Revealing the Barriers and Facilitators Impacting Uptake of Open-Source Software and Open-Access Data Within Built-Environment Professional Practice Using Actor-Network Theory

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ABSTRACT

This thesis investigates the barriers and facilitators impacting uptake of Free/Libre Open-Source Software (FLOSS) and Open-Access Data (OAD) among built-environment professionals in Greater Melbourne, Victoria, Australia. By adapting Actor-Network Theory (ANT), this research examines software uptake in professional practice not as a product of individual logical choice but rather as a series of negotiations among heterogeneous actors within professional networks. The study responds to critical concerns of the Smart City's reliance on proprietary technologies by exploring how Open-Source principles might redistribute agency and uphold democracy within professional practice. Through twelve semi-structured interviews with urban planners, designers, engineers, and geospatial analysts across public, private and educational sectors, this exploratory qualitative research employs an adapted ANT methodology that identifies the key domains shaping FLOSS and OAD uptake within professional networks. Findings reveal that FLOSS uptake is less dependent on software's technical competence than on the successful construction of durable networks of social actors. The major barriers revealed include IT departments, cognitive reinforcement of workflows, persistent expectations for file formats, legitimacy concerns and the segregation of professional roles. Key facilitators include individual vanguard actors, informal peer support networks, modular plugin ecosystems, increasing OAD availability, and demonstrated technical FLOSS proficiency. This minor thesis identifies and makes recommendations for strategies to construct durable FLOSS networks requiring the collaboration of institutional organisations and social actors. To the best knowledge of the author, this study provides the first systematic network analysis of FLOSS and OAD adoption within professional built-environment practice.

ACKNOWLEDGEMENTS

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Chapter I: Introduction

1.1 Background and Setting

The integration of digital instrumentation in professional urban planning practice has progressed significantly over the past half-century. What first emerged in the mid 1950s as fledgling exercises of digital computing and urban data processing (Creighton et al., 1959) has evolved into a profession that extends beyond planning to include a collective network of built-environment professionals who each occupy discrete roles of digital aptitude. Geographic Information Systems (GIS), data projection, statistical analysis, report preparation, and creative design have become obligatory passage points (Latour 1990) through which the contemporary network of built-environment practitioners must negotiate, conforming to the discrete role orientations they occupy.

Smart Cities have emerged as the vehicle of digital urban practice, moulded by collective digital instrumentation (Schaffers et al., 2011). While originally envisioned as an amalgam of information and communication technologies (ICT) and the Internet of Things (IoT) to generate and analyse data intending to improve urban life through efficiency and sustainability (Zanella et al., 2018), Smart Cities have now become tied to austerity-driven neoliberalism (Kirk, 2023) (Cardullo & Kitchin, 2019) (Albino et al., 2015) (Grossi & Pianezzi 2017). Contemporary Smart City discourse identifies these networks as reliant on private corporate mechanisms for technology provision in urban governance. Characterisations include "Dracula Urbanism" (Kirk, 2023) and "anti-democratic neoliberalism" (Cardullo & Kitchin, 2019), reflecting apoplexy over the acquiescence of user-agency to large market actors such as IBM, Cisco Systems, Siemens

AG and others who utilise utopian entrepreneurialism to position themselves as essential partners in urban digital transformation (Albino et al., 2015). As Smart City development has become synonymous with a dependency on market provision, there materialises a reduction of the citizen from an agent of political action to that of data generation, expediting capital extraction (Grossi & Pianezzi, 2017). Understanding this threat requires descending from large scale urban infrastructure to examine the digital instruments that practitioners use daily, the specific utensils by which practitioner knowledge is fabricated, analysed and dispersed.

These specific instruments comprise a standard-issue digital toolbox mediating built-environment practice authored by proprietary software companies. The specific uses include as GIS platforms such as Esri's ArcGIS suite, Computer-Aided Design (CAD) software like Autodesk's AutoCAD and Revit, Graphical suites such as Adobe's Creative Suite, Office suites such as Microsoft 365, Statistical analysis platforms like SPSS and Stata and many others (Mader & Schenk, 2017). Yet, parallel to this proprietary dominance, Free/Libre Open-Source Software (FLOSS) alternatives have expanded significantly. FLOSS tools represent solutions typically developed by non-profit communities rather than market providers and distributed through public access licenses such as the GNU General Public License (GPL) free to run, study and modify for all users. (Stallman, 2015). QGIS is among the most popular FLOSS alternative within built-environment practice. Others such as LibreOffice, Blender, R studio and Python are among only a few of the ever-expanding array of proprietary of FLOSS tools challenging normative proprietary dominance (Yap et al., 2022), (Xia et al., 2024). These FLOSS instruments, coupled with complementary Open Access Data (OAD) repositories like OpenStreetMap (Haklay & Weber, 2008), government open data portals, and citizen science platforms like PurpleAir (Barkjohn et al., 2021), present mechanism for which communities may

produce relevant data and disperse it freely and accessibly for all potential users. Extensive literature demonstrates the competence of FLOSS and OAD across planning domains (Boeing et al., 2022), (Pires et al., 2019), (Gani et al., 2024), however there remains a lack of scholarship investigating the strategies to increase uptake of these instruments among professionals.

Greater Melbourne, Victoria, Australia is a prominent case for investigating the rising digital interface with contemporary neoliberal practice and the development of the Smart City. As one of Australia's largest metropolitan centres and among the fastest urbanising regions in the global north, projected to reach 6.4 million residents by 2034, with significant growth around outer suburbs (Rahnama et al., 2020). Greater Melbourne embodies the interwoven nature of market-driven Smart City initiatives and individual professional practice. The City of Melbourne positions itself as leader in Smart City interventions including public city-wide Wi-Fi, urban sensing, and extensive publicly-provided open-data portals (Tariq et al., 2020). This private-public partnership approach can be described as the "entrepreneurial smart city" model (Vanolo, 2016) prioritising technological solutions through market providers.

At the state level, the Government of Victoria invests in digital planning infrastructure tools including VicPlan (Victorian Government , 2023) and DataVic (Victorian Government, 2021), therefore encouraging standardised practice across planning authorities and private consultancies. This smart development has occurred through partnerships with private firms and through facilitation by major educational institutions like Melbourne University where built-environment study programs like the Master of Urban Planning, Urban Design, Civil Engineering and Data Analytics are taught through proprietary instruments such as Esri's ArcGIS (UoM) (The University of Melbourne, 2022). Melbourne's context provides a

transferable setting for examining the uptake barriers and facilitators facing FLOSS and OAD instrumentation in practice within neoliberal Smart City contexts.

Through inclusion of current and future practitioners within built-environment practice across Greater Melbourne, representing public sector agencies (local and state government), private consultancies, and master's-level planning students at Melbourne and RMIT Universities, this minor thesis utilises ANT framework to identify the barriers and the facilitators currently impacting uptake of FLOSS and OAD instruments within professional built-environment practice.

1.2 Data Collection Procedure

This study employs an exploratory qualitative research study using semi-structured interviews as its data collection method. The interview participants were selected among currently practicing planning professionals, designers, engineers, and geospatial analysts who represent a collection of diverse actors within professional built-environment practice. These participants were recruited through sampling via email and LinkedIn messaging (Appendix A) across four practitioner categories: public sector planners (local councils located within Greater Melbourne Statistical Area), private sector planners (consultancies and private development facilitators), Melbourne University urban planning and urban design students (master’s level), and RMIT University urban planning students (master’s level). Interviews spanned 30 to 70 minutes, focusing on eleven core questions exploring participants' professional roles, organisational contexts, software usage patterns, and experiences with FLOSS and OAD tools (Appendix C). Participant Details can be found in Table (1)

Participant #	Current Role	Broad Discipline	Current Organisation	Sex	Years of Experience Within Field
1	Urban Designer / Committee Member	Urban Design	Urban Design Forum Australia / Geelong City Council	Male	10-15
2	Urban Planning Specialist – Senior Associate	Urban Planning	CS Town Planning	Male	15+
3	Master's Student	Urban Planning	Melbourne University	Male	1 to 5
4	Master's Student	Urban Planning	RMIT University	Male	1 to 5
5	Master's Student/ Planning Assistant	Urban Planning	Melbourne University / Cogency Melbourne	Male	1 to 5
6	Master's Student	Urban Planning	Melbourne University	Male	1 to 5
7	Master's Student / Urban Design Assistant	Urban Design	Melbourne University / Urbis Melbourne	Female	1 to 5
8	Master's Student / Assistant Planner	Urban Planning	Melbourne University / Tract Melbourne	Male	1 to 5
9	Transport Engineer	Geospatial Analysis	Maribyrnong City Council	Male	5 to 10
10	Strategic Growth Manager	Urban Planning	Greater Dandenong City Council	Female	15+
11	Maps Officer / Cartography Librarian	Geospatial Projection	Melbourne University	Male	15+
12	Data Analyst	Geospatial Analysis	Infrastructure Victoria	Male	1 to 5

Table 1: Research Participants Breakdown (Information can be found in Appendix E).

Data analysis followed the Qualitative Codebook method (Creswell, 2017) and organised according to Yin (2014) and MacCallum et al. (2019). Interview transcripts were systematically coded using thematic analysis principles (Naeem et al., 2023). This strategy enabled identification of seven major thematic codes aligned with Actor-Network Theory concepts: (1)Non-Human Actors, (2)Human Actors, (3)Material Inscriptions, (4)Stability and Fragility, (5)Interactions and Relations, (6)Legitimacy Work, and (7)Translation and Enrolment. These codes were ranked by response frequency (Figure 2) and analysed to reveal thematic patterns in the identification of barriers and facilitators impacting the uptake of FLOSS and OAD instruments within built-environment practice.

1.3 Project Outcome

To the best knowledge of the author, this minor thesis is the first systematic examination of FLOSS and OAD uptake barriers and facilitators within professional built-environment practice. This novel study utilises an adapted model of the Actor-Network Theory framework informed by Callon (1986) and Latour (1987) & (1990) to demonstrate that software choice in professional networks is not a technical decision of problem-solving capacity but instead the result of composite negotiations among diverse actors.

The study identifies seven significant domains where FLOSS networks either are successfully formed or fragmented: (1) Non-Human Actors: An Extensive Landscape of Unfamiliar Instruments (2) Human Actors: The Gatekeepers and Vanguards in FLOSS Uptake; (3) Material Inscriptions: The Persistence of Proprietary Standards; (4) Stability and Fragility: Tangible and Imagined; (5) Interactions and Relations: An Enthusiastic Community Marred by

Institutional Trepidation; (6) Legitimacy Work: A Future of Publicly Accessible Privacy Infringement; and (7) Translation and Enrolment: Vanguards in Need of Institutional Backing.

These seven domains reveal patterns of identified barriers reducing uptake of FLOSS within practice. These barriers include institutional IT departments who operate as obligatory passage points, a cognitive naturalisation of proprietary workflows which form subconscious antagonism to alternatives, a persistent expectation of proprietary file formats enforcing dependence on associated proprietary software, trepidation over perceived professional integrity provided by industry-standard software, and a segregation of responsibilities between professional roles reducing the transfer of knowledge. However, this research study also reveals the opportunities provided by key facilitators, aiding in the dispersal of FLOSS and OAD instruments within practice. These mechanisms include individual vanguards who demonstrate FLOSS utility through practical application, networks of peer support advancing informal training and endorsement, modular plugin ecosystems offering technical flexibility, increasing availability of open-access datasets, and a greater recognition of technical capabilities through demonstrated competency.

