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The Efficacy of Digital Mapping Workshops (IMW) in Transferring Traditional Knowledge and Data Governance Skills to Indigenous Communities

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Abstract

This study employs Participatory Action Research (PAR) to assess the dual-dimensional efficacy of Indigenous Mapping Workshops (IMW) within the Australian Indigenous Mapping Workshop programme, evaluating their contribution to ancestral knowledge preservation and practical community capacity in GIS and Indigenous Data Sovereignty (IDS). The research positions digital mapping as a convergence site where Western geospatial science meets the ontological imperatives of Indigenous land relationships, generating opportunities and tensions that existing evaluative frameworks inadequately capture. Through direct collaborative engagement with participants from three Aboriginal and Torres Strait Islander communities in South-East Queensland, the Northern Territory Top End, and the Pilbara region, the PAR methodology monitors post-workshop deployment of GIS skills in community-led land management, native title, and cultural heritage protection, while assessing intergenerational knowledge transfer and horizontal technology skills transfer. Findings reveal that the IMW model is most efficacious as a knowledge preservation instrument when governed by community-determined protocols, with epistemic authority determining what is mapped, at what scale, and under what access governance. Conversely, the model generates the highest data governance capacity when participants are equipped not merely with technical GIS skills but with conceptual frameworks for asserting Indigenous Data Sovereignty, including the CARE Principles, the OCAP Principles (Ownership, Control, Access, and Possession), and Traditional Knowledge (TK) Labels that translate community authority into technically enforceable instruments. The study contributes the Community Spatial Sovereignty Framework (CSSF), an evidence-based protocol architecture for the design and evaluation of future IMW programmes that maximises efficacy across both knowledge preservation and data governance dimensions, thereby ensuring long-term self-determination within evolving national digital policy landscapes.

Keywords: Indigenous Mapping Workshops, Participatory Action Research, Traditional Knowledge, Indigenous Data Sovereignty, GIS, CARE Principles, OCAP Principles, Intergenerational Knowledge Transfer, Community Spatial Sovereignty, Digital Decolonisation.

1. INTRODUCTION

The Australian continent's landscape constitutes, for Aboriginal and Torres Strait Islander peoples, an epistemological archive of immeasurable depth and complexity. Country the term used across many Indigenous Australian communities to describe the land, waters, sky, and all living and spiritual relationships that constitute a people's ancestral territory is not a passive geographic substrate but an active, relational entity that stores and transmits knowledge through its topography, its ecological patterns, its sacred sites, its song lines, and its ceremonial geographies (Rose, 1996; Gammage, 2011). The systematic documentation, management, and governance of spatial relationships with Country has always been central to Indigenous knowledge practices encoded in oral traditions, ceremonial performance, kinship systems, and the rich visual languages of rock art, sand drawings, and body painting that constitute some of the world's oldest cartographic traditions (Lewis, 1976). In this context, the emergence of digital Geographic Information Systems as a tool for Indigenous spatial knowledge management represents not the introduction of an entirely foreign technology, but the arrival of a new technical medium for practices of spatial knowledge encoding that Indigenous communities have conducted across millennia through their own epistemic instruments.

The Indigenous Mapping Workshop (IMW) model as developed and practised in Australia through the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS)-supported Indigenous Mapping Workshop programme, and in parallel by allied initiatives including the First Nations Technology Council's Mapping for Country programme and various state and territory land council mapping capacities provides structured, community-based training in GIS technical skills for Aboriginal and Torres Strait Islander

community members, designed to enable communities to create, manage, and govern their own spatial datasets for a range of community-determined purposes: native title applications and management, cultural heritage site registration, land management planning, environmental monitoring, and the documentation and preservation of ancestral place-name systems and associated traditional ecological knowledge (AIATSIS, 2021). The IMW model emerged from the recognition, progressively consolidated across the 1990s and 2000s, that the application of GIS to Indigenous land and resource management was being overwhelmingly conducted by non-Indigenous researchers, government agencies, and resource companies using data derived from Indigenous knowledge holders, without adequate community ownership, control, or benefit a pattern that constituted a digital dimension of the extractive research practices that decolonising methodologies scholars had been critiquing in the broader research ethics context (Smith, 2012; Tuhiwai Smith, 1999).

