Surveying the future: A framework for business model innovation in the land surveying industry

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Key words: business model innovation, land surveying, professional services, geospatial, technology disruption

1. SUMMARY

Land surveying firms are under increasing pressure to adapt their business models in response to technological disruption, market consolidation, and a critical shortage of skilled professionals. While land surveying plays a foundational role in managing the built environment, limited research exists on how firms in this sector can tactically evolve to remain competitive and resilient.

This study investigates the constraints inhibiting business model innovation in the land surveying industry through a two-phase qualitative research design. First, a systematic content analysis of 149 North America firm websites was conducted to find dominant business model archetypes. This was followed by 15 semi-structured interviews with firm owners and decision-makers across different specializations and sizes, offering qualitative insight into business challenges, operational models, and developing innovative practices.

The outcomes reveal four recurring business model types—ranging from local sole proprietors to large, multi-disciplinary engineering firms—each facing unique pressures from technology commoditization and workforce attrition. While many firms stay profitable under traditional models, this often masks long-term vulnerability to non-surveyor competitors and devaluation of core services. Innovative firms are responding by repositioning their value propositions toward consulting, risk mitigation, and using data as an asset, rather than focusing solely on measurement and delivery.

Drawing on tactics from innovative firms, this research identifies the important barriers to innovation and proposes a new framework designed to overcome these constraints by repositioning the surveyors' value proposition. It proposes a foundation for rethinking how land surveying firms can align their business strategies with evolving market demands

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2. Introduction

Land surveying is a critical function for developing the built environment by providing measurements on, above, or below the surface of the land and sea (FIG, 2025). Modern tools like GNSS, UAS, and LiDAR are shifting the surveyor's role from a data collector to a data manager capable of digital twin creation and construction verification (Chauhan, 2019). The modern surveyor 'requires managing the collection, organization, analysis, storage, and the dissemination of the data' for clients (Coutts, p. 202, 2017).

Despite the potential of technological progress, the land surveying industry faces a complex transformation. While the profession has rigorous licensing and ethical standards, modernization is limited by high software costs, complex digital workflows, and organizational resistance (Coutts and Strack, 2019, Nkwunonwo et al., 2023; Hakim et al., 2024). These internal obstacles are compounded by external pressures, including labor shortages and intensifying regulatory demands (Nave, 2005). Additionally, many firm owners are skilled practitioners who lack the formal business training necessary to navigate shifting markets (Oluborode and Oluborode, 2023). Collectively, these factors jeopardize the long-term viability of traditional business models (BM).

Firms must evaluate their commercial environment to manage these pressures and ensure sustained competitiveness. This calls for a focus on business model innovation (BMI) (Teece, 2010). Rather than making reactive changes, BMI provides frameworks and pathways for firms to redefine their value proposition, create new revenue models, and build more adaptable operations capable of tactically using technology, people, and economics to meet market demands (Morris, Schindehutte and Allen, 2005).

While BMI is well researched in other sectors, it remains underexplored in niche professional services like land surveying. However, the successful implementation in industries like manufacturing and construction help set a precedent where service-based models and modular construction improved profitability (Frankenberger et al., 2013; Liu et al., 2016; Das et al., 2023). These examples highlight the potential for BMI to address technological disruption, changing client needs, and regulatory dynamics, within the surveying profession (Velu, 2024).

Therefore, this research addresses a key gap in literature by investigating the constraints that inhibit BMI in land surveying firms. It looks to answer the following research question: *What constraints inhibit business model innovation in land surveying, and what framework can be derived from innovative companies to overcome these constraints?*

By answering this question, the study aims to contribute to the academic understanding of BMI in specialized industries and offer guidance for practitioners. It achieves this by diagnosing the system constraints the inhibit innovation – a vicious cycle between technology,

value, pricing, and workforce – and deriving a framework from the strategies of innovative companies designed to overcome these pressures.

3. The Land Surveying Industry and Business Model Innovation

The industry is a mature, profitable sector defined by heavy regulation and high barriers to entry (IBIS World, 2024). While these professionals are subject to strict technical and ethical guidelines, the literature notes a gap in business management education. This lack of business acumen is a critical vulnerability as firm owners are vulnerable to technology disruption and workforce attrition.