This project advocates that for FLOSS and OAD instruments to persuade greater uptake, there is a need for reform within socio-technical networks. There must be an increased enrolment of IT departments and leadership, a greater degree of educational curricula inclusion, forming wide-ranging networks of legitimacy and developing hybridised FLOSS and proprietary approaches that allow practitioners to preserve relationships with clientele while incorporating FLOSS and OAD.

1.4 Statement of Problem and Research Question

Despite extensive technical literature demonstrating that FLOSS alternatives can effectively complete planning tasks across multiple domains (Boeing et al., 2022), (Pires et al., 2019), (Gani et al., 2024) and extensive surveys cataloguing the expanding array of FLOSS options for geographical sciences (Mader & Schenk, 2017), (Yap et al., 2022), (Xia et al., 2024), to the best knowledge of the author, there are comparably few studies that examine how widespread these tools currently are within contemporary practice. There have been related studies on Linux operating systems that aid in explaining how demonstrated advantages offered by the FLOSS model do not necessarily equate to higher user uptake (Awan, 2022), (Ovadia, 2013), however fall short of investigating actor-network dimensionality. Recognising this research gap necessitates transcending technical feature comparisons to examine the socio-technical networks within which individual software choices are imbued.

To aid in bridging this research gap, this thesis aims to answer the following question:

What socio-technical factors create barriers reducing uptake or facilitators expanding uptake of FLOSS and OAD instruments within professional built-environment practice?

1.5 Limitations of Study

This minor thesis faces several methodological limitations that should be recognised.

The limited sample size of twelve semi-structured interviews from Greater Melbourne, while appropriate for exploratory qualitative research and elaborate network tracing for

individual actors, limits possible generalisability across the broader Australian built-environment profession.

The lack of cross-temporal research processes within this study presents limitations for exhaustive Actor-Network Theory analysis, which would ideally follow actors and networks as they develop over time. The research also considers a practitioner-centric perspective that may obscure the agency of other crucial network actors beyond individual practitioners.

Finally, the study's focus on Greater Melbourne, Victoria's planning practice limits cross-cultural comparison and may not reflect how other national or international contexts with alternative institutional or cultural structures would facilitate or inhibit practical FLOSS and OAD distribution.

1.6 Basic Assumptions of Study

The data analysed within this minor thesis will be necessary to understanding software uptake choices as more than just a question of technical superiority but as a question of socio-technical network formation. This research project assumes that the participants involved were truthful in their answers and more broadly, that current and future practitioners possess valuable knowledge about their professional contexts and organisational dynamics. This study assumes that these contributions can illuminate patterns of uptake with the capacity to inform a greater expansion of knowledge pertaining to FLOSS and OAD implementation strategies within professional built-environment practice.

1.7 Definition of Terms

Proprietary Software: Software applications owned and managed by single entities which typically are corporations primarily for profit through control of intellectual property, where source code remains closed and usage is restricted by licensing agreements (Wise, 2012), (Weber, 2004).

Free/Libre Open-Source Software (FLOSS): Software applications whose source code is openly available for inspection, modification, and redistribution under licenses such as the GNU General Public License (GPL). The term combines both "free software" and "open-source software". FLOSS differs from proprietary software in providing users with freedoms to run, study, modify, and distribute the software (Stallman, 2015).

Open Access Data (OAD): Publicly available datasets that can be freely accessed, used, redistributed, and repurposed without licensing restrictions or payment requirements. Examples include OpenStreetMap, government open data portals (Data Victoria), and citizen science platforms like PurpleAir (Barkjohn et al., 2021).

Actor-Network Theory (ANT): An analytical framework treating social and technical elements symmetrically, examining how durable associations among human and non-human actors create stable artefacts or social structures. ANT focuses on processes of translation, enrolment, and network stabilisation (Callon, 1986), (Latour, 1987).

Smart Cities: Urban environments defined by information and communication technology and the internet of things to generate and analyse data with the original intention of improving urban quality through efficient and sustainable utility provision. Common criticisms have recognised the neoliberalisation of urban centres through the Smart City paradigm (Zanella et al., 2018), (Cardullo & Kitchin, 2019).

Open-Source Urbanism OSU: An emerging framework appropriating concepts from FLOSS development into built-environment processes that emphasises decentralised forms of knowledge-sharing through citizen-produced programmes and direct participation as an agonism felt towards the technocratic neoliberalism offered by Smart City models (Berisha & Juvančič, 2022).

GIS: Digital systems for capturing, storing, analysing and managing spatial and geographic data. These instruments function as obligatory passage points in contemporary planning practice through platforms such as Esri's ArcGIS or open-source alternatives like QGIS.

Built-Environment Professionals: Practitioners operating within urban planning, architecture, design, civil engineering, and spatial analysis disciplines who together shape physical development through technical expertise and democratic facilitation.

Translation: The process through which actors define roles for others, negotiate interests, and construct networks where none existed before. (Callon, 1986).

Enrolment: The process by which actors define and interrelate roles within emerging networks, establishing commitments and interdependencies that stabilise collective action (Callon, 1986).

Vanguards/Translators: Individual actors who actively demonstrate the value of alternative technologies through practical application, performing the work of enrolling colleagues into new network configurations and facilitating translation processes.

Chapter II: Literature Review

This literature review details five areas: (1) Smart Cites and the impacts of a changing Digital Industry; (2) Neoliberalism and Open-Source Urbanism as a Disruptor; (3) Open-Source Software and Open-Access Data as Instruments in Practice; (4) The Role of the Professional Built-Environment: Planners, Designers, Engineers and Analysts; (5) Using Actor-Networks to Trace Application of FLOSS in Practice

2.1 Smart Cities and the Impacts of a Changing Digital Industry

Urban development in the second half of the 20th century is denoted by the advancement of computer technology. Within this context, forecasting for growth has become intertwined with the development of computer technologies, data collection, retention and information systems. Roger L. Creighton, Douglas Carroll Jr. and Graham Finney are among the first academics to apply these newly emerging digital technologies with direct urbanism considerations in their 1959 journal article: *Data Processing for City Planning* (Creighton et al., 1959). In this article, the emerging distinction between the analogue and the digital machine is discussed. Specifically, the digital machine's potential to produce vivid spatial imagery of urban phenomena with the capacity to "reduce voluminous data to the point where they can be analyzed".(p.103). Critically, the authors describe how the skills to operate these instruments of spatial analysis will increasingly become a prerequisite for the practice of urban geography.

This relationship between urban form and digital technologies has intensified since the mid 20th century, transforming how urban and built-environment planning is executed. According to Brotchie et al. (1987), information and communication technologies (ICT) have

revolutionised traditional patterns of work and residential proximity, initiating a digital transformation of urban policymaking and practice. This transformation accelerated as local governments embraced Geographic Information Systems (GIS) and other ancillary digital planning tools as mechanisms to streamline zoning and automate practice to resist austerity (Batty, 2021). These technologies also facilitated private utility providers in the installation of infrastructure (Maeng & Nedovic-Budic, 2008) therefore accelerating market-led infrastructure provision.

The contemporary ecosystem of this digital transformation is captured by the Smart City concept, envisioning urban environments saturated with interconnected sensors, data streams, and computational infrastructure. This paradigm has been described as the Internet of Things (IoT) within urban contexts (Zanella et al. 2018). Smart cities were positioned as necessary responses to dual-challenges of sustainability and rapid urbanisation (Bibri & Krogstie, 2017), promising data-driven urban system optimisation through computerised monitoring and algorithmic intervention.

The implementation of ever-smarter city visions has however garnered criticism within academic scholarship for its reliance on corporate technology provision (Albino et al., 2015) (Grossi & Pianezzi, 2017) (Shelton et al., 2014). This pursuit of Smart Cities is typically described through essential partnerships with multinational ICT firms, creating what Grossi & Pianezzi (2017) identify as a problematic transformation of citizens from political actors into data points for corporate extraction. Major technology corporations including IBM, Cisco Systems, and Siemens AG have positioned themselves as necessary partners in Smart City transformation (Albino et al., 2015), yet their interventions in projects like Songdo, South Korea,

Masdar City, U.A.E. and PlanIT Valley, Portugal have been criticised for oversimplifying urban complexity and prioritising corporate interests over human-scale urban needs (Shelton et al., 2014).

Critical scholarship has consequently characterised contemporary Smart City implementation through terms like "Dracula Urbanism" (Kirk, 2023), "anti-democratic neoliberalism" (Cardullo & Kitchin, 2019), and as adjacent to an emerging "techno-feudalism" (Varoufakis, 2023) (Gilbert, 2024). Yet as Alizadeh & Sharifi (2023) argue, the problem lies not in the choice to incorporate digital urban technologies but to implement them exclusively through proprietary, market-led platforms. This critique opens space for considering alternative technological assemblages that might enable alternative methodologies, with the capacity to redistribute agency within professional practice to include grassroots communities as key actors in urban processes.

2.2 Neoliberalism and Open-Source Urbanism as a Disruptor

The critique of Smart Cities' reliance on market-action extends to broader concerns about neoliberal ideology within urban administration. When Smart City implementation becomes synonymous with proprietary governance, it reinforces Grossi & Pianezzi's (2017) reduction of citizenry from political actors to consumers and data generators. This commercialisation of choice extends beyond large-scale Smart City infrastructure to also include the individual desktop software tools that practitioners use daily to incorporate new built environment infrastructure, the specific instruments through which planning knowledge is produced, analysed, and exhibited.

In response to our perceived reliance on proprietary instrumentation, various reactionary movements have emerged advocating for grassroots, pluralistic and community-controlled approaches to urban policymaking and implementation processes. Berisha & Juvančič's (2022) concept of Open-Source Urbanism (OSU) is a prominent emerging framework that appropriates concepts from technical software development into built-environment processes, incorporating decentralised knowledge-sharing through community-produced platforms like Openstreetmap.org (Haklay & Weber, 2008), Bikemaps.org (Nelson et al., 2015) and Purpleair/Sensors.community (Barkjohn et al., 2021). OSU has also taken the form of direct citizen participation projects like Space-S in Eindhoven, Netherlands or grassroots citizen interventions like guerrilla gardening (Berisha & Juvančič, 2022). These initiatives demonstrate attempts to construct alternative socio-technical systems providing pathways towards redistributing power within neoliberal Smart Cities.

OSU and the underlying open-source philosophy aligns with key perspectives on urban form such as Kevin Lynch's (1981) ideal egalitarian society of local control, openness to diverse users, and subversion of dominant power structures, Chantal Mouffe's (2005) Multipolar societies which reinforce social democracy through collective action and Sherry Arnstein's (1969) democratic planning as a pursuit of citizen control, where participants command power to govern programmes and arbitrate changes with external actors.

These prominent visions of democratic urbanism conceptually reflect open-source development models, which prioritise collaborative contribution over centralised proprietary control. However, as Raymond's (2001) *Cathedral and the Bazaar* documents, successful open-source projects require more than ideological commitment, they rely on the construction of inter-

organisational networks capable of coordinating distributed labour and technical standards while opposing capture by proprietary actors.

2.3 Open-Source Software, Open-Access Data and User Autonomy as a Key Feature

Free/Libre Open-Source Software (FLOSS) (Stallman 2015) and Open-Access Data (OAD) (Neves et al., 2020) have emerged as open and pluralistic software instruments that may challenge the dominance of proprietary software infrastructure.