Despite the IMW model's growing institutionalisation across Australia and internationally, with analogues in the United States (National Conference of American Indians mapping programmes), Canada (First Nations Information Governance Centre GIS training), and Aotearoa New Zealand (Māori Spatial Data Infrastructure initiatives), rigorous empirical evaluation of its efficacy across its two primary stated objectives remains underdeveloped in the published literature. Most extant assessments of IMW programmes are descriptive and programmatic rather than analytically rigorous, documenting workshop output numbers of participants trained, spatial datasets created, community mapping projects initiated, without systematically investigating the quality and durability of the knowledge preservation and data governance capacity outcomes that these outputs are presumed to generate (Chapin et al., 2005; Tobias, 2009). This evaluative gap is particularly consequential in the context of the accelerating global agenda of Indigenous Data Sovereignty (IDS), which demands that Indigenous communities not merely create spatial datasets but genuinely own, control, and govern them in accordance with their own community protocols and legal rights (Carroll et al., 2020; Kukutai & Taylor, 2016). The question of whether IMW programmes, as currently designed and delivered, adequately equip participants with the conceptual and practical data governance skills required to operationalise IDS in their communities' spatial data management practices is one that the literature has not yet addressed with the empirical rigour it demands.

This study addresses this gap by employing a Participatory Action Research methodology to conduct a longitudinal, community-embedded assessment of IMW efficacy across both the traditional knowledge preservation and data governance capacity dimensions. The research is explicitly positioned within the tradition of decolonising research methodologies (Tuhiwai Smith, 1999; Wilson, 2008), treating the communities who participate in IMW programmes not as research subjects whose outcomes are observed and reported by external researchers, but as co-investigators whose own assessment of what constitutes effective knowledge preservation and data governance capacity provides the primary evidential basis for the study's findings. This epistemological positioning has direct methodological implications, most significantly in the study's adoption of community-determined success criteria for both evaluation dimensions, rather than researcher-imposed outcome metrics derived from Western knowledge management or information systems frameworks.

The study's empirical contribution is grounded in three community partnerships established through QUT's Oodgeroo Unit's long-standing institutional relationships with Aboriginal and Torres Strait Islander communities and organisations. Each community partnership has a distinct configuration of cultural context, land management priorities, and prior GIS engagement that provides the cross-community variation necessary for the development of theoretically generalisable, rather than site-specific, conclusions about IMW efficacy. The theoretical contribution of the study is the Community Spatial Sovereignty Framework (CSSF), an evidence-based protocol architecture for the design, delivery, and evaluation of IMW programmes that integrates the technical requirements of GIS capacity building with the epistemic and governance imperatives of Indigenous Data Sovereignty, traditional knowledge preservation, and community self-determination.

2. METHODOLOGY

The study employs Participatory Action Research (PAR) as its overarching methodological framework, a research design that is both epistemologically appropriate and ethically imperative for research conducted in partnership with Indigenous communities on questions of knowledge sovereignty and community capacity

(Kemmis & McTaggart, 2005; Smith, 2012). PAR's defining features, the integration of research, action, and community participation in a cyclical, iterative process; the positioning of community members as co-researchers rather than research subjects; and the orientation of the research process toward the production of actionable knowledge that serves community-determined objectives, align directly with the IMW programme's own community-empowerment ethos and with the decolonising research ethics principles that govern QUT's Oodgeroo Unit's community partnership protocols (AIATSIS, 2020; Wilson, 2008).

2.1. Community Partnership Architecture and Ethical Framework

Three community partnerships were established through a formal research agreement process negotiated with community governance structures, specifically, the elected councils and cultural governance committees of each partner community over a six-month pre-fieldwork period. The first partner community is a South-East Queensland coastal Aboriginal community whose Country encompasses a complex of estuarine wetlands, coastal heath, and eucalypt forest that constitutes both a culturally significant ceremonial landscape and a site of active contested land management involving local government, state heritage agencies, and a mining company with an approved exploration licence over a portion of the community's Country. This community had participated in an IMW programme two years before the study's commencement, and the research partnership focuses on assessing the degree to which workshop-acquired GIS skills have been subsequently deployed in the community's ongoing cultural heritage protection and native title management activities. The second partner community is located in the Northern Territory Top End, on Amhem Land Aboriginal Land Trust country. It comprises a remote community with a complex multilingual cultural environment encompassing speakers of four distinct Aboriginal languages. This community's mapping priorities are focused on documenting seasonal resource management knowledge, particularly fire management, water source management, and marine resource stewardship associated with specific geographical features of their Country, and on protecting this knowledge from unauthorised access under the Northern Territory's Aboriginal Sacred Sites Act 1989. The third partner community is located in the Pilbara region of Western Australia, on the pastoral lands and adjacent Aboriginal reserves that constitute the traditional Country of a Ngarluma-speaking community currently engaged in a contested free, prior and informed consent (FPIC) process with an iron ore mining company seeking to expand its operational footprint over a section of the community's Country that contains sites of significant cultural heritage value.

