Cost Reduction in Cadastral Surveying Using 360-Degree Cameras to Produce Photogrammetric Orthophotos

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SUMMARY

Japan's cadastral mapping is guided by two laws: Article 14 of the Real Property Registration Act (Ministry of Justice) and Article 2 of the National Land Survey Act (MLIT). Together they have produced about 50% nationwide, but only around 30% in Densely Inhabited Districts (DIDs) as of 2022. Finishing the maps sooner is important for land management, disaster resilience, and protection of ownership rights. Progress is slow because strict legal procedures must be followed, field work is heavy, and agreement among many landowners takes time. "The official Cadastral Survey Operational Guidelines" lay out step-by-step procedures for survey tasks, data checks, and map production. Within this legal framework, the study examines how low-cost photogrammetry can support—not replace—formal surveys by improving early data collection and helping communication with stakeholders.

Rural and mountain areas can often use remote sensing (satellites, aerial photos, drones). Urban areas are harder: buildings block views and regulations limit drone flights. Ground-based tools such as handheld SLAM and terrestrial laser scanning (TLS) can work but remain costly for both procuring local governments and small surveying firms.

This study tests an affordable 360-degree omnidirectional camera to build photogrammetric 3D models. The workflow creates preliminary maps for planning, field verification, and early consensus building. Panoramic capture is fast, requires simple setup, and integrates with common photogrammetry software to produce dense point clouds and textures.

Results indicate meaningful reductions in total time and cost for documenting complex urban spaces, while keeping accuracy good enough for pre-registration uses. The approach also improves transparency and collaboration by letting surveyors and landowners review visual 3D evidence

together.

In conclusion, combining 360-degree photogrammetry with existing standards offers a practical hybrid workflow. It helps budget-limited municipalities, accelerates urban coverage, and supports Japan’s long-term goal of completing its cadastral map, all while staying within the current legal and technical framework.