FLOSS refers to software applications whose source code is open for inspection, modification, and redistribution expediated by licenses granting users autonomy like the GNU General Public License (Stallman, 2015) to modify and share the software (Stallman, 2015). The term encompasses both "free software" which emphasises liberty and user rights and "open-source software" emphasising the tenants of collaboration, aligned by their opposition to proprietary control over code (Raymond, 2001). It is important to note that FLOSS would not apply to proprietary software which is dispersed through “freeware” methods unless the underlying source code is available to modify and disperse without restriction (Mader & Schenk, 2017).

Open Access Data (OAD), which is adjacent to FLOSS, concerns publicly available datasets that can be freely accessed and repurposed without licensing restrictions or requirements for payment (Neves et al., 2020). OpenStreetMap's crowd-compiled geographic information is among the most prominent OAD archives (Haklay & Weber, 2008). Also included are open government data portals providing administrative and spatial datasets and citizen science

platforms like PurpleAir (Barkjohn et al., 2021) that democratise environmental monitoring. Together, FLOSS and OAD represent technical infrastructures and philosophical commitments to knowledge accessibility, challenging proprietary models that restrict access through intellectual property controls (Weber, 2004).

Smartphones and mobile computing have also played a transformative role in facilitating the growth of urban data production using crowdsourcing tactics. However, unlike the FLOSS model, much of the tactics used by mobile computing data generation rely on proprietary applications aligning with Grossi & Pianezzi's (2017) observation of citizens as data generators rather than decision makers. These tactics have come to be known as "citizen sensing" (Coulson et al., 2021), or what is often appropriated as the misnomer: the "democratization of data" (Kopackova & Libalova, 2023), implying citizens have autonomy over their data which in practice they cannot freely access or redistribute (Huang et al., 2020). Applications such as Waze or Google maps exemplify this paradigm whereby crowdsourced travel data is utilised to generate real-time traffic congestion and navigation data (Hoseinzadeh et al., 2020), however unlike Openstreetmap data, Waze and Google data cannot be repurposed within GIS or other complementary data analysis software freely or easily (Haklay & Weber, 2008).

The landscape of FLOSS and OAD tools available to built-environment practitioners has expanded significantly in recent years (Yap et al. 2022), (Xia et al. 2024), already creating substantial challengers to market-led distributions within practice. However, this market-led proprietary software still maintains prominence within arenas of practice (Mader & Schenk 2017). These options, defined by Wise (2012) as solutions owned and managed by single entities primarily for profit through the control of intellectual software, has dominated professional built-

environment practice since the 1980s (Weber, 2004). Companies including Adobe, Microsoft, Autodesk, Oracle, and Esri develop and distribute proprietary tools for office suites, graphical design, CAD, database management, and GIS, becoming industry standards (Mader & Schenk, 2017). These instruments now function as what Bruno Latour (1990) would describe as obligatory passage points, or structures by which practice must acquiesce, regardless of individual practitioner preference.

Recent technical literature demonstrates that FLOSS alternatives can effectively complete planning tasks across multiple domains. Boeing et al. (2022) illustrate how OpenStreetMap data combined with open-source analytical tools enable development of spatial indicators for healthy and sustainable cities. Studies by Pires et al. (2019) and Gani et al. (2024) document successful FLOSS applications in urban analysis, land use mapping, and planning system architecture. Comprehensive surveys by Mader & Schenk (2017), Yap et al. (2022), and Xia et al. (2024) catalogue expanding FLOSS options for geographical sciences and urban planning, including LibreOffice, Blender, Inkscape, and QGIS as alternatives to proprietary offerings.

Linux operating systems: FLOSS desktop OS's as a case may illustrate the possibilities and limitations for uptake of FLOSS in practice. Linux while dominating server infrastructure and select mobile platforms such as Android (Moody, 2015) fails to penetrate desktop operating system market share despite advantages in cost of ownership, security, flexibility, and hardware efficiency (Awan, 2022), (Ovadia, 2013), demonstrating that software application in practice derives from external factors beyond just technical calibre. For FLOSS urbanism considerations, these external factors have been inadequately considered within research studies of FLOSS and OAD application within professional practice.

There have however been an emergent number of studies communicating the competency and opportunities available to built-environment practitioners using FLOSS instrumentation (Von Hippel 2005), (Von Krogh & Spaeth 2007), (Bhatt et al. 2016). Von Krogh & Spaeth (2007) identify benefits in modular architecture, transparent development processes, and engaged user communities as advantages for FLOSS instrumentation. Von Hippel (2005) describes how user innovation in open-source contexts may democratise technological development and distribute creativity greater than the capacity of corporate means. Bhatt et al. (2016) document how open-source software encourages "frugal innovation" in resource-limited contexts like India, where local communities leverage FLOSS instruments because of their advantages in accessibility that proprietary means would be uneconomical to include. However, scholarship has to the author's best knowledge, not examined the institutional, cultural, or material factors that determine uptake within professional practice. Amending this research gap requires examining the socio-technical networks where individual software choices are formed.

2.4 The Role of the Professional Built-Environment: Planners, Designers, Engineers and Analysts

A key concept in recognising how practice may incorporate FLOSS and OAD is understanding the often-segregated roles of the built-environment professional. For the modern built-environment professional, their roles are formed through their degree to fulfill public interest (Alexander, 2002), (Moroni, 2018) and social justice (Dadashpoor et al., 2024), with social equity emerging as a necessary feature of just planning outcomes (Deakin, 1999) (Comber et al., 2008). That being said, the development of built environment planning as a democratic practice has occurred alongside the profession's increasing technological dependence. As Batty

(2021) remarks, planning education and practice have interwoven with digital proficiencies, transforming the field to which professionals must demonstrate expertise in both democratic facilitation and in an expanding array of digital tools (Sabri & Witte, 2023).

This technological revolution derivates professional identity into distinct roles. Howe's (1980) work identifies planners as three distinct role orientations: the technician who provides objective expertise, the politician who mediates interests, and hybridised positions which fuse these approaches to varying degrees. Further scholarship (Howe, 1992) demonstrated that the method in which planners determine "public interest" depends on their role orientation, technicians emphasise rational proceduralism and politicians emphasise responsiveness to democratic principles. Fox-Rogers & Murphy's (2015) research reveals that these differences in professional roles are further segregated by the inclusion of technologic planning systems, where practitioners struggle to negotiate emergent professional roles, the technical expert, the democratic facilitator, the policy implementer, and the community advocate. Within this paradigm there emerges an ethical Catch-22 for digital built-environment professionals as to play the role of "technical experts" who in many cases, must utilise undemocratic proprietary software, would require relinquishing the principles of the "democratic facilitator" who champions accessibility and transparency.

A planner committed to public participation who relies exclusively on expensive proprietary tools may exclude community members from meaningful engagement in technical analysis. Conversely, a planner who adopts FLOSS tools to increase accessibility may face questions about professional credibility from colleagues or clients who associate legitimacy with industry-standard proprietary platforms. These paradoxes reflect Howe's (1992) observation that

the ethical decision making of planners is formed by their role orientation where technological choices morph into ethical dilemmas inadvertently determining who can participate in planning processes. Albrechts (1991) documents how changing technological landscapes have historically reshaped planning roles, with each technological shift bringing anxieties about deskilling, professionalisation, and the dividing-line between technical know-how and democratic participation.

The question of which technologies planners incorporate becomes conjoined to questions of professional identity and legitimacy. As technological proficiency increasingly determines professional integrity, the specific tools that become standardised within planning education and practice shape not only what planners can do, but who can become a planner. Proprietary software requirements create financial barriers to entry, while software-specific training in educational institutions inscribes discrete technological pathways for future practitioners. The planner who gains expertise in ArcGIS, AutoCAD, and Adobe Creative Suite constructs a different professional identity, and potentially different planning outcomes than one trained in QGIS and using OpenStreetMap even when completing operationally similar tasks.

Recent academic scholarship suggests digital technologies could either advance or undermine planning's democratic foundation (Sabri & Witte, 2023), (Sharma et al., 2023). The critical query is which digital instruments, developed by whom, and encased within what institutional assemblages should built-environment professionals utilise within practice. Planners, designers and spatial analysts materialise as actors who are enrolled within socio-technical networks that dictate available choices and restrict individual autonomy. Professional

identity has become a reverberation of networks of educational institutions, licensing bodies, organisations of employment, distributors of software and built-environment practice itself.

2.5 Using Actor-Networks to Trace Application of FLOSS in Practice

Actor-Network Theory (ANT) may be a competent method for analysing FLOSS uptake in professional practice as a process of network-building among actors of differing role orientations rather than as an individual choice. Developed by Michel Callon, Bruno Latour, John Law, and others, ANT associates social and technical elements simultaneously, and according to Latour (2005), treats individual actors as "blind, myopic, workaholic, train-sniffing and collective traveler(s)" or 'ants' within colonies (p. 9). ANT provides a framework for examining how stable artefacts and social frameworks develop from persistent relationships among human and non-human actors using key concepts:

Translation: is a critical process to ANT network building, revealing which actors define roles for others, negotiate interests, and construct networks where previously none existed. Callon's (1986) study of scallop domestication organised translation's four periods: problematisation, interessement, enrolment, and mobilisation, each requiring ongoing maintenance to prevent disintegration of fledgling networks. (Callon, 1986 pp. 196-233)

Black boxing: describing how stable networks become naturalised by revealing the internal mechanisms that spread and legitimise acceptance. Proprietary software currently represents successful black boxes with their layouts and interfaces appearing as the standard to which competing software emulate. (Latour 1987 pp. 1-17)

Scripts of Action: Inscribed in artefacts to express how technical objects delegate certain behaviours while forbidding others. (Akrich 1992 pp. 205-224)

Inscribed User: Reveals how designers predict and dictate the behaviours of users. Processes of "de-scription" may be applied to resist or subvert intended scripts (Akrich's, 1992 pp. 205-224)

Irreversibility: addresses stable network maintenance where high irreversibility networks retain structure despite the appearance of potentially superior alternatives while networks with low irreversibility remain fragile when key actors are uninvolved. This distinction aids in explaining why FLOSS tools that demonstrate technical competency may fail to replace proprietary systems. (Callon 1991 pp. 132-161)

The Social Construction of Technology (SCOT): How social groups ascribe meaning to technology. SCOT perspectives may reveal inherent cognitive impressions FLOSS has to practitioners, where in some cases FLOSS may represent innovation and in others it may represent unprofessionalism. (Pinch & Bijker 1984 pp. 399-405)

Institutional isomorphism: How organisations incorporate similar tools through forces of coercion, imitation, and normative processing. (DiMaggio & Powell, 1983, pp. 147-160)

Cultural Capital: Shows how specific software proficiency becomes a professional credential. (Bourdieu, 1986, pp. 243-248)

Weak Ties: Illuminates how information spreads through professional networks. (Granovetter's, 1973, pp. 1360-1366)

Communities of Practice: How newcomers learn routine practice through professional socialisation. (Lave & Wenger's, 1991, pp. 29-43)

ANT's relevance to FLOSS adoption materialises when recognising that software choice is seldom only technical. The dominance of proprietary instruments reflects successful network-building by proprietary distributors who enrolled educational institutions through licensing programs, clients through the dependence on file formats, IT departments through support contracts, and professional cultures through industry standards. Companies like Adobe, Autodesk, and Esri succeeded not primarily through technical superiority but through constructing extensive networks that create obligatory passage points for their software.