The ethical architecture governing all three community partnerships is structured around four principles derived from the AIATSIS Code of Ethics for Aboriginal and Torres Strait Islander Research (2020) and the First Nations Information Governance Centre's OCAP Principles (Ownership, Control, Access, and Possession). Ownership: all spatial datasets produced through the research partnership are legally and morally the property of the partner communities; the university holds no intellectual property rights over community-generated data. Control: all research design decisions, including what is mapped, at what scale of detail, with what access restrictions, and for what purposes, are determined by the community governance structures, not by the research team. Access: access to research outputs, including community spatial datasets and interview transcripts, is governed by community-determined protocols; the research team's access to community knowledge is conditional on community consent and revocable at any time. Possession: physical and digital custody of all research outputs is held by the partner communities; the university retains copies only of de-identified analytical materials approved by community governance structures for research publication (FNIGC, 2019; Carroll et al., 2020).

2.2. PAR Cycles and Data Collection Methods

The research proceeded through three iterative PAR cycles across an eighteen-month engagement period with each community partnership, following the cyclical PAR logic of reconnaissance (understanding the existing situation), planning (designing the intervention or investigation), action (implementing and documenting the intervention), observation (systematically recording outcomes), and reflection (collectively analysing and interpreting observations to inform the next cycle) (Kemmis & McTaggart, 2005). In Cycle 1, the reconnaissance phase involved in-depth community consultations conducted through structured yarning circles with Elders, workshops with prior IMW participants, and individual semi-structured interviews with community governance representatives to establish community-determined criteria for assessing IMW efficacy

across both the traditional knowledge preservation and data governance dimensions. The recognition that success criteria must be community-determined rather than researcher-imposed was methodologically foundational: the same GIS output that a researcher might assess as a successful knowledge preservation product might be deemed inadequate by community Elders. After all, it represents knowledge at a level of spatial detail or public accessibility that violates cultural protocols or is considered excessive because it renders visible knowledge whose power derives from its restricted circulation. Community-determined success criteria were documented and formalised in a Community Research Protocol, which guided all subsequent data collection and analysis decisions.

In Cycle 2, the action and observation phase, the research team conducted systematic monitoring of how GIS mapping skills acquired through prior IMW participation had been deployed in community-led projects during the period between workshop completion and the study's commencement (retrospective monitoring) and during the study's active fieldwork period (prospective monitoring). This monitoring encompassed structured observation of community GIS work sessions, analysis of community-produced spatial datasets with community members' commentary on their production processes and governance status, and systematic documentation of instances in which mapping skills were transferred from workshop-trained participants to other community members through peer-to-peer horizontal transfer. The intergenerational knowledge transfer dimension, the vertical axis of the study's dual-transfer assessment, was monitored through structured observation of mapping sessions that involved both Elder knowledge holders and younger community members, documenting the processes through which traditional place knowledge, ecological management information, and ceremonial geography were translated into GIS-compatible representations, and the negotiations, limitations, and cultural protocols that governed those translation processes.

In Cycle 3, the reflection and framework construction phase, collective analytical sessions were conducted with community governance representatives and IMW participants to collectively interpret the monitoring data and identify the structural conditions in terms of workshop design, community protocol architecture, data governance toolkits, and ongoing technical support availability that most reliably produced efficacious outcomes across both evaluation dimensions. These collective reflection sessions, conducted using a structured deliberative methodology adapted from the World Cafe facilitation framework (Brown & Isaacs, 2005) to align with community conversational norms, produced the primary evidential basis for the Community Spatial Sovereignty Framework developed in Section 3.5 of this paper.

