Surveying the Shift: Strengthening Government Surveying Capability for NSW's Digital Infrastructure Future

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ABSTRACT

Government surveyors in New South Wales (NSW) have long underpinned the integrity of the state's land and infrastructure systems, ensuring that cadastral boundaries, transport corridors and public assets are accurately defined and positioned. Digital engineering, Building Information Modelling (BIM) and digital twins are becoming more mainstream and now require rich spatial data that works together across the full asset lifecycle. At the same time, machinery of government changes, workforce attrition and increased outsourcing have eroded in-house surveying capability in many government agencies, weakening technical assurance when it is most critical. Agencies may meet delivery milestones yet fall short on spatial data quality, interoperability and long-term asset reliability. Drawing on experience across NSW government agencies, this paper presents a practical 4-pillar framework for strengthening government surveying capability: technical leadership, strategic procurement, workforce development, and data governance. Rather than a final solution, it serves as a starting point, with a dedicated APAS2026 conference discussion forum including live polling aimed at testing and refining these concepts with input from government and industry delegates.

KEYWORDS: *Digital infrastructure, government surveyors, spatial data governance, NSW Spatial Digital Twin, capability framework.*

1 INTRODUCTION

Since the appointment of the first Surveyor-General in 1828 and the creation of the Lands Department in the late 19th century, government surveyors have been central to how New South Wales (NSW) understands, manages and develops its land. Historically, large in-house teams within agencies such as the Department of Public Works, Department of Main Roads and the Department of Lands provided continuity of expertise, maintained cadastral integrity and supported the delivery of major infrastructure programs across the state.

This crucial role is now under pressure. The rapid shift toward digital engineering, Building Information Modelling (BIM) and emerging digital twin platforms demands rich, interoperable spatial data maintained across the asset lifecycle, enabling advanced applications such as machine guidance, automated construction workflows and real-time positioning systems that rely on survey-grade accuracy. At the same time, survey teams have shrunk dramatically, leaving agencies without the technical leadership needed to govern these complex digital workflows. Without clear surveying oversight, project scoping can leave out control requirements, procurement lacks technical standards, and spatial datasets arrive in forms incompatible with digital engineering environments. This leaves a growing gap between what government expects from surveyors and what teams can actually deliver.

This paper addresses this gap by proposing a practical capability framework focused on the role of government surveyors in NSW. It touches on the policy and practice settings reshaping expectations of spatial data, outlines key capability pressures, and introduces a 4-pillar framework centred on technical leadership, strategic procurement, investment in people and digital skills, and data governance and interoperability. Together, these four pillars give agencies a practical tool to diagnose gaps and strengthen surveying capability for NSW's digital future.

2 POLICY AND DIGITAL DRIVERS

Government surveying in NSW now operates within a policy environment that treats spatial data as a strategic asset for infrastructure planning, delivery and operations. The NSW Infrastructure Digitalisation and Data (IDD) policy (Infrastructure NSW, 2025) emphasises integrated digital delivery across the asset lifecycle and requires agencies to adopt standards that support positional accuracy and interoperability.

In parallel, the NSW Spatial Digital Twin (SDT) policy framework (DCS Spatial Services, 2026a) and associated technical guidelines set expectations for agencies contributing data to the SDT, demanding consistent spatial data that works across government. These whole-of-government directions sit alongside statutory laws and regulations such as the Surveying and Spatial Information Act 2002, Surveying and Spatial Information Regulation 2024 and Surveyor-General's Directions (DCS Spatial Services, 2026c), which define accuracy, control and practice standards for survey work in NSW.

At an agency level, these policies translate into detailed digital engineering requirements. For example, Transport for NSW's Digital Engineering policy and standards (Transport for NSW, 2026) specify expectations for survey control, model coordination and spatial data handover on major transport projects, embedding spatial governance within BIM and model-based delivery processes. Similar approaches are emerging in other sectors as agencies seek to align design, construction and asset management data with digital twin and integrated planning platforms.

Internationally, initiatives such as the integration of Ordnance Survey data into UK digital twin programs (OS, 2024; University of Cambridge, 2026) and Singapore's use of geospatially enabled 3D city models under its Smart Nation agenda (Geospatial World, 2026; Smart Nation Singapore, 2026) show a broader trend. Survey data is now the foundation of digital infrastructure, not an afterthought.