FLOSS adoption requires constructing alternative networks capable of enrolling these same actors toward alternative assemblages through many of the strategies outlined within ANT Though application of ANT, this study reorients the question of open-source distribution from "why don't built-environment professionals use FLOSS instruments?" to "what networks stabilise proprietary software in built-environment practice, and what alternative methods could facilitate FLOSS networks to form and persist?" This study, unlike to the author’s best knowledge of any other built-environment-related study employs Actor-Network Theory to analyse how professional built-environment practice uses network structures either to facilitate uptake or construct barriers that dissuade FLOSS and OAD use in favour of dominant proprietary infrastructure.

Chapter III: Methodology:

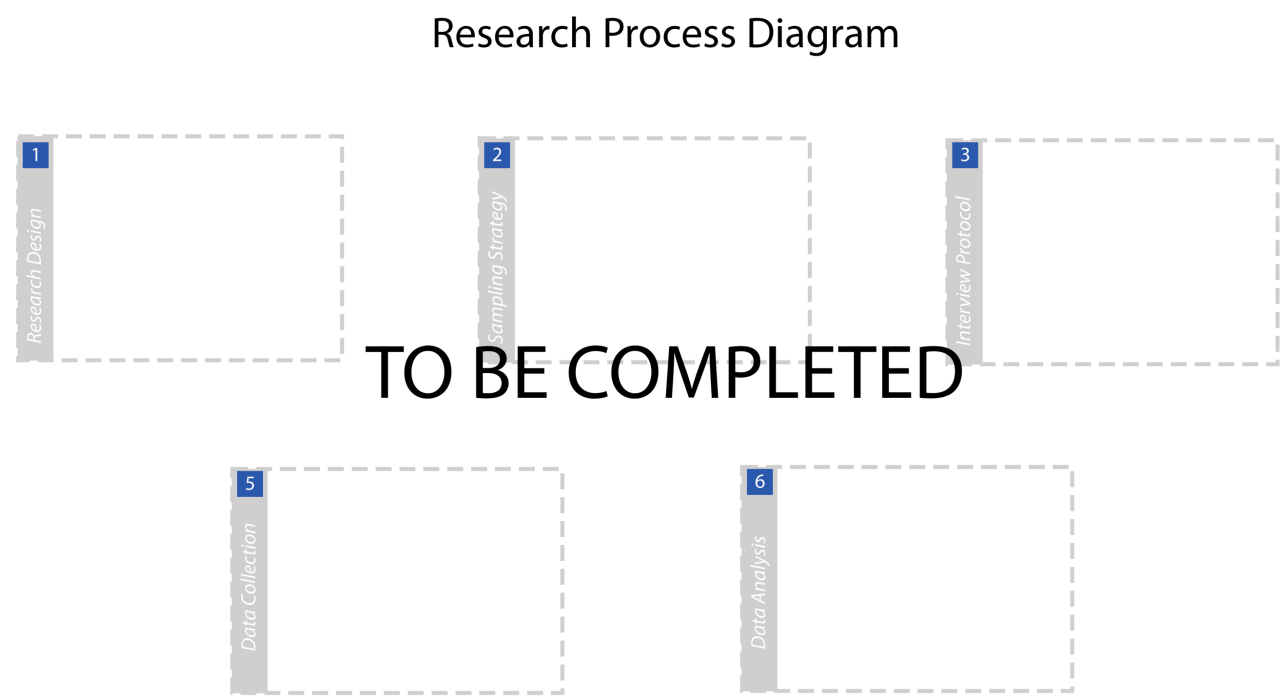

Figure 1 Research Process Diagram

3.1 Research Design

This study employs an exploratory qualitative research design to investigate the barriers and facilitators impacting FLOSS and OAD uptake among built-environment professionals in Greater Melbourne, Victoria, Australia. The qualitative approach informed by Neuman (2020), MacCallum (2019) and Creswell (2017) was selected as most appropriate for examining the large networks surrounding software uptake in professional practice (Neuman, 2020). Unlike quantitative methods that would measure adoption rates or user satisfaction scores, this

exploratory design enables deep investigation into how practitioners navigate institutional contexts and shape their technological choices.

Research is based in ANT theory informed by the work of Michael Callon (1986) and Bruno Latour (1987) and (1990) which considers technological adoption not as a derivation of individual rational choices but as a process of network-building among different actors. Semi-structured interviews were selected to conduct this research as according to Diana MacCallum et al. (2019), they invite flexibility and produce unexpected connections yet maintain a consistent structure between disparate participants (MacCallum et al., 2019).

3.2 Sampling Strategy and Population

Twelve participants were recruited as part of this study, representing a diverse array of professionals within Greater Melbourne's built-environment professional networks. Practitioners were selected with exposure to proprietary and FLOSS to illuminate potential network dynamics in line with recruitment methods by Creswell (2017). The sample included public sector planners from local and state government agencies, private sector consultants and master's-level planning and design students from Melbourne and RMIT Universities. This diversity of participants enabled institutional examination of how context shapes network components differently.

Recruitment occurred through professional networks, email invitations, and LinkedIn messaging (Appendix A). This process considered practitioners of diverse experience within professional networks: students entering their disciplines, mid-career professionals navigating constraints of organisations, senior practitioners with decision-making authority. This variety

responds to ANT's principle that networks comprise actors with varying capacities to enrol others and stabilise assemblages (Latour, 1990).

3.3 Development of Interview Protocol

The semi-structured interview method was used to encourage organic emergence of ANT concepts and maintain conversational adaptability. Eleven core questions (Appendix C) explored participants' professional identities, their context within their organisations, workflows and perspectives on FLOSS and OAD instruments. The semi-structured format was chosen in favour of completely structured interviews as according to Diana MacCallum et al. (2019), this format allows participants to introduce unexpected actors, reveal unanticipated network relationships, and describe translation processes in their own language. This approach respects that researchers cannot predict in advance which actors will prove significant in any given network.

The method asked participants to broadly describe how they encountered tools, whether others influenced their patterns of uptake, the obstacles they face, and how they respond to the requirements of institutions.

3.4 Data Collection Procedures

Interviews were conducted between June and August of 2025 elapsing between 30 and 70 minutes. All participants were provided informed consent forms to voluntarily sign (Appendix D) as required by the protocols of ethical research, contributing direct explanation of research purposes and retention of anonymity. Interviews were recorded and transcribed with the explicit permission of participants. The differentiation in length of interviews reflected the semi-

structured interview format's responsiveness to knowledge of participants. Practitioners with extensive FLOSS experience provided robust accounts of the network-building process, while those with limited exposure presented useful perspectives revealing barriers inhibiting network formation.

3.5 Data Analysis Framework

Data analysis adapted Creswell's (2017) qualitative codebook approach whereby distinct codes were created to reflect ANT's nature for inter-actor relations. The responses provided by subjects were manually sorted into their relevant codes (Appendix E). Those responses that did not fit into any relevant code were left uncoded. Analysis proceeded through a five-part iterative process of (1) familiarisation with interview transcripts, (2) identification of emergent themes, (3) indexing, (4) charting, and (5) interpretation. Seven major thematic codes were developed to investigate ANT concepts, each documenting different dimensions in the formation and dissolution of networks surrounding FLOSS and OAD uptake in practice. The seven distinct codes used in this analysis are as follows:

3.5.1 Human Actors:

This code operationalises ANT's principle of symmetry (Callon, 1986, pp. 200-204) by examining how different human actors, including individual practitioners, IT staff, policymakers, and developers attempt to define roles for others, communicate interests, and create alliances (Latour, 1987, pp. 196-200). Analysis traced which human actors functioned as translators or gatekeepers who advocated for FLOSS or prevented uptake, revealing how professional identities shaped network inclusion.

3.5.2 Non-Human Actors:

FLOSS instruments, proprietary software, data formats, and technical infrastructure as active subjects in network assemblage. Reflecting ANT's methodological directive to grant analytical symmetry to non-human entities (Callon, 1986, pp. 200-204) is also followed in this code. Non-Human Actors are treated as actants with agency rather than passive instruments (Latour, 1987, pp. 78-82), tracing how software functionality, file formats, and technical architecture either facilitate or restrict practitioner choices.

3.5.3 Interactions and Relations:

The interfaces among actors including workarounds practitioners develop, practices of collaboration and points of friction where networks can divide. This code utilises ANT's focus on associations rather than entities (Latour, 1987, pp. 132-144) to examine how relationships may constitute networks rather than pre-existing social structures determining outcomes.

3.5.4 Translation and Enrolment

This code identifies Callon's four moments of translation (Callon, 1986, pp. 203-218): problematisation (defining why FLOSS matters), interessement (attracting practitioners to experiment), enrolment (defining roles within emerging FLOSS networks), and mobilisation (ensuring sustained commitment) for the purpose of tracing how successful or unsuccessful translations occur.

3.5.5 Stability and Fragility

An application of Callon's (1991, pp. 143-148) concept of irreversibility or the degree to which networks resist dismantling. This code investigates the durability of network configurations by documenting the routine practices that enforce proprietary dominance. These

instances may include events of instability or unreliability that create opportunities for alternatives that might stabilise into new assemblages.

3.5.6 Material Inscriptions

The templates, standards, and deliverable expectations within practice that influence assumptions about legitimate instrumentation (Latour, 1990, pp. 103-131). These artefacts operate as “scripts of action” (Akrich, 1992, pp. 205-224) that elicit certain behaviours while forbidding others. These include proprietary file formats that decide possibilities for collaboration, organisational templates that necessitate compatible software and professional standards that exclude FLOSS file compatibility.

3.5.7 Legitimacy Work

Attempts at increasing FLOSS credibility within professional networks that normatively associates legitimacy with proprietary standards. This code captures efforts to establish professional acceptance, build reputation, and construct authority for FLOSS tools within sceptical institutional contexts by connecting FLOSS legitimacy to ANT’s processes of artefact stabilisation aligning with concepts of “fact building” (Callon 1986, pp. 224-229).

Adapting Naeem et al.'s (2023) keyword approach to thematic analysis, this study interprets response themes in line with the seven codes to place responses into coded buckets. These coded responses were then ranked by frequency and analysed to reveal patterns (Table x). This ranking provided insight into which network dimensions proved most consequential for practitioners while acknowledging that frequency alone does not determine significance, low-frequency codes may identify critical leverage points for intervention despite appearing less often in conversation.

3.6 Trustworthiness and Credibility

This study employed strategies to ensure trustworthiness, adapting naturalistic inquiry as discussed by Yin (2014, pp. 45-49) for case study research. Research credibility was established through prolonged engagement with interview transcripts, cycles of iterative coding allowing patterns to emerge organically (Creswell, 2017, pp. 201-204), and triangulating results across participants, comparing accounts from students, public sector practitioners, and private consultants revealed consistent patterns while revealing specific context differences (Neuman, 2020, pp. 165-167).

The codebook development process followed Creswell's (2017, pp. 184-189) iterative approach, with codes refined through successive passes through the data to ensure they reflected participant intentions rather than imposing the preconceptions of the researcher. The dependability of this thesis was addressed through detailed documentation of data collection and analysis procedures (Appendix E), providing what Neuman (2020, p. 171) describes as sufficient procedural transparency to enable informed assessment of the quality of research employed. Transferability is supported through description of local context, participant characteristics, and organisational settings (MacCallum et al., 2019, pp. 60-61), allowing readers to assess applicability to other contexts while recognising this study's geographic and professional specificity.