2.3. Analytical Framework: Dual-Dimension Efficacy Assessment

Analytical rigour was maintained through a triangulated evidence framework that combined three data streams: direct observational records from community GIS work sessions and knowledge transfer events; participant-generated reflective accounts collected through yarning circle sessions and individual interviews; and material artefact analysis of community-produced spatial datasets, data governance documents, and Traditional Knowledge Label applications. Each data stream was independently coded using a dual-dimension coding schema, distinguishing between data bearing on the traditional knowledge preservation dimension and data bearing on the data governance capacity dimension. The coded outputs from each stream were subjected to constant comparative analysis to identify convergences, divergences, and tensions across the three data types. Analytical conclusions were member-checked with community governance representatives at each partner community before being incorporated into the study's findings, ensuring that the research team's interpretations remained accountable to the communities' own understandings of their experiences (Wilson, 2008).

3. RESULTS AND DISCUSSION

3.1. The Dual-Transfer Architecture: Intergenerational and Horizontal Knowledge Flows

The PAR monitoring data reveal that the IMW model generates two structurally distinct but interdependent knowledge transfer processes that operate simultaneously but through different social mechanisms and produce qualitatively different outcomes. The intergenerational transfer process, the vertical axis along which traditional ecological knowledge, place-name systems, ceremonial geography, and land management practices are transferred from Elder knowledge holders to younger community members through the medium

of the mapping workshop, is not primarily technical. It is a relational and ceremonial process in which the GIS tool functions as a facilitator of Elder-youth engagement rather than as the primary transfer instrument. In all three community partnerships, the most substantive traditional knowledge transfer events observed during the research period occurred not in front of a computer screen but on Country during field mapping sessions in which Elder knowledge holders walked the land with younger community members and, in the process of identifying and describing sites for GPS recording, transmitted the layered narratives of connection, responsibility, and relational accountability that constitute the living meaning of those sites within the community's knowledge system.

This finding has a significant implication for the design of IMW programmes that is not consistently reflected in current workshop delivery models: the technical GIS training component of an IMW should be understood as preparation for on-Country knowledge documentation, not as a substitute for it. The workshops observed in this study that generated the most substantive intergenerational knowledge transfer outcomes were those that explicitly structured the technical training phase as preparation for subsequent on-Country field sessions, with Elders involved in planning the mapping priorities and field methodology from the programme's inception, rather than being introduced as knowledge sources after the technical training was complete. Conversely, the workshops where intergenerational transfer was most constrained were those in which technical training was self-contained, with participants acquiring GIS skills in a classroom or computer lab setting without a structured on-Country application phase, and where Elders were not systematically involved in determining the mapping protocol.

The horizontal technology skills transfer process, the lateral axis along which GIS skills acquired by workshop participants are subsequently transferred to other community members who did not participate in the original workshop, presents a more complex and variable pattern. Across all three community partnerships, post-workshop skills transfer to non-participants was substantially higher in communities where workshop-trained participants occupied recognised leadership or governance roles as land council representatives, community enterprise managers, or cultural heritage officers than in communities where workshop participants were selected primarily based on interest or availability rather than governance standing. The social mechanism explaining this pattern is the authority dimension of skills transfer: GIS mapping is not a politically neutral activity in Indigenous communities. The production of spatial datasets that document cultural heritage sites, sacred places, or resource management areas has direct implications for land rights, mining negotiations, and cultural governance implications that mean that community members are more likely to engage with and build upon GIS mapping work initiated by individuals whose community authority they recognise and respect. Workshop participant selection that prioritises governance standing over technical aptitude thus produces higher downstream skills diffusion, even if initial technical uptake during the workshop is somewhat lower.

3.2. Traditional Knowledge Preservation: What the Map Does and Does Not Capture

The most analytically challenging dimension of this study's evaluation of IMW efficacy for traditional knowledge preservation is the irreducible tension between the epistemological architecture of GIS and the ontological character of the knowledge it is being deployed to document. GIS is a system for representing the world as bounded spatial objects assigned to fixed coordinate locations on a reference plane. This fundamentally Cartesian spatial ontology treats place as a geometric property of physical location (Longley et al., 2015). Indigenous spatial knowledge, by contrast, treats place as a relational property. A site is defined not by its coordinates but by its web of relationships: to the Dreaming narratives that created it, to the kinship systems that govern custodianship of it, to the seasonal ecological patterns that animate it, and to the ceremonies and obligations that maintain it (Rose, 1996; Gammage, 2011). The translation of relational place-knowledge into coordinate-assigned GIS objects necessarily involves a degree of ontological reduction, which the Elder knowledge holders in all three community partnerships identified as a legitimate concern.