Generic public sector capability frameworks, such as the NSW Public Sector Capability Framework, set expectations for behaviours and skills across government don't cover what surveyors specifically need for digital engineering. Similarly, digital engineering and spatial data roadmaps outline whole-of-system requirements for model-based delivery and spatial infrastructure, yet they rarely provide a focused view of how government surveying capability should be structured and developed within agencies.

3 CAPABILITY PRESSURES ON GOVERNMENT SURVEYORS

Digital policies demand more, but survey teams keep contracting. Historically, specialist teams in agencies could number in the hundreds, providing expert oversight, continuity and institutional knowledge for statewide mapping and infrastructure programs. Today, many agencies operate with small survey teams or without registered surveyors or senior technical leadership at all, relying heavily on external providers for both routine and specialist functions. This trend is not limited to state agencies, as many NSW local councils also lack a registered surveyor or any dedicated surveying resource, leaving critical spatial and surveying related decisions, including Preservation of Survey Infrastructure (POSI) compliance, to engineers or project managers without specialist expertise.

Several factors drive this pressure. Workforce attrition sees senior surveyors leave without replacement, while recruitment of registered surveyors into government can be lengthy and uncompetitive compared to private sector roles that offer higher salaries and faster onboarding, encouraging experienced practitioners to move into consultancy. Machinery of government changes and budget constraints have fragmented technical teams, while outsourcing has become the default response to workload growth, often without always retaining strong internal oversight.

The impact is evident across major state entities such as Schools Infrastructure NSW, Health Infrastructure NSW, Sydney Water, Property and Development NSW, and the Department of Climate Change, Energy, the Environment and Water (DCCEEW), where surveying capability has been almost entirely outsourced. As digital engineering, Light Detection and Ranging (LiDAR) capture and digital twins add new data governance demands, teams simply cannot keep up. The drivers and impacts of capability pressures on government surveyors are summarised in Figure 1.

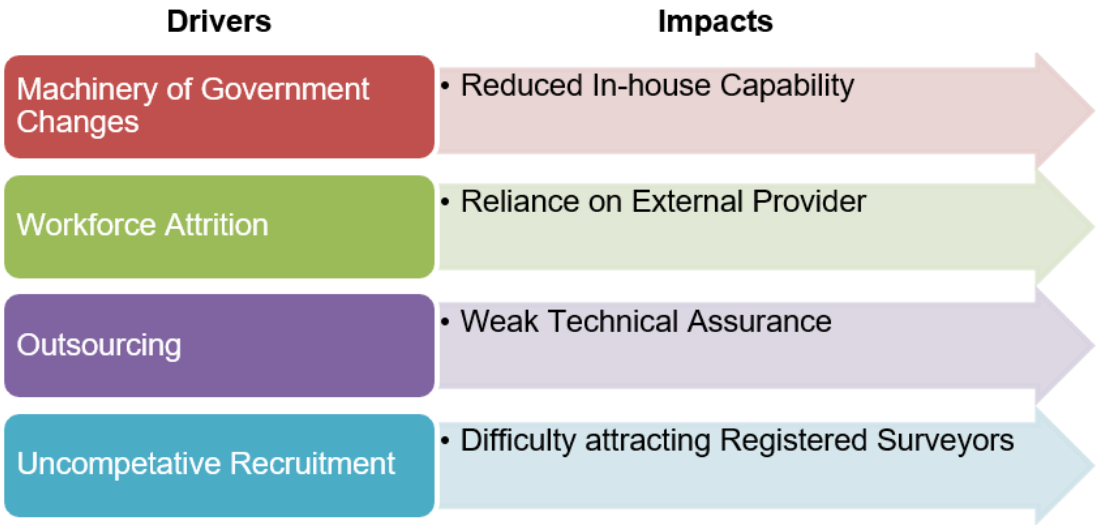

Figure 1: Drivers and impacts of capability pressures on government surveyors.

National workforce studies indicate that Australia faces a sustained shortage of surveying and spatial professionals over the coming decade, with demand projected to exceed supply even before accounting for the additional skills required for digital engineering and spatial digital twin initiatives (e.g. The Surveyors' Trust, 2022; Consulting Surveyors National, 2023; Jobs and Skills Australia, 2026). These national trends are consistent with what agencies are seeing, where small internal teams and increased outsourcing are now common.

While this paper draws on practitioner experience and policy review, quantitative workforce data across NSW agencies remains limited. National studies confirm sustained shortages of surveying professionals (The Surveyors' Trust, 2022; Consulting Surveyors National, 2023), underscoring the need of capability strengthening.