Chapter IV: Results

Twelve semi-structured interviews were administered for this research study. These interviews spanned 30-70 minutes with a concentration on 11 central questions (Appendix C) pertaining to the professional's role, their organisation and the relationship they have as a practitioner with digital technology, particularly open-source software and the application of open-access data.

4.1 Demographics and Roles

The participant ages spanned from middle 20s to late 50s. 10 participants were male and 2 were female. The participants were gathered from a range of disciplines within the geographic sciences, including urban planning, urban design, cartographical analysis, and geospatial analysis (Figure 1).

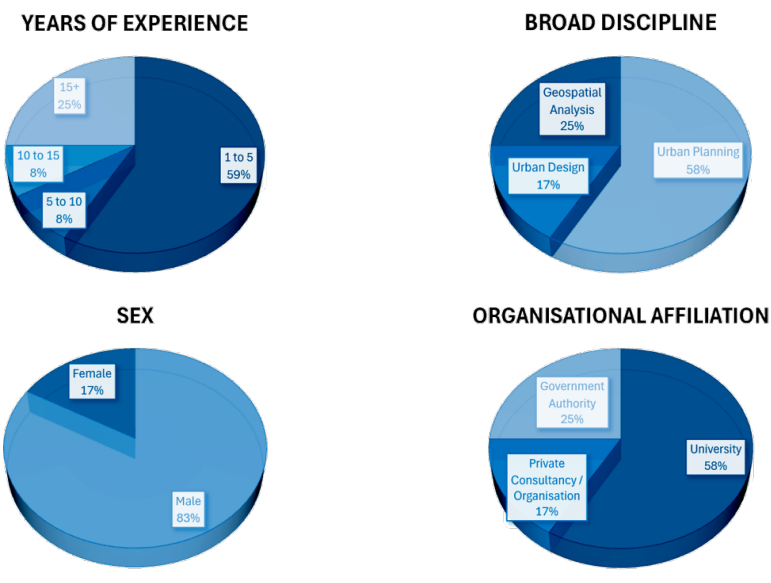

Figure 2 : Demographics of research participants

Participants were experienced in an array of different organisational backgrounds all centred within metropolitan Melbourne, Victoria including local city councils, private consultancy groups, state government officials and Master's level students at both Melbourne University and RMIT University. (Table 2).

4.2 Overall Codes and Response Rate

The results reveal seven major identified arenas of discourse that featured both facilitating factors that encouraged uptake of FLOSS and use of OAD but also revealed barriers inhibiting uptake within professional practice (Table 2); (Figure 2).

Key Domain Codes	Total Responses (Organised by response frequency: highest to lowest)	Most Identified Examples of Themes	Key Facilitators	Key Barriers
1. Non-Human Actors	502	FLOSS tools; Proprietary software; Data formats	Community-driven instruments, High access data availability	Proprietary software lock-in,
2. Human Actors	397	Fellow Practitioners; IT staff; policy-makers; developers	Individual Vanguards who influence peers, Professional and Educational networks	IT departments enforcing policy restrictions, Confidence shortfalls among practitoners
3. Material Inscriptions	158	Templates; Standards; Deliverables	Routinisation of workflows, Technical relevancy advantages from community-driven solutions	Industry expectations of proprietary file formats.
4. Stability and Fragility	127	Routine practice; Breakdown events; Experimentation	Flexible organisational software policies,	Established proprietary routines, inherent bias towards offerings with large market support
5. Interactions and Relations	89	Workarounds; Collaboration; Friction	Informal peer support networks,	Differing professional roles inhibiting broad knowledges among decision-makers
6. Legitimacy Work	82	Professional acceptance; Reputation; Authority	Earning validation through proficient demonstration	Industry standard associations, validation of community driven instruments, privacy infringement of publicly accessible data
7. Translation and Enrolment	45	Persuasion; Demonstration; Enrolment of tools	Individuals as vanguards for translation, peer-to-peer communication networks	Absence of compelling use cases, lack of structured training infrastructure

Table 2: Breakdown of coding analysis revealing instances of each coded response and barriers to each response

4.3 Individual Codes Breakdown and Analysis

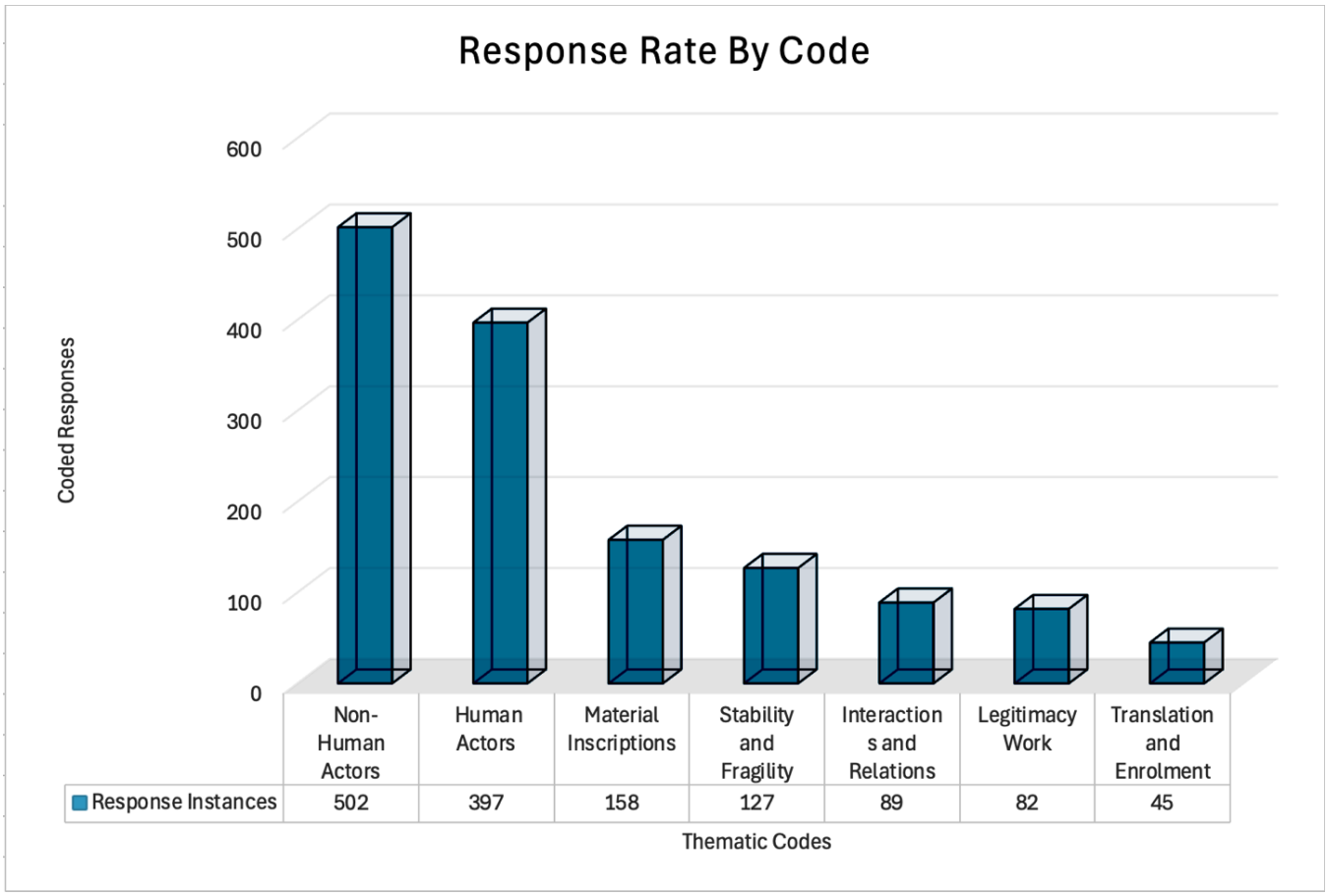

Figure 3: Bar graph displaying instances of codes identified within the analysis found in Appendix E

4.4.1 Non-Human Actors: An Extensive Landscape of Unfamiliar Instruments

The most identified code impacting uptake of FLOSS instruments in professional practice from the semi-structured interviews was the influence of non-human actors with 502 cases (figure x). The coding process of non-human actors displays a manifold landscape where digital artefacts both enable and restrict the uptake of FLOSS in professional settings. The modular plugin ecosystems and extensive community support structures compassing open-source tools emerged as a prominent facilitating factor identified, with practitioners valuing the synergistic development strategies often adopted by FLOSS. As Participant #12 explained:

"I'd say one of the massive advantages of R is its open-source packet Open-source package library... And thank God someone has written some function or package years ago and they've maintained it. And it solves… my exact issue."

Another critical component identified as a facilitating component was the emergent role of relevant OAD availability, with Participant #11 noting a transformative shift over time:

"And then the open spatial revolutions happened... things really sped up at about 2015. And with a lot of open data portals, large amounts of data started really being pushed out."

Yet, the results also reveal that entrenched institutional barriers within professional practice that undermine these facilitating elements. The propensity of proprietary software lock-in emerged as a barrier discouraging FLOSS uptake. Practitioners become anchored to specific software workflows and interface conventions. This was identified by Participant #9's observation about colleagues transitioning between platforms:

"She was a former ArcGIS user, now she's been converted to QGIS. But the way that she approaches problems is thinking... Oh, I remember the ArcGIS function that I would use... Oh… that's not in QGIS."

This observation of reinforced practice creating dependence on established proprietary instruments is echoed by Participant #7:

"I mean, I think because I am already studying and I already have the educational license licenses like for Rhino... I'm really done with Adobe, but I think my life kind of has always revolved around it, so. So I think I would find it really hard to go onto like, affinity."

Within these descriptions, perceptions of personal user proficiency with specific software overcome dissatisfaction with the proprietary instruments leading to continued dependency rather than changing workflows.

4.4.2 Human Actors: The Gatekeepers and Vanguards in FLOSS Adoption

The second most identified code was the influence of human actors with 397 instances. This code analysis reveals that human actors serve as sentries in FLOSS adoption within planning organisations, functioning as both facilitators and barriers where utility must be demonstrated before uptake can occur. The presence of organisational vanguards who actively demonstrate the value of FLOSS through practical application emerged as a foremost facilitating factor impacting FLOSS uptake. This pattern was exemplified by Participant #9's experience where initial scepticism transformed into endorsement:

"I think (REDACTED NAME) *was one of those people who initially saw me coding when I joined IV* (Infrastructure Victoria)*. She didn't understand why I was doing it... once she saw the*

kind of things that could be done and the value that they added into the work that we did at IV, her tune changed entirely."

Professional networks and educational experiences also emerged as critical facilitators encouraging interest in FLOSS within professional arenas. Participant #9's academic introduction to FLOSS illustrates this:

"I only got into open-source coding because I attended... a class with someone named (REDACTED NAME) *who did... He introduced us to modelling using R... I thought it was the coolest thing I'd ever seen."*

This coding analysis also reveals significant barriers for FLOSS uptake, the emergence of institutional gatekeepers impeded FLOSS adoption through formal and informal bulwarks. IT departments were identified as significant barriers, imposing proprietary software protocols even when FLOSS alternatives are favoured. As Participant #1 explained:

"When organisations are already signed up with ESRI, they're very reluctant to kind of even let you download QGIS... So even if it's free, they'll be reluctant to let you use it because it's not one of their approved programs."