In the South-East Queensland community partnership, the most explicit articulation of this tension emerged during a community reflection session in which a senior Elder described the experience of watching a younger community member assign a GPS point to a location associated with a sacred ceremony as 'putting a pin through a butterfly,' capturing the physical location while puncturing the living significance that gives the location its meaning. This metaphor encapsulates a critical limitation of even the most culturally sensitive IMW design: the GIS representation can document that a place exists and where it is located, but it cannot, in its current technical form, adequately encode the relational, dynamic, and ceremonially restricted knowledge

dimensions that constitute the place's actual cultural significance. The community reflection process identified three principal categories of traditional knowledge that the GIS medium manages relatively well, and three categories for which it is fundamentally inadequate without supplementary non-spatial knowledge management instruments. GIS manages well the documentation of physical site locations and basic descriptive attributes; the delineation of country boundaries and resource management zones; and the temporal mapping of seasonal ecological patterns tied to specific geographic features. GIS poorly manages the encoding of the narrative and ceremonial dimensions of sites; the representation of the relational obligations and kinship protocols that govern access to different knowledge layers; and the dynamic, living quality of traditional ecological knowledge, which changes with season, ceremony, and the authority level of the knowledge holder.

The implication of this analysis for IMW programme design is not that GIS is an inappropriate tool for traditional knowledge preservation the communities' own assessments consistently affirmed that GIS provides genuinely valuable documentation capacity, particularly for the defensive purpose of establishing an evidential record of cultural heritage that can be deployed in native title and heritage protection contexts but that GIS documentation should be explicitly designed as one layer in a multi-instrument knowledge preservation architecture. The Northern Territory community partnership had independently arrived at this conclusion before the research partnership's commencement, developing a community knowledge management system that integrates GIS spatial layers with an audiovisual archive of Elder narratives and on-Country recordings linked to spatial features through a locally governed database. The PAR process validated and refined this integrated architecture as a model for the other two community partnerships and as a component of the Community Spatial Sovereignty Framework.

3.3. Data Governance Capacity: From Technical Skill to Sovereignty in Practice

The data governance capacity dimension of the study's dual evaluation yields findings that are simultaneously more technically tractable and more structurally challenging than the traditional knowledge preservation dimension. The technical GIS skills acquired through IMW participation, including spatial data creation, attribute table management, coordinate system assignment, layer styling, and basic spatial analysis, were assessed by monitoring participants' post-workshop project work and found to be adequate for the community-scale mapping tasks that constitute the primary practical demand on IMW graduates. However, the monitoring data across all three community partnerships revealed a consistent and significant gap between technical GIS proficiency and the data governance capacity required to operationalise Indigenous Data Sovereignty in practice. This gap manifests in three specific governance capability deficits.

The first deficit is the absence of metadata governance skills. The creation of a GIS spatial dataset for community purposes, for example, a layer documenting cultural heritage site locations for use in a native title management application, generates not only the spatial data itself but a suite of metadata: file format and storage location records, attribute field descriptions, data creation date and creator identity, coordinate system documentation, and accuracy and completeness assessments. In a standard metropolitan GIS workflow, these metadata are managed through standard institutional documentation procedures. In a community mapping context governed by Indigenous Data Sovereignty principles, metadata governance is a culturally and legally consequential activity: the metadata record establishes the dataset's provenance, ownership, and access permissions in ways that have direct implications for the community's ability to assert legal custodianship over the dataset and to prevent its misappropriation by external agencies. Participants across all three community partnerships reported that their IMW training had provided minimal or no instruction in culturally appropriate metadata governance, leaving them dependent on non-community-controlled metadata conventions that were inadequate for IDS purposes.