4 RISKS AND IMPLICATIONS

The decline in government surveying capability is more than a staffing issue and creates real problems: Agencies cannot properly specify, check or manage spatial data. As agencies lean further into digital engineering, BIM and digital twin initiatives, processes still expect strong survey teams, but a lot of agencies do not have these anymore. Policies demand what some teams cannot deliver. In practice, several recurring gaps are evident. Many agencies and councils now operate without a registered surveyor on staff, with technical decisions delegated to project managers or engineers who may lack specialist spatial expertise. Outsourcing is often used to plug resourcing gaps, but where internal governance is weak, external providers may be engaged under contracts that lack clear spatial standards, accuracy tolerances or data governance requirements. Digital complexity adds a further layer, as teams are asked to manage LiDAR capture, Unmanned Aerial Vehicle (UAV) photogrammetry, BIM integration and digital twin ingestion without established structures for spatial data ownership, metadata and lifecycle control.

These gaps create specific risks that affect project delivery. Table 1 summarises key risks observed across agencies and links them to common underlying causes.

Table 1: Key risk categories arising from reduced government surveying capability.

Risk Category	Underlying Cause	Impact	Example
Compliance Failure	No registered surveyor, decisions delegated to non-specialists.	Legal disputes, costly rework, project delays.	A boundary alignment error is discovered during construction, forcing redesign of an access road and triggering a dispute, compounded by Preservation of Survey Infrastructure (POSI) compliance issues with destruction of marks.
Procurement Issues	Contracts issued without technical input or clear spatial standards.	Scope creep, disputes with external providers.	A survey contract omits accuracy classes and formats, leading to additional variations when deliverables cannot be used in the agency's digital engineering environment.
Data Integrity	Poor lifecycle management of spatial data, lack of governance.	Incompatibility with BIM/digital twins, asset reliability compromised.	Without in-house surveyors, agencies struggle to review open point cloud datasets from private providers, unable to assess quality or verify value for money. As-constructed survey data is delivered in ad-hoc formats without metadata, so it cannot be reliably ingested into the asset systems.
Loss of Public Trust	Errors in land boundaries or the set-out of public infrastructure.	Reduced confidence in government systems and decision making.	A public building/facility that is built over the boundary results in media coverage and community concern about the reliability of government processes.

Beyond these discrete risks, a broader threat emerges: Agencies may deliver projects that appear successful in traditional terms, on time and on budget, yet fail to meet interoperability requirements or support future digital twin integration. Without a structured approach to renewing capability, government surveyors will risk being sidelined when their custodial role over spatial integrity is most important.

5 A FRAMEWORK FOR CAPABILITY RENEWAL

Addressing these capability gaps requires more than additional resources or ad-hoc training; it requires a structured approach to how government surveyors contribute to digital delivery and spatial governance. To support agencies in reviewing and strengthening their arrangements, this paper proposes a practical capability renewal framework built around four pillars that build on each other (Figure 2):

- *Technical Leadership and Assurance*: Embedding government surveyors early in project lifecycles and establishing clear hold points, so spatial data is validated before it underpins design and construction.
- *Strategic Procurement Frameworks*: Using shared panels, standardised scopes and embedded spatial standards to improve the quality and consistency of externally delivered survey services.
- *People, Skills and Career Pathways*: Rebuilding a resilient government surveying workforce and pairing traditional competencies with digital skills in LiDAR processing, spatial data Quality Assurance (QA), validation and digital twin management.
- *Data Governance and Interoperability*: Treating spatial data as a managed asset, with defined ownership, metadata, accuracy standards and handover requirements aligned to digital engineering and spatial digital twin programs.

Together, these four pillars form a capability framework that agencies can use to diagnose current strengths and gaps, prioritise interventions and clarify the role of government surveyors within multidisciplinary digital delivery teams. The following sections describe each pillar in more detail, including its purpose, the challenges it seeks to address, practical actions agencies can take, and examples from NSW practice.