This inertia of bureaucracy is exacerbated by what the results reveal as ancillary confidence shortfalls among practitioners, where rather than software limitations, technical difficulties are ascribed by practitioners to personal inadequacy. The synergy of senior decision-maker risk aversion and a perceived dependency on proprietary file infrastructure results in resistance that individual vanguards must negotiate. This outcome suggests that while human

actors can serve as a stimulus for FLOSS adoption, they operate within cautiously normative institutional lattices that favour proprietary software in professional practice.

4.4.3 Material Inscriptions: The Persistence of Proprietary Standards

Responses were coded with material inscriptions 158 times. The analysis of material inscriptions reveals a discord between the technical potential of FLOSS tools and the rooted expectations of professional deliverables within planning practice. While practitioners have demonstrated the proficiency to produce effective open-source workflows and templates, this revolution remains constrained by industry-wide format standardisation around proprietary software suites. Among the most impactful factors identified in facilitating FLOSS uptake was the development of reproducible OSS workflows that meet operational requirements, as illustrated by Participant #9's description of organisational template creation:

"So he just like made the… base map template that we use every single time we have a new site and it has all of our…extracted...GIS groups data so that we can use that in every new project. So it is a bit more seamless."

This excerpt demonstrates how practitioners can successfully inscribe open-source practices into routine organisational methodologies.

The capacity of OAD sources to match or exceed professional standards emerged as another facilitating factor, with practitioners recognising the update-agility of community-maintained resources in certain contexts. Participant #11's advocacy for OpenStreetMap encapsulates this pattern:

"I find especially with the OpenStreetMap. OpenStreetMap is the most current of all the online maps…I've used it time and again in official capacity and we've recently used it as well for some mapping exercise internally."

This finding challenges assumptions about the intrinsic precedence of proprietary data sources and suggests that open alternatives can achieve professional legitimacy when they demonstrate explicit technical or relevancy advantages.

On the other hand, the coding process identifies that these localised successes are undermined by broader industry expectations for proprietary file formats and output standards. The persistence of proprietary format requirements emerged as the most significant barrier, creating a significant collaboration obstruction as described by Participant #7:

"You can't collaborate with someone. Like, let's Say it's a project in Photoshop. You can't send them that project file if they use Affinity and vice versa... No one's going to accept your weird affinity file to work on."

This illustrates how material inscriptions extend beyond individual organisations to encompass entire professional networks, amplifying Hughes' technological momentum at an inter-industry level. The analysis suggests that while practitioners can successfully develop FLOSS workflows internally, the requirement to interface with clients and collaborators who expect proprietary formats creates a persistent curtailment that limits the revolutionary potential of open-source adoption in professional practice.

4.4.4. Stability and Fragility: Tangible and Imagined

Stability and fragility were coded 127 times. The analysis of stability and fragility patterns reveals a contradictory relationship between open-source software adoption and organisational workflow integration. While FLOSS tools demonstrate the capacity to become stable and reliable components of professional practice once successfully integrated, the transition period remains distinguished by increased perceptions of risk and volatility. A significant facilitating factor identified was organisational flexibility allowing practitioners to maintain established FLOSS workflows across different contexts. This was exemplified by Participant #12's experience transitioning between professional roles:

"I'm fortunate that my current position let me use the same tools and the same workflow that I had done for YIMBY Melbourne. They're very flexible about that. They're like, just do whatever works."

This excerpt suggests that when institutional constraints are removed, practitioners can successfully stabilise open-source workflows and demonstrate their professional viability.

However, practitioner preference also reveals that established proprietary routines create powerful inertial forces that resist disruption, even when practitioners recognise the shortcomings of their current tools. This pattern was exemplified in Participant #7's reflection on software dependencies:

"I mean, I think because I am already studying and I already have the educational license licenses like for Rhino... I'm really done with Adobe, but I think my life kind of has always revolved around it, so. So I think I would find it really hard to go onto like, affinity."

This condition users' interpretations and interactions with technology becoming reinforced through repeated use and entrenched expectations.

A key barrier identified within the stability/fragility code was the attribution of technical problems to an inherent "unreliability" of open-source tools, while similar failures in proprietary software are typically attributed to user error or acceptable system limitations. This double-standard of risk perception was demonstrated by Participant #2 who characterised FLOSS experimentation as untrustworthy or unstable:

"I've tended to rely on using software companies that are established that you have to pay for because they're more, they're more reliable."

This finding recognises that the same technical phenomena can be understood differently depending on social context and prior assumptions of the interpreter. The results suggests that FLOSS adoption is hindered not by inherent technical instability, but by structural cultures that interpret technical problems through predetermined frameworks that favour proprietary offerings.

4.4.5 Interactions and Relations: An Enthusiastic Community Marred by Institutional Trepidation

Interactions and relations as a code was identified 89 times. The analysis of interactions and relations reveals how collaborative networks emerged as a decisive structure shaping patterns of FLOSS uptake, with peer support systems emerging as crucial facilitators while organisational silos create ever-present barriers. Informal peer support networks emerged as a

unique universal facilitator providing confidence and problem-solving guidance. This phenomenon was illustrated by Participant #8's reflection on their growing technical confidence:

"So I think I become more confident to use that (QGIS) *in these days, especially in people because I think recently I've got a lot of friends. We've got a lot of friends recently. So if we have any problem then we can just discuss with them."*

This finding demonstrates how social capital and peer relationships influence individual engagement with FLOSS and OAD.

The outcome also revealed the distinctive characteristics of open-source communities, where users can access direct developer support and extensive knowledge repositories. Collective passion emerged as a motivating factor for the development of comprehensive support networks. Participant #12's recounting of contacting the specific software developers embodies this bilateralism, fundamentally separating FLOSS and OAD dispersion from proprietary tools.

"Sometimes I've had problems with some small plugin. You just email the guy, you're like, please, I'm having this issue... I'm always continually surprised about how much free time people dedicate to improving open-source software."

Participant #9 similarly highlighted the value of community support infrastructure:

"You know, and an open-source software has a strong community... There's notice boards and discussion circles and tutorial videos and everything you need online."

These observations supports the effectiveness of decentralised knowledge dispersion methods via user networks rather than formal organisational structures.

However, the data reveals that these collaborative potentials are constrained by resistant organisational divisions that segregate knowledge between different professional roles. The separation between technical specialists and planning practitioners emerged as one such barrier, with Participant #1 explaining the risks of role boundary crossing:

"And there's risk. There's risks as well like in the urban designer taking on too much of that role. Because if we, you know, most of us... won't have any formal training in GIS... There'll be very much a GIS team is usually in a completely different division."

This departmental segregation prevents the interrelationship of technical knowledge that could facilitate broader FLOSS adoption. This analysis of interactions/relations suggests that while open-source communities provide rich collaborative environments, persistent organisational structures in practice often fragment these networks, limiting the potential of peer-to-peer knowledge sharing and reinforcing dependence on centralised technical expertise.

4.4.6. Legitimacy Work: A Future of Publicly Accessible Privacy Infringement

Legitimacy work was coded 82 times. The coding analysis of legitimacy work reveals a dynamic where fragments of FLOSS and OAD can both enhance and undermine professional credibility, depending on the context and audience involved. Individual practitioners demonstrated the capacity to gain significant reputational advantages through novel FLOSS applications, particularly when these efforts demonstrate visible professional outcomes. This pattern was exemplified by Participant #12's career utilisation using FLOSS and OAD:

"So then last year I did three research projects for YIMBY Melbourne, Pretty big ones. They all got decent amount of press and media attention... And then I used that to get my current job as a data analyst at Infrastructure Victoria."

Similarly, Participant #9 described how showcasing open-source capabilities…

"definitely turned a lot of heads"

These findings suggest that FLOSS competency can function as a form of cultural capital distinguishing practitioners as technically sophisticated and innovative, where FLOSS legitimacy can be enhanced through visible use cases.

The legitimacy of FLOSS and OAD was further reinforced through academic and professional validation of their technical superiority in specific contexts. Participant #11's assessment of OpenStreetMap illustrates this pattern:

"Higher quality, more reliable. I find especially with the OpenStreetMap... I've used it time and again in official capacity."

This pattern demonstrates how FLOSS tools can achieve legitimacy through demonstrated performance rather than institutional backing.

That being said, the analysis uncovers consistent institutional biases that privilege proprietary software as tenants of professional legitimacy. The association between industry-standard software and professional identity was notable among students and early-career practitioners. According to Participant #3:

"And you feel more professional if you use the industry standard. You feel like a professional... ArcGIS, like it's. And things like Photoshop, they're like industry standards."

This observation identifies that organisations tend to embrace practices that confer legitimacy rather than efficiency. The analysis also identified consistent perceptions of reputational risks associated with FLOSS adoption, particularly in government contexts where FLOSS and OAD raise concerns regarding privacy and confidentiality, potentially reflecting poorly on public sector professionals. As Participant #10 explains:

"And again, it might be because of my role in government…the red flag for me is the privacy and confidentiality… we will have open data, everything can be accessible and confidentiality and the privacy and of all of this problems that it created."

These barriers to legitimacy create what the research reveals as a persistent conflict between individual innovation and institutional conformity, where practitioners must reconcile competing pressures for technical advancement and professional respectability within established organisational cultures.

4.4.7. Translation and Enrolment: Vanguards in Need of Institutional Backing

Translation and Enrolment was coded the fewest of all the coded responses with 42 instances. The analysis of translation and enrolment processes reveals that successful FLOSS adoption is contingent on the presence of skilled advocates who can effectively display utility and guide their colleagues through the process of adoption. Vanguard actors emerged again as a key significant factor: those who actively convince colleagues through practical exhibition of

FLOSS and OAD capabilities. This process was exemplified by Participant #9's reflection on leadership and influence:

"I think someone needs to take the lead and invest in this and then people around them who might be less inclined... Will learn through the value that it creates, but not before then."

Practitioner #9's own introduction experience illustrates the importance of influential educators:

"I only got into open source coding because I attended... a class with someone named [REDACTED NAME] *who did... He introduced us to modeling using R."*

Translation processes supports this identification, where successful enrolment requires interested actors who can enunciate benefits and guide others through the challenges of uptake.

The identified results also revealed the significance of peer-to-peer processes of enrolment, where informal demonstrations may quickly convert potential users. This was expressed by Participant #3's immediate experimentation following casual exposure:

"Just word of mouth. I just had a friend who I saw was using it in class one day I was like, wow, that looks great. Downloaded it five minutes later and then we're set up."

Based on this pattern, this identified response suggests that for FLOSS tools which possess advantages in lower barriers for entry, translation can occur swiftly through social networks rather than formal institutional mediums.

The absence of compelling use cases emerged as a critical barrier for uptake of FLOSS tools within the translation and enrolment process, with Participant #6 expressing annoyance at inadequately supported methods for transition:

"So you insist me to use some open source software... But that's literally my stereotype is that that's literally so clunky and I don't know where to start. And also the learning resources is much more not that organised."

The lack of structured training infrastructure exacerbates these challenges, the lack of educational institutions providing formalised support networks of FLOSS exemplified this. Significantly, organisational failures to mesh FLOSS uptake with existing technical infrastructure create barriers that undermine even technically successful adoption. As Participant #10 explained:

"So the transferring all of the data... implementing training and integrating with the other systems... they all hadn't been supported... So then even the software might be good. The implementation failed."