The second deficit concerns the application of the Traditional Knowledge Label. The Local Contexts system of Traditional Knowledge (TK) Labels and Notices, developed through a collaboration between the Local Contexts Project and the First Nations Information Governance Centre, provides a standardised set of digital labels that can be attached to digital datasets including GIS files to communicate community protocols governing the appropriate use, access, and circulation of the knowledge those datasets encode (Anderson & Hudson, 2020). TK Labels provide a technically interoperable, internationally recognised mechanism for translating community knowledge governance protocols into digital data governance instructions that can be recognised and respected by external data systems, repositories, and users. Despite their direct relevance to

the data governance objectives of IMW programmes, TK Labels were introduced and practically applied in only one of the six post-workshop community mapping projects monitored during the research period in the Pilbara community partnership, where a KAMS-trained community data coordinator had been introduced to the Local Contexts system through a separate data sovereignty training programme. This finding suggests a significant gap in IMW programme curricula between the technical GIS skills being taught and the data governance tools required to ensure that the datasets produced remain under genuine community control.

The third governance deficit is the lack of practical frameworks for managing the multi-tiered access architecture required by Indigenous spatial data governance. Many of the spatial datasets produced in community mapping projects contain knowledge of varying levels of cultural sensitivity and access restriction: some spatial features are public or semi-public and can be appropriately shared with government agencies, researchers, and the general public; others are restricted to specific kinship groups, initiated community members, or the Elders who hold custodial authority over them; and others are so sensitive because they document the locations of sacred sites, restricted ceremonial spaces, or burial grounds that any external access, regardless of context or purpose, would constitute a fundamental violation of cultural protocol. Managing this multi-tier access architecture in a GIS environment requires technical capabilities, including role-based access control in spatial database platforms, encrypted layer management, and geofencing protocols that are substantially beyond the scope of standard IMW technical training, and conceptual frameworks for formalising community decisions about access governance that most participants reported having not encountered in their workshop experience.

3.4. Why Community-Led Governance Protocols Must Precede Technical Training

The PAR reflection sessions across all three community partnerships converged on a finding that the research team had not fully anticipated at the study's design stage, but which emerged with sufficient consistency and analytical depth to constitute one of the study's most significant theoretical contributions: the efficacy of IMW programmes as data governance capacity-building instruments is primarily determined not by the quality of the technical GIS training delivered but by the presence or absence of a community-governed data sovereignty protocol that precedes, frames, and gives purpose to the technical training. Communities that entered the IMW programme with an existing, community-articulated governance framework specifying what categories of knowledge were appropriate for digital documentation, what access governance architecture would govern the resulting datasets, and what decision-making processes would manage requests for external data sharing consistently demonstrated higher data governance capacity outcomes than communities where GIS skills were acquired in a governance framework vacuum and community data governance decisions were made retrospectively, after datasets had already been created.

This finding inverts the conventional logic of digital capacity-building programmes, which typically deliver technical training first on the assumption that governance frameworks will develop organically as communities gain technical capability and experience. In the Indigenous spatial data context, this sequence creates a period of significant data sovereignty vulnerability: communities produce spatial datasets encoding sensitive traditional knowledge during the governance framework vacuum, potentially creating documentation that can be accessed, copied, or subpoenaed by external agencies before adequate access controls are established. The Pilbara community partnership provided the most explicit illustration of this risk: during the pre-study retrospective monitoring, it was established that spatial data produced during a previous mapping project conducted with minimal community data governance framework had been incorporated into a state government heritage register database without the community's explicit consent, a development that had significantly damaged community trust in digital mapping activities generally and that had created ongoing legal complications for the community's FPIC process with the mining company.

The theoretical implication is that the IMW programme design should incorporate a structured Community Data Sovereignty Planning phase as a mandatory prerequisite for the delivery of technical GIS training. This planning phase should guide communities through the articulation of their data governance values and priorities, the identification of knowledge categories and their appropriate access governance levels, the establishment of community decision-making processes for data governance, and the documentation of these determinations in a Community Data Governance Charter that becomes the governing instrument for all subsequent GIS activity. The investment of programme time in this pre-technical phase is not a diversion from

capacity building; it is the foundational capacity without which technical GIS skills cannot be deployed in a manner consistent with Indigenous Data Sovereignty.

3.5. The Community Spatial Sovereignty Framework (CSSF): Architecture and Application

The Community Spatial Sovereignty Framework is constructed from the synthesis of the PAR findings across all three community partnerships and their collective reflection outputs. It is structured as a four-phase programme design architecture for IMW programmes that integrates the traditional knowledge preservation and data governance dimensions of the workshop model within a coherent, community-sovereignty-centred protocol sequence. The four phases are not discrete, sequential stages, but iteratively connected cycles that should each be revisited as community mapping priorities evolve and community data governance capacity deepens.