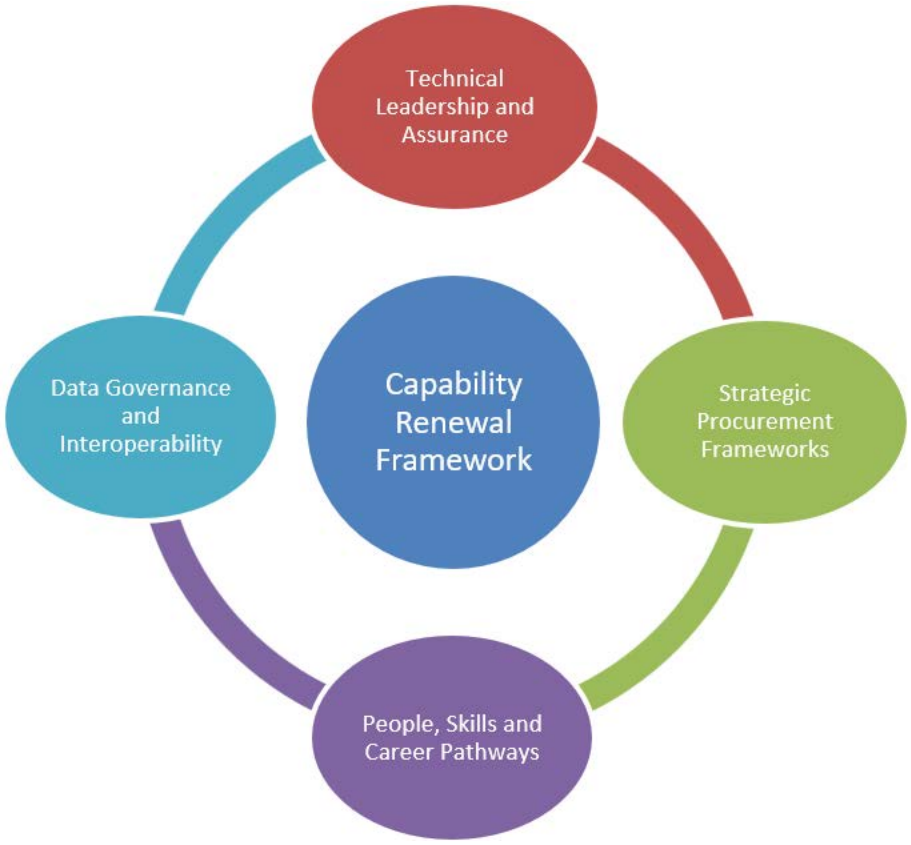

Figure 2: Four pillars of the capability renewal framework for government surveying.

5.1 Pillar 1: Technical Leadership and Assurance

Government surveyors are most effective when they act as technical leaders rather than simply service providers brought in after key decisions have already been made. In a digital delivery environment, this role includes defining spatial requirements at project inception, advising on control and accuracy standards, and providing formal assurance that data is suitable for use in detailed design, BIM and digital engineering workflows. Without this role, critical decisions about spatial datasets may fall to non-specialists, increasing the likelihood of errors, costly rework and compliance issues.

In many agencies, current processes do not consistently embed surveyors throughout the project stages. Projects may advance to detailed design or even construction before proper survey advice is sought, or spatial data may be procured and ingested into models without structured review against agreed tolerances and control frameworks. This creates a weak assurance chain. Issues with datum, control or capture methods often surface only when conflicts appear between the model and the physical environment by which time changes are costly and disruptive.

Enhancing technical leadership and assurance requires clear, repeatable processes for survey input and sign-off. To this end, Table 2 summarises practical actions agencies can take and their purpose.

Table 2: Practical actions to strengthen technical leadership and assurance.

Action	Purpose / Explanation
Embed survey requirements into project initiation documents and digital engineering standards.	Ensure spatial control, accuracy classes and metadata expectations are defined at the outset, so they flow through the design and delivery stages.
Establish mandatory survey review hold points at concept and detailed design stages.	Formal checkpoints help validate spatial data before it underpins engineering models and set-outs.
Publish agency-wide deliverable checklists and accuracy tolerances.	Standardised expectations reduce ambiguity and improve consistency across projects.
Require registered surveyor sign-off for spatial datasets underpinning engineering models and set-outs.	Provides formal assurance that data meets positional accuracy and compliance requirements.

Early involvement of survey teams in digital engineering programs, such as those within Transport for NSW, has shown that validating spatial data during the design phases can prevent alignment issues, reduce schedule impacts and uphold positional accuracy requirements.

Prompt questions for discussion:

- Are surveyors involved at planning and concept design stages of major projects?
- Do projects include formal review gates for spatial data *before* it is used in engineering models and set-outs?
- Is registered surveyor sign-off required for key spatial datasets underpinning design and construction?
- Are survey requirements documented in project initiation and digital engineering standards, with deliverable checklists and accuracy tolerances consistently applied?