The industry is further challenged by a dual crisis of workforce depletion and technological disruption (Hannah et al., 2009; Keenan, 2020; IBIS World, 2024). Research indicates a declining workforce characterized by an aging demographic, where over half of the professionals in certain regions are over the age of 50 (Survey General Branch, 2016). The education and experience requirements, such as digital skills (Coutts, 2017; Bolkas and Gouak, 2020), create a high barrier to entry, exacerbating the issue (Blicavs, 2024). Concurrently, digital transformation redefined operational practices through the integration of Geographic Information Systems (GIS), Building Information Modelling (BIM), and big data analytics. While these advancements offer increased efficiency, they also present barriers such as prohibitive investment costs, complex workflows, and organizational resistance to change (Chauhan, 2019). This points to a need for educational reform and continuous professional development to align workforce skills with industry needs and incorporate business acumen (Masum et al., 2019; Sandru, Radutu and Nedelcu, 2021).

This is further challenged by a fragmented industry, comprising mainly of small businesses averaging four employees supplemented by a handful of large organizations (IBIS World, 2024). This is supported by construction literature, where small business failure where a lack of business acumen and management experience is a significant contributor (Mukopfa, 2021; Arditi, Koksal and Kale, 2000).

These factors present operational and strategic challenges for land surveying firms. Existing literature covers technology use cases and land boundary science, but less attention is paid to the BMs required to be competitive. Tactics for how to capitalize on new opportunities or realigning to different markets are unclear for these firms.

3.1 Business models and business model innovation theory

Business model theory defines how a company creates, delivers, and captures value to function and compete (Teece, 2010). The BM helps to translate strategic intent into reality by defining the internal and external resources and their beneficial relationships to achieve a desired outcome (Grabowska, 2015). It has growing importance as technology implementation or innovation often fail without a strong BM to commercialize it effectively (Velu, 2024). To analyze these complex interactions, firms often utilize the Business Model Canvas (BMC) (Osterwalder, 2004). While it potentially oversimplifies the logic, this format allows stakeholders to analyze and comprehend the complex interactions in the business (Micieta et al., 2020).

Business Model Innovation is the deliberate change to the core logic of a firm's BM in response to external disruptions or business goals (Frankenberger et al., 2013; Foss and Saebi, 2016). It is an iterative process that enables firms to adjust how they create, deliver, and capture value. The incremental or radical change is driven by external pressures, such as shifting market demands or technological disruptions, and internal goals, like improving operational efficiency or proactively entering new markets (Aagaard, 2024). However, implementing BMI presents significant challenges, especially for established firms, which must overcome the resistance of existing processes, systems, and power structures (Amit and Zott, 2012). Overcoming these barriers requires a holistic approach considering technology, sustainability, collaboration, and workforce.

3.2 Business models in land surveying

Digital transformation is redefining operational practices in land surveying (De Zeeuw, 2012). The integration of tools like GIS, BIM, and big data analytics is central to this shift (Li, Liu and Ao, 2020). Data science offers potential for data-driven BMs, which shift the value proposition from a one-time deliverable (e.g., a map) to a continuous service (e.g., a subscription for ongoing site monitoring) (Doukas, 2019).

Despite these opportunities, significant barriers impede innovation, including high initial investment costs, limited workforce expertise, and integration with existing processes (Abeynayake, Perera and Hadiwattege, 2022; Ebinne et al., 2022). Organizational resistance remains a hurdle, manifesting as reluctance from senior management accustomed to legacy workflows or from administrative departments struggling to price new intangible data services (De Zeeuw, 2012).

Furthermore, firms are increasingly expected to address broader societal challenges, such as sustainability and the circular economy. This requires adapting services to provide, for example, precise volumetric surveys that track the reuse of excavated material, directly supporting a client's sustainability reporting (Syed Abdul Rahman et al., 2023). This need for business acumen calls for a more entrepreneurial mindset that proactively identifies new opportunities and managing business risk across diverse projects (Greenway, 2002; Owusu-Awuah, 2024).

3.3 Lessons learned from business model innovation in industrial sectors

Analysis of BMI across manufacturing, construction, automotive, and agriculture reveals