Phase 1, Community Sovereignty Foundation, encompasses the community data governance protocol development activities described in Section 3.4 above. The outputs of this phase are a Community Data Governance Charter specifying the community's knowledge categorisation framework and associated access governance architecture, a Community Mapping Priorities Document identifying the specific knowledge domains and geographic areas that the community wishes to document through GIS, and a Community Research Ethics Agreement formalising the OCAP Principles-based governance arrangements for the mapping partnership. This phase typically requires between four and eight weeks of facilitated community engagement. It should be conducted by a facilitator with both Indigenous data governance expertise and deep cultural competency, ideally a community member or a researcher with long-standing community relationships.

Phase 2, Technical Capacity Building, delivers the GIS technical training that constitutes the core of conventional IMW programmes, but with three significant modifications derived from the study's findings. First, the technical curriculum is explicitly sequenced to support the community's previously articulated mapping priorities rather than following a generic GIS skill progression designed for metropolitan professional applications. Second, the technical training incorporates a dedicated module on culturally appropriate metadata governance, TK Label application through the Local Contexts platform, and practical exercises in implementing the community's multi-tier access governance architecture within the GIS platform being deployed. Third, the training programme explicitly addresses the selection and governance of GIS platform technology for community data sovereignty, including evaluating open-source alternatives to proprietary GIS platforms that may store community data on vendor-controlled servers outside community jurisdiction, and using locally hosted or community-controlled cloud storage for sensitive spatial datasets.

Phase 3, On-Country Knowledge Documentation, operationalises the field-mapping activities identified by the study's intergenerational transfer findings as the most substantive site of traditional knowledge preservation within the IMW model. This phase is structured around Elder-led field mapping sessions in which workshop-trained GIS practitioners accompany Elder knowledge holders on Country, with the Elder determining the mapping itinerary, the level of spatial and descriptive detail appropriate for each site, and the access governance status of the knowledge shared. The GIS practitioner's role in this phase is explicitly that of a technical servant to the Elder's epistemological authority. The participant captures what the Elder determines should be captured, at the scale and level of detail the Elder considers appropriate, and the Elder retains the primary authority to authorise, modify, or withdraw the documentation of any site or knowledge element. The on-Country sessions are supplemented by audiovisual recordings of Elder narratives, which are linked to GIS spatial features through the community knowledge management database architecture to create the multi-instrument knowledge preservation record that the study's findings recommend.

Phase 4, Governance Consolidation and Peer Transfer, addresses the horizontal skills transfer dimension of the study's dual-transfer assessment. It encompasses a structured programme of peer-facilitated GIS skills workshops, delivered by workshop-trained community members to non-participating community members, with ongoing technical mentoring from the IMW programme team. It also includes a formal governance review session, conducted with community governance structures six to twelve months post-workshop, to assess how effectively the Community Data Governance Charter is functioning in practice, to update the knowledge categorisation framework in light of experience, and to review the adequacy of the technical data governance instruments, TK Labels, access controls, and metadata documentation in enforcing the Charter's provisions.

This review mechanism transforms the CSSF from a static design protocol into a dynamic, self-correcting governance architecture that improves its effectiveness over time through the community's own reflective engagement with its outcomes.

4. CONCLUSION

This Participatory Action Research study has provided a rigorously community-grounded empirical assessment of the dual efficacy of Indigenous Mapping Workshops as instruments for traditional knowledge preservation and for building Indigenous Data Sovereignty capacity in Aboriginal and Torres Strait Islander communities in Australia. The findings confirm that the IMW model possesses genuine and significant potential across both dimensions as a facilitator of intergenerational knowledge transfer through Elder-led on-Country documentation, and as a vehicle for building community GIS and data governance capacity that enables communities to assert and operationalise their sovereign authority over their own spatial knowledge. However, this potential is consistently realised only when the community's epistemic and governance authority precedes, frames, and constrains the technical dimension of the workshop model, determining what is mapped, at what scale, for what purpose, and under what access governance architecture before the GIS tool is deployed.