5.2 Pillar 2: Strategic Procurement Frameworks

Government surveyors increasingly work through external providers, and procurement is now a capability tool not just purchasing services. When surveyors help shape procurement frameworks, they can embed clear scopes, accuracy requirements and data governance expectations that support integrated digital delivery across design, construction and asset management. The strategic use of panels and standardised scopes enable agencies to access specialist skills quickly while maintaining transparency and technical oversight.

Where survey input to procurement is limited, contracts are often issued without robust spatial standards or clear deliverables. Project managers may specify outputs in broad terms, leaving method, control and formats to the market, which can result in inconsistent quality and data that is difficult to integrate into BIM or digital twin environments. Fragmented panels and one-off engagements can also increase lead times and reduce the ability to build long-term capability aligned with agency standards and systems.

Strengthening strategic procurement frameworks requires using government surveyors as technical advisers in the management of survey contracts. This approach ensures value for money, helps select the right survey firms when invited to tender, and supports the evaluation of bids against clear briefs so that technically compliant tenders are chosen. Table 3 summarises practical actions and their purpose.

Table 3: Practical actions to strengthen strategic procurement frameworks.

Action	Purpose / Explanation
Develop whole-of-government or shared panels with pre-qualified survey suppliers and standardised scopes.	Improves consistency and reduces procurement lead times by using vetted suppliers familiar with agency standards.
Bundle recurrent tasks into larger contracts with clear service-level expectations.	Streamlines engagement for routine work and ensures predictable quality and turnaround times.
Include explicit spatial data governance clauses covering control, accuracy, formats and metadata.	Embeds technical standards into contracts, reducing ambiguity and ensuring deliverables are fit for digital engineering and digital twin integration.
Position surveyors as technical reviewers during tender evaluation and contract management.	Ensures technical compliance and alignment with agency spatial standards throughout the procurement lifecycle.

Examples of existing shared panels with embedded technical standards include Transport for NSW's dedicated survey panels and the Remote Sensing and Spatial Elevation (ReSSE) scheme managed by DCS Spatial Services (2026b).

Prompt questions for discussion:

- Are surveyors involved in designing and reviewing survey-related contracts and panels?
- Do standard scopes and conditions clearly define control, accuracy, format and data governance requirements?
- Can agencies quickly access pre-qualified survey suppliers for digital engineering and digital twin related tasks?
- Do procurement processes include technical review by a registered or senior surveyor before awarding survey contracts?

5.3 Pillar 3: People, Skills and Career Pathways

Capability renewal ultimately depends on people, i.e. attracting, developing and retaining government surveyors with both traditional and digital skills. Modern infrastructure delivery requires surveyors who understand cadastral and engineering surveying as well as point cloud processing and the governance requirements for digital twins and enterprise spatial systems. Structured career pathways, mentoring and targeted training are therefore central to sustaining government's control of spatial data quality.

Many government survey teams face challenges in recruiting and retaining registered surveyors, competing with private sector salaries and more flexible employment conditions. In some agencies, roles have narrowed to particular functions, offering limited exposure to complex projects or digital workflows and thus discouraging early-career surveyors seeking growth. At the same time, limited access to mentoring and on-the-job support can slow progress toward registration and reduce confidence in handling digital workflows.

Strengthening people resources, skills and career pathways requires coordinated action across recruitment, development and professional support. Table 4 summarises practical actions agencies can take and their purpose.

Table 4: Practical actions to strengthen people, skills and career pathways.

Action	Purpose / Explanation
Establish cross-agency graduate rotations.	Expose early-career surveyors to cadastral, infrastructure and asset management tasks to broaden experience. Secondment opportunities could include rotations between agencies such as Transport for NSW, NSW Public Works, Crown Lands, Sydney Trains and DCS Spatial Services to provide diverse project exposure and accelerate professional development.
Create formal mentoring arrangements.	Connect graduates and early-career staff with experienced registered and senior surveyors to accelerate learning and registration.
Invest in micro-credentials and targeted training.	Build digital skills in data governance, interoperability standards, BIM workflows and spatial analytics alongside traditional competencies.
Develop structured career pathways.	Provide clear progression from graduate to senior technical roles, improving retention and capability resilience.
Offer cross-agency and rural placements and rotations in diverse environments.	Accelerate practical learning and confidence through exposure to varied projects and contexts. Seek rural placement opportunities through other agencies to broaden experience and strengthen capability in different operational settings.