The results suggest that wider uptake calls for institutional commitments to FLOSS integration within practice, including the apparatus to support training and ancillary technical support trained in FLOSS that many organisations currently lack despite the action of individual vanguards who successfully translate FLOSS utility and enrol colleagues.

Chapter V: Discussion

5.1 Discussion

To the best knowledge of the author, this is the first research project to reveal the barriers and facilitators of open-source software (FLOSS) and open-access data (OAD) within professional geospatial, planning and design practice. While the potential benefits of FLOSS tools have been extensively documented in exploratory technical literature (Mader & Schenk, 2017) (Yap et al., 2022) (Pardo-García, 2018), this study takes a different approach and reveals the intricate socio-technical networks that facilitate and impede FLOSS and OAD adoption in the context of professional practice taking influence from the principles of "Open-Source Urbanism" (OSU) (Berisha & Juvančič, 2022) and "Multipolarism" (Mouffe, 2005). The analysis of twelve semi-structured interviews with planners, designers, analysts, and related professionals within built-environment practice illustrates that FLOSS uptake is not only a matter of technical capability but rather relies on the successful continuity of human actors, institutional entities, material practices, and frameworks of legitimacy. The most prominent barriers to emerge included IT departments that adopted the role of gatekeepers, cognitive naturalisation of workflows, legitimacy and privacy concerns and the segregation of professional roles within professional practice. The most prominent facilitator to emerge from this research was the role of the vanguard champions who functioned as advocates within organisations pushing peers towards recognising the utility and agility offered by FLOSS and OAD tools.

5.1.1 Institutional IT Policies as Gatekeepers

IT departments and the role of institutional IT policies in regulating FLOSS adoption play a major role in impacting FLOSS uptake, sometimes against the preference and technical competencies among practitioners. As Participant #9 explained:

"So I instead have to use it on my home computer. And there's been several requests by different staff to involve to allow us to download this program and use it in lieu of the one that's sanctioned by the organization. But it has simply not budged."

Reinforced by Participant #1:

"When organisations are already signed up with ESRI, they're very reluctant to kind of even let you download QGIS... So even if it's free, they'll be reluctant to let you use it because it's not one of their approved programs."

This structural opposition persists regardless of the exhibited technical capacity and lower cost of FLOSS alternatives, indicating that uptake barriers emit from organisational taboos rather than technical utility considerations. This outcome reinforces Callon's (1986) "obligatory passage points", in this context, that restrict dispersion of FLOSS tools regardless of practitioner preference. This outcome suggests that successful FLOSS dispersion requires perspective reorientation before technical training within organisations toward more flexible approaches of descision-making.

5.1.2 Black Boxes and Cognitive Entanglements

The analysis revealed how established proprietary software function as a black box (Latour, 1987), where complex assemblages of tools, workflows, and cognitive patterns crystallise and develop resistant to re-evaluation or alteration. This was prominently illustrated in practitioners' cognitive anchoring to specific software interfaces and workflows, as observed by Participant #9:

"She was a former ArcGIS user, now she's been converted to QGIS. But the way that she approaches problems is thinking... Oh, I remember the ArcGIS function that I would use... Oh shit, that's not in QGIS."

The research revealed that established proprietary routines create what Hughes (1987) describes as technological momentum, where existing systems become increasingly difficult to disrupt. This finding demonstrates that proprietary software systems create magnetic networks that encompass more than the software but also the cognitive practices and normative preferences reinforced by perpetual use. If FLOSS is to pierce these networks, successful integration requires opening these black boxes and favouring networks that prioritise practitioner autonomy.

5.1.3 Individual Vanguards as Network Translators

The coding and analysis process frequently identified individual vanguard actors as champions who played a critical role in the prosses of translation by enrolling unfamiliar actors into FLOSS instrumentation. These vanguards emerged as the most recognised reason for FLOSS uptake or FLOSS experimentation. According to Callon (1986) translators contribute a necessary role in creating relationships where previously none exist. In the case of FLOSS and

OAD application in practice, these translators may increase collective uptake by demonstrating FLOSS utility through novel and visible application. Participant #9's role discusses this process where their demonstration translated previously unrecognised technical capacity to organisational decision-makers:

"I think Kath was one of those people who initially saw me coding... once she saw the kind of things that could be done and the value that they added... had tune changed entirely."

A potential limitation to the emergence of personality-centric applications is that actor-dependency could potentially reveal fragility concerns. When key translators leave organisations, the networks they construct may disintegrate, as the connections between actors were dependent on ongoing colloquiality and negotiation rather than institutional formalisation. This concept is what Callon (1991) refers to as "low irreversibility" and to which he offers organisational routinisation, regulatory embedding and the enrolment of interest aligned actors as tactics of mitigation (Callon, 1990). For FLOSS networks where decentralisation offers many of the instruments' agility strengths, these solutions may be difficult to implement within formal institutional networks such as professional built-environment practice.

5.1.4 Material Inscriptions, File Formats and Incarcerative Business Practice

File formats were identified as a core anxiety by practitioners considering migrating software suites. The trepidation that negotiating file formats brings became an emergent barrier identified that could impede client and professional expectations for deliverables in proprietary formats. As one Participant #7 explained:

"You can't collaborate on someone... You can't send them that project file if they use Affinity and vice versa... No one's going to accept your weird affinity file to work on."

This coding process reflects Latour's (1987) inscriptions as programs of action serving as "scripts" or the built-in prescriptions of technology. These technical artefacts enforce network boundaries and exclude alternative tools such as FLOSS. Some FLOSS instruments mitigate this barrier through allowing the export of files in proprietary counterpart format such as QGIS with 'ESRI Shapefiles' or Blender with the SketchUp-combatable 'Collada'. In other cases, such as the Adobe creative suite, file formats are utilised as a weapon to not only dissuade alternative FLOSS or competing proprietary software such as Inkscape or Affinity Creative Suite but also a way to convert illegitimate: "pirated versions" into subscription customers. Microsoft's windows strategy in the late 1990s' emerging Chinese market illustrates this paradigm (Shen, 2005). A veritable "razor-blade model" or 'the first hit is always free'. In this context, proprietary formats become an actant enforcing discipline across professional practice and organisational boundaries which form industry-wide networks that resist localised attempts at reassembly.

5.1.5 Professional Identity and the perceived illegitimacy of FLOSS and OAD

Legitimacy appeared as a recurring feature of this research proving to be a particular barrier which re-enforced organisational taboos. While some practitioners successfully enrolled FLOSS into novel problem-solving assemblages, normative institutional culture maintained segregated networks that affiliated proprietary software with professional network credibility. Among students, this sentiment was commonly identified such as by Participant #3.

"And you feel more professional if you use the industry standard... ArcGIS, like it's. And things like Photoshop, they're like industry standards."

These parallel networks create situations where the same practitioner must perform different professional identities depending on context, switching between FLOSS-centered and proprietary-centered assemblages without being able to fully stabilize either as the dominant configuration.

5.2 Limitations

This research project faced several methodological and empirical limitations that warrant acknowledgment. The limited sample size of twelve semi-structured interviews, while adequate for exploratory qualitative research and circumstantial network tracing, reduces the generalisability of results across the broader Australian professional geospatial, planning and design realm. The cautious sampling approach, though suitable for investigating information-abundant accounts, may favour individual practitioners with existing FLOSS awareness or experience, potentially overrepresenting successful network-building attempts while underrepresenting contexts where FLOSS networks never formed.

The decision to include cross-sectional snapshots within this research project presents limitations for ANT analysis, which instead, ideally follows actors and networks as they temporally develop. The interview results provide views of existing network configurations but cannot completely recount the dynamic processes of translation, enrolment, and stabilisation that develop over months or years. Under this constraint, the recounting of network irreversibility becomes difficult to trace deluding whether FLOSS networks will build or dissolve.

Another limitation identified is the choice of practitioner-subjects who may recount a perspective that obscures the power of other identified actors in these networks such as clients, IT departments, software distributors, and consortiums of regulation who each play distinctive roles in shaping FLOSS uptake outcomes. The influence of these actors is however, partially reflected within this project through practitioner-description, although a thorough ANT methodology ideally requires following each actor symmetrically.

Finally, the study's focus on Melbournian or Victorian planning practice limits cross-regional comparison and may not capture how different national contexts which display varying regulatory environments, professional cultures, and institutional structures enable or constrain FLOSS network configurations. The findings should therefore be understood as specific to this particular collection of actors, institutions, and material processes that constitute Greater Melbourne planning at this moment.

5.3 Project Observations

The semi-structured interview results revealed how individual actors demonstrate differing patterns of use with respect to software practices within organisations. Organisations with flexible IT policies displayed the greatest capacity for uptake of FLOSS tools into their practice, on the other hand, restrictive IT practices functioned as anti-programs (Latour, 1991) inhibiting the formation of facilitative networks for FLOSS uptake. Government organisations with authoritative and professional scepticism expressed the most reservation in welcoming the application of FLOSS and OAD within routine practice. In governmental contexts, data security protocols and accountability frameworks functioned as gatekeepers in the distribution of FLOSS and OAD instruments.

Educational institutions recurred as opportunities for FLOSS induction and network formation, despite formal curricula often favouring proprietary tools through educational licenses, these arenas with diverse individual actors allowed greater mobility for FLOSS implantation. The flexible roles of students often encourage greater experimentation due to a greater diversity of tasks, where professional roles often retain rigidity due to less dynamic expectations. The results identified generational dimensions to network participation, with master's students exhibiting greater willingness to experiment with alternative FLOSS instruments compared to practitioners, however continue to demonstrate restriction by the obligatory passage points of professional socialisation and institutional requirements.

5.4 Conclusion and Recommendations for Practice

The transcript and coding process results from this research project suggest that successful FLOSS induction in Greater Melbourne planning practice is best characterised not as individual decision-making but as an interlocked process of network translation and stabilisation requiring simultaneous enrolment and arrangement of heterogeneous actors. For the successful formation of durable FLOSS and OAD networks, the extent of technical capabilities must be demonstrated by vanguard individual actors while institutional gatekeepers must be persuaded to facilitate the opening of black-boxes. To this end, the contemporary professional legitimacy networks of digital built-environment practice must be reconstructed to allow for increased agency for individual practitioners encouraging successful enrolment of FLOSS and OAD within professional practice networks.

This study's ANT framework proved valuable in revealing how technical decisions about software preference revealed themselves as negotiations among diverse actors with competing

interests. Software choice serves as the outcome of successful or unsuccessful attempts to form and stabilise heterogeneous networks capable of producing effective planning, design, geospatial or analytical outputs. The results of this research study demonstrate that FLOSS uptake in professional practice among planners, designers, engineers, geospatial analysts and others practicing in the built-environment sciences within Greater Melbourne, Victoria requires the purposeful construction of socio-technical networks that can enrol and retain connections among a myriad of actors with competing interests.

Based on the research findings, several specific recommendations for practice emerge for organisations seeking to construct FLOSS networks:

5.4.1 Holistic Enrolment Among Organisations:

Organisations must take an active step to enrol their IT departments and leadership into FLOSS networks rather than relying on the advocacy of vanguard actors. This requires demonstrating how FLOSS tools can be implemented into existing institutional objectives centring cost reduction, flexibility, decentralised development and innovation while addressing security and reliability concerns.