The study's most consequential finding is the identification of a systematic gap between the technical GIS skills delivered by current IMW programmes and the data governance capabilities required to operationalise Indigenous Data Sovereignty in community spatial data management. Specifically, the absence of metadata governance instruction, TK Label application training, and multi-tier access control implementation from standard IMW curricula leaves communities technically capable of producing spatial datasets but insufficiently equipped to govern those datasets in a manner consistent with the OCAP Principles and the CARE Principles for Indigenous Data Governance. This curriculum gap represents an urgent design priority for the IMW programme architecture and for the broader community of practice engaged in Indigenous spatial capacity building.

The Community Spatial Sovereignty Framework proposed by this study offers a theoretically grounded, empirically validated protocol architecture for addressing this gap, integrating community sovereignty foundation activities, contextually adapted technical training, Elder-governed on-Country documentation, and sustained governance consolidation into a coherent four-phase programme design that maximises IMW efficacy across both the knowledge preservation and data governance dimensions. The CSSF is offered not as a prescriptive template but as a flexible architecture that must be adapted to each community partnership's specific cultural, geographic, and governance contexts. The deepest principle that the Country must govern the map, not the Country by the map, reflects a spatial epistemology that has sustained human relationships with the Australian landscape for tens of thousands of years, and that the tools of the digital age must serve rather than supplant.

REFERENCES

- Anderson, J., & Hudson, M. (2020). The LOCAL CONTEXTS licensing project: Traditional knowledge labels as a strategy for Indigenous community rights. In R. Hobbs & S. Layard (Eds.), *Oxford handbook on music law and policy*. Oxford University Press.
- Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS). (2020). *AIATSIS Code of Ethics for Aboriginal and Torres Strait Islander Research*. AIATSIS.
- Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS). (2021). *Indigenous mapping workshop program: Overview and outcomes 2015-2021*. AIATSIS.
- Brown, J., & Isaacs, D. (2005). *The world cafe: Shaping our futures through conversations that matter*. Berrett-Koehler Publishers.
- Carroll, S. R., Garba, I., Figueroa-Rodríguez, O. L., Holbrook, J., Lovett, R., Materechera, S., Parsons, M., Raseroka, K., Rodriguez-Lonebear, D., Rowe, R., Sara, R., Walker, J. D., Anderson, J., & Hudson, M. (2020). The CARE Principles for Indigenous Data Governance. *Data Science Journal*, 19(1), 43. <http://doi.org/10.5334/dsj-2020-043>
- Chapin, M., Lamb, Z., & Threlkeld, B. (2005). Mapping indigenous lands. *Annual Review of Anthropology*, 34, 619-638. <https://doi.org/10.1146/annurev.anthro.34.081804.120429>
- First Nations Information Governance Centre (FNIGC). (2019). *The First Nations principles of OCAP*. FNIGC. <https://fnigc.ca/ocap-training/>
- Gammage, B. (2011). *The biggest estate on earth: How Aborigines made Australia*. Allen and Unwin.

- Kemmis, S., & McTaggart, R. (2005). Participatory action research: Communicative action and the public sphere. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (3rd ed., pp. 559-603). SAGE Publications.
- Kukutai, T., & Taylor, J. (Eds.). (2016). *Indigenous data sovereignty: Toward an agenda*. ANU Press. <https://doi.org/10.22459/CAEPR38.11.2016>
- Lewis, D. (1976). Observations on route-finding and spatial orientation among the Aboriginal peoples of the Western Desert region of Central Australia. *Oceania*, 46(4), 249-282.
- Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2015). *Geographic information science and systems* (4th ed.). Wiley.
- Rose, D. B. (1996). *Nourishing terrains: Australian Aboriginal views of landscape and wilderness*. Australian Heritage Commission.
- Smith, L. T. (2012). *Decolonizing methodologies: Research and Indigenous peoples* (2nd ed.). Zed Books.
- Tobias, T. N. (2009). *Living proof: The essential data collection guide for Indigenous use-and-occupancy map surveys—Union of BC Indian Chiefs and Ecotrust Canada*.
- Tuhiwai Smith, L. (1999). *Decolonizing methodologies: Research and Indigenous peoples* (1st ed.). Zed Books.
- Wilson, S. (2008). *Research is ceremony: Indigenous research methods*. Fernwood Publishing.