Experience from rural placements and rotations within organisations such as Crown Lands shows that structured exposure to diverse environments can accelerate learning, build confidence and create a more resilient government surveying workforce.

Prompt questions for discussion:

- Do government surveyors have clear pathways and support to progress to registration and senior technical roles?
- Are digital skills in BIM, point clouds and data governance embedded alongside traditional surveying competencies?
- Are there cross-agency rotations or mentoring arrangements that broaden experience and strengthen retention?
- Is targeted training in interoperability and spatial analysis available and accessible?

5.4 Pillar 4: Data Governance and Interoperability

Spatial data is now a long-lived asset in its own right, underpinning decisions from initial planning through to operation and renewal of infrastructure. Government surveyors are uniquely placed to define and uphold the governance arrangements that keep this data accurate, authoritative and interoperable across systems and over time. This includes setting standards for control, accuracy, metadata, formats and data handover that align with digital engineering requirements and the NSW Spatial Digital Twin.

In many agencies, however, spatial data governance remains fragmented. Datasets are often captured project-by-project with limited attention to lifecycle management, leading to duplication, inconsistent coordinate references and uncertainty about which datasets are correct. Without clear standards and schema validation, data supplied for BIM or digital twin ingestion may be difficult to integrate or may fail to meet the standards expected under policies such as the IDD and SDT frameworks.

Strengthening data governance and interoperability requires treating survey and spatial data as managed assets with defined owners, rules and quality controls. Table 5 summarises practical actions and their purpose.

Table 5: Practical actions to strengthen data governance and interoperability.

Action	Purpose / Explanation
Publish a survey data governance policy.	Sets out custodianship, metadata requirements, accuracy classes and quality assurance processes.
Mandate interoperable formats and schema validation at handover.	Ensures data can be integrated into BIM, GIS and digital twin platforms.
Maintain authoritative registers for control networks and benchmarks.	Provides a single source of truth for spatial control across projects, reducing duplication and misalignment.
Define lifecycle ownership for spatial datasets.	Clarifies who is responsible for maintaining data accuracy and integrity over time.
Mandate POSI processes (Surveyor-General's Direction No. 11).	In-house surveyors ensure survey mark preservation during works, maintaining cadastral and design model integrity.
Implement QA processes for positional accuracy and metadata compliance.	Reduces risk of errors and improves confidence in spatially enabled decision making.

Practical examples include ensuring compliance with Surveyor-General's Direction No. 11 (Preservation of Survey Infrastructure). In-house government surveyors, particularly in local government, lead POSI audits and control surveys during infrastructure works, maintaining Permanent Survey Marks (PSMs) that anchor cadastral and design model accuracy. These governance processes extend to data lifecycle management across projects. Projects that adopt robust survey control registers and interoperable formats, such as Transport for NSW's G73 Detail Survey specification (Transport for NSW, 2023), enable smoother integration of design and as-built data into digital twin platforms and corporate spatial systems, reducing rework and improving confidence in spatially enabled decision making.

Prompt questions for discussion:

- Is there a clear survey and spatial data governance policy that defines ownership, standards and quality controls?
- Are interoperable formats, schemas and metadata requirements mandated for survey deliverables and handover?
- Are authoritative control networks and key asset coordinates maintained and reused across projects rather than recreated from scratch?
- Are QA processes in place to validate positional accuracy and metadata compliance before data ingestion?

6 CONCLUDING REMARKS

Government surveyors in NSW face rising expectations for spatial data and digital delivery under policies like IDD and SDT, while in-house capability has shrunk from workforce changes and outsourcing, creating real risks such as compliance failures, weak procurement and data unfit for ongoing project delivery.

This paper has outlined key capability pressures for government surveyors and then proposed a 4-pillar capability renewal framework consisting of (1) technical leadership and assurance, (2) strategic procurement frameworks, (3) people, skills and career pathways, and (4) data governance and interoperability. This framework offers agencies a practical tool to diagnose gaps, align themselves with NSW's digital goals, and strengthen government surveying capability for NSW's digital infrastructure future. Based on local experience, it is anticipated that the framework will be refined through feedback from government and industry surveyors following a dedicated APAS2026 conference discussion forum to deliver clear, actionable tools for the profession.

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