5.4.2 Opening Black Boxes within Education:

Amending education programs to incorporate FLOSS tools into curricula provides an opportunity to open the black boxes of professional practice itself. This change may decode how different tools create different assumptions between practitioners and their objects of study. This approach recognises cognitive impasse by uncovering the constructed character of software relationships.

5.4.3 Constructing Large Industry Networks

Professional bodies could function as significant translators by enrolling FLOSS tools into professional networks of legitimacy through formalised endorsement, training courses, and a development of standards that accommodate the decentralised nature of FLOSS and OAD. Without cooperative network building, individual actor innovation will result in disjointed network formation.

5.4.4 Forming Hybridised Network Schemes:

Rather than attempting to replace proprietary networks, organisations may construct hybridised networks allowing practitioners to transition between different tool configurations while retaining required connections to clients and professional communities. This acknowledges the need for flexibility during transitional periods and grants agency to individual practitioners while maintaining organisational relationships.

5.5 Recommendations for Further Research

This study provides a foundation for recognising FLOSS adoption as a process for network-building, but there remain several domains that warrant further investigation:

Future research may trace the process of FLOSS network evolution over time through *Longitudinal Network Analysis*, by scrutinising which connections prove resilient, and which remain fragile, and how new actors become enrolled or ostracised from these networks. Longitudinal Network Analysis has been demonstrated by Greenhalgh & Stones's (2010) study

of healthcare IT implementation, tracking networks as they stabilise or fail to stabilise in which a cross-sectional analysis could not.

Cross-regional comparisons such as *Comparative Network Studies* provide the potential to reveal how different configurations of regulatory agents, professional networks, and institutional arrangements facilitate or constrain FLOSS network establishment along different regional contexts. Bartels et al. (2020) have provided case study research guidance for urban and regional studies which in the case of FLOSS or OAD network formation, may reveal methods to transfer successful uptake methods across differing regional contexts.

While this research focused primarily on practitioner experiences, clients function as critical actors whose enrolment is required for stable FLOSS networks. Including studies into multiple stakeholders may unveil competing or collaborative perspectives. Further research could explore how clients IT departments and other actors perceive and engage with FLOSS outputs and what would enable their enrolment into FLOSS assemblages further facilitating the uptake of FLOSS instruments into professional practice. Recent research conducted by Matt et al. (2021) demonstrates the value of multi-stakeholder studies in revealing technology adoption, particularly in perceptions of risk and legitimacy.

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Appendix A.

Email & LinkedIn Recruitment Message

Subject: Invitation to Participate in a Research Interview on Digital Tools in Planning and Design

Dear [Name],

I hope this message finds you well. My name is Graham Inglert, and I am a Master of Urban Planning student at the University of Melbourne. I am currently undertaking a minor thesis supervised by Professor Alan March, and I'm reaching out to invite you to participate in a research interview for this project.

This research explores how digital desktop software, especially open-source and open-access tools, is used in planning and design practice. It aims to understand how such tools might support greater digital independence for professionals like planners, designers, architects, and others working in the geographic sciences.

If you choose to take part, the process involves a one-on-one audio-recorded interview (via Zoom or in person at a public location of your choice and at your convenience) that will take no more than one hour. We'll be discussing your professional experiences and views on digital software used in your field.

Participation is entirely voluntary, and you're welcome to skip any questions or withdraw at any time. While there is no financial compensation, your insights could contribute meaningfully to future planning and digital policy discussions.

Attached are the project summary and consent form to be signed should you agree to participate. If you are interested or have any questions, feel free to reply to this email or contact me directly at **ginglert@student.unimelb.edu.au**.

Thank you for considering this opportunity, I would greatly value your input.

Warm regards,
Graham Inglert
Master of Urban Planning
University of Melbourne
ginglert@student.unimelb.edu.au

Supervised by:
Professor Alan March
Email: alanpm@unimelb.edu.au
Tel: +61 3 8344 7077

Appendix B.

Plain Language Statement

Melbourne School of Design

Project: Master of Urban Planning Minor Thesis

Project Supervisor: Professor Alan March
Tel: +61 3 8344 7077 Email: alanpm@unimelb.edu.au
Additional Researchers:
Graham Inglert, Master of Urban Planning
Email: ginglert@student.unimelb.edu.au

Introduction
Thank you for your interest in participating in this research project. The following few pages will provide you with further information about the project, so that you can decide if you would like to take part in this research.

Please take the time to read this information carefully. You may ask questions about anything you don't understand or want to know more about.

Your participation is voluntary. If you don't wish to take part, you don't have to. If you begin participating, you can also stop at any time.

What is this research about?
This research considers the role that desktop software has in planning and design practice. This thesis examines the role of open-source and open-access desktop software to supplement current digital practice with the goal of increased digital sovereignty for planners, designers, architects, urban sociologists and other practitioners within the geographic sciences.

What will I be asked to do?
Should you agree to participate, you will be asked to take part in an audio-recorded interview that will last approximately 45-60 minutes conducted either by zoom or in-person at a public location at your convenience. The interviews investigate your professional role as a planner, designer, or other adjacent field professional with respect to digital desktop software used in completing the tasks associated with your professional role.

What are the possible benefits?
We cannot promise that you will directly benefit from your participation in this research project, nor will we pay or reimburse you for your participation. Your responses may contribute to further understandings on addressing the challenges posed by the current distribution of digital desktop software for design and planning practice.

What are the possible risks?
In the interview, we will be talking about your views on making decisions about personal desktop software and digital instruments pertaining to your current or future role as a planner, designer, architect or urban sociologist. There is a risk that these questions may cause you discomfort, or if you have had negative experiences, that discussing them could be distressing. If there are any questions that you don't want to answer, or if you feel uncomfortable at any point, just let the interviewer know and they will move on to the next question. all information you share is strictly confidential and will not be attributed to your name

Do I have to take part?
No. Participation is completely voluntary. You can withdraw at any time by writing to the responsible researcher: Alan March (see above for contact details). If you withdraw, any unprocessed data collected from you will be destroyed and not used in the study.

Will I hear about the results of this project?
A copy of the thesis will be available in the University of Melbourne's online research repository; 'Minerva', upon request, the researcher can forward the results of this research to your email following the project's completion.

What will happen to information about me?
All data pertaining to this research including transcripts, recordings and documents containing personal information will be kept on a secure, password-protected computer. Published material will contain your professional role, title and organisation. No published material will contain confidential individual personal information including name, age, gender and other information that can be used to trace you or your identity.

Where can I get further information?
If you would like more information about the project, please contact the researchers; Professor Alan March: Email: alanpm@unimelb.edu.au, Phone: +61 3 8344 7077, Graham Inglert: Email: ginglert@student.unimelb.edu.au.

Who can I contact if I have any concerns about the project?
This project has human research ethics approval from The University of Melbourne 30907. If you have any concerns or complaints about the conduct of this research project, which you do not wish to discuss with the research team, you should contact the Research Integrity Administrator, Office of Research Ethics and Integrity, University of Melbourne, VIC 3010. Tel: +61 3 8344 1376 or Email: research-integrity@unimelb.edu.au. All complaints will be treated confidentially. In any correspondence please provide the name of the research team and/or the name or ethics ID number of the research project.

Project ID Number: 30907 Plain Language Statement Version 3: 26 June 25

Appendix C.

Interview Questions and Topics

1. Can you walk me through your journey into the geographic sciences — how did you come into your current role, and what does your professional identity look like within your organisation?

2. What does a typical day in your role look like — and how do digital tools shape or structure that daily rhythm?

3. Can you recall a moment when desktop software either solved a major challenge in your work — or completely let you down?

4. How has your progression into more senior or specialised roles changed your relationship with planning or design software? Do you use it more, less, or differently now?

5. Have you ever found yourself limited by the digital tools at your disposal? What was missing, and did you find a workaround — or just have to live with it?

6. What do you think keeps professionals like yourself from exploring new or different software tools — is it time, training, culture, or something else?

7. Can you think of a time when the software you were using actually got in the way of your work? What do you wish had been different?

8. If your organisation didn't provide your software, and you had to choose what to invest in yourself — what would you keep, what would you ditch, and what would you seek out instead?

9. When you hear the terms 'Open-Source' or 'Open-Access', what associations or impressions come to mind? Have you ever experimented with tools like QGIS or OpenStreetMap?

   9a. What would it take for you to feel comfortable integrating open-source tools into your daily work? Have you ever been tempted to make that leap?

10. In your view, how much power do large software companies hold in shaping the tools — and even the mindsets — of professionals in the built environment? Should we be questioning this influence more openly?

11. Do you see open-source tools, open-access data, or ideas like digital sovereignty playing a role in giving planners and designers more independence from major software platforms? What would need to change for these alternatives to become a real part of your everyday practice?

Appendix D.

Consent Form

Melbourne School of Design

Project: Master of Urban Planning Minor Thesis

Project Supervisor: Professor Alan March
Tel: +61 3 8344 7077 Email: alanpm@unimelb.edu.au
Additional Researchers: Graham Inglert, Master of Urban Planning
Email: ginglert@student.unimelb.edu.au

Name of Participant: _____

1. I consent to participate in this project, the details of which have been explained to me, and I have been provided with a written plain language statement to keep.
2. I understand that the purpose of this research is to investigate the role of desktop software and the opportunities for open-source software in planning and design practice.
3. I understand that my participation in this project is for research purposes only.
4. I acknowledge that the possible effects of participating in this research project have been explained to my satisfaction.
5. In this project I will be required to participate in an interview discussing my role as a planner, designer or other professional working in the geographic sciences in relation to desktop digital software that is necessary for the completion of my role.
6. I understand that my interviews may be audio recorded and involve a transcription of my words for analysis and use within research.
7. I understand that my participation is voluntary and that I am free to withdraw from this project anytime without explanation or prejudice and to withdraw any unprocessed data that I have provided.
8. I understand that the data from this research will be stored at the University of Melbourne and will be destroyed 5 years after publication.
9. I have been informed that the confidentiality of the information I provide will be safeguarded subject to any legal requirements; my data will be password protected and accessible only by the named researchers.
10. I understand that my name and my role will remain anonymous in this study, but my employer and/or educational institution will be named.
11. I understand that after I sign and return this consent form, it will be retained by the researcher.

Participant Signature: _____ **Date:** _____

Project ID Number: 30907 Project Start Date: 11 July 2025 Version: 2

Appendix E.

ANT CODING MASTER DOCUMENT:

Verbatim Interview Subject Quotes and Corresponding ANT Codes

1. Participant #1 : Urban Designer / Committee Member- Geelong City Council / Urban Design Forum Australia

Direct Quote (Subject)	ANT Code(s)
Yeah, yeah. Q1.	Uncoded
Yeah, sure. So currently my identity is an urban designer. And yeah, I started out, I started out originally studying architecture and then I kind of fell into urban design through an internship with the city of Hobart and that was where I got into the geographical sciences and I basically self taught myself how to use QGIs.	Human Actors; Non-Human Actors
Right.	Uncoded
And then it was actually like, it was actually kind of the thing that got me into urban design because at that time, and this is a quite a common situation in councils, they weren't doing mapping really for like planning or design or strategic design purposes.	Human Actors; Material Inscriptions
Yeah, yeah.	Uncoded
They had like a geographic GIS team who were doing, maintaining an asset database yet GIS files that kind of record where things are and doing kind of, you know, various GIs, I guess what they do to support	Human Actors; Non-Human Actors

Complete document found in “Attached Materials”