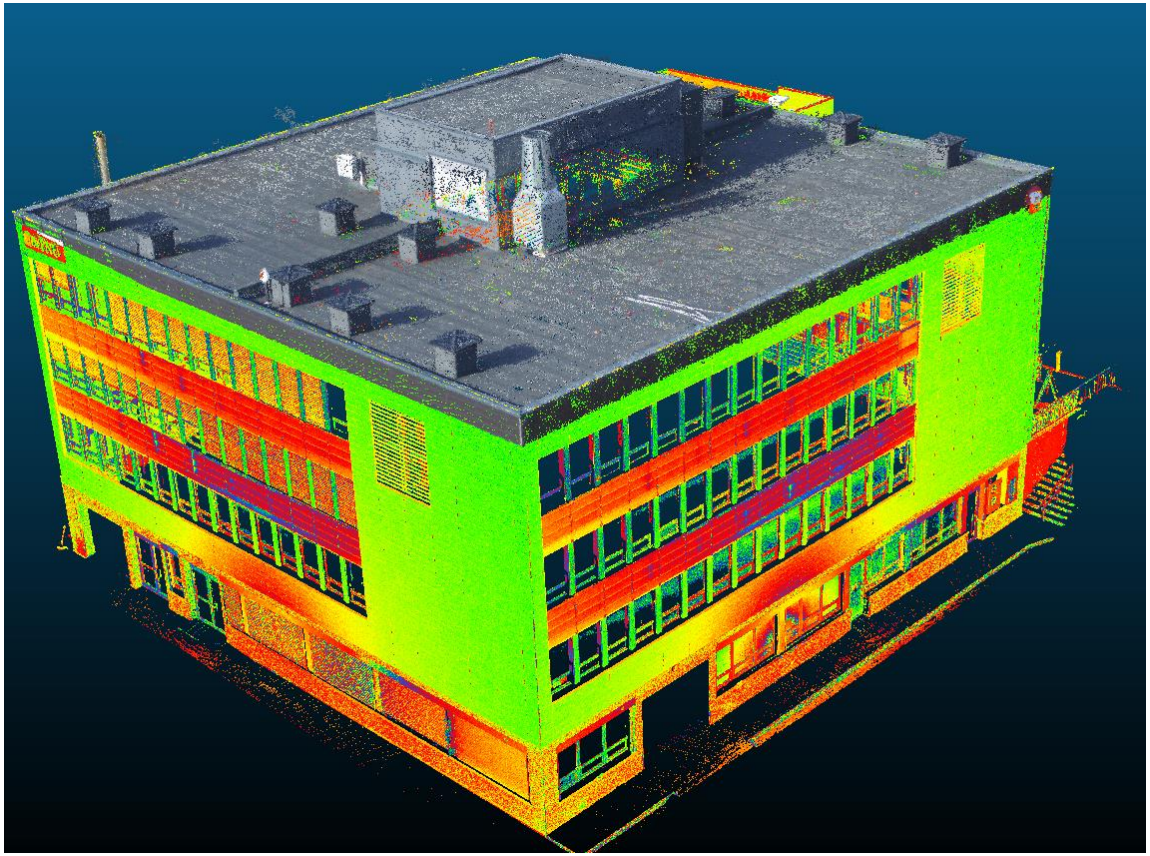
TLS Data



Combination of TLS Data and Drone Data



Drone data on the roof, TLS in areas with colours



Distances measured with laser and in Recap

	Measured area	Measured with laser	Measured in point cloud (m)	Difference (m)
1	Short side	3.765	3.712	0.053 m
2	Distance between corner and door frame	22.170	22.171	0,001 m
3	Distance between corner and door, long side	18.179	18.188	0.091 m
4	Length partition ceiling	9.524	9.509	0.015 m
5	Distance between two ventilation towers on roofs	25.941	25.810	0.131 m
6	Length long side of the building roof	10.396	10.381	0.015 m
7	Length short side of the building roof	6.841	6.891	0.050 m

Drones with higher resolution cameras can provide higher accuracy.

Measuring Systems with Integrated, Manual Data Capture and Modelling Software Inside

- It becomes like a surveying equipment that connects directly to the PC and can be used for quality assurance of existing drawings or to create all models from scratch to get the proper basis for further planning. The solution appears to be suitable measuring key points for walls, floors and ceilings. Manually selected points outside or inside a building can be measured, drawn and modelled completely in one operation.
- The geometric accuracy of this method will depend on the measurement plan and the quality of the measurement equipment.

Conclusions and future work

- There is no doubt that TLS is more accurate than a model generated from photogrammetry, especially when using inexpensive equipment.
- A TLS normally would be used, when high accuracy is wanted, drawings are inadequate, and the model have to be georeferenced in a nationally adopted reference system.

- TLS will anyhow often leave some bad mapped or missing areas. Our study show that the combination of TLS and a simple drone can help improve the geometric model.

- However, how much geometry accuracy a drone could provide required more details study in the future.

- Also more work is required to compare the cost and accurancy of TLS and ”Measuring systems with integrated manual data capture and modelling software inside”.

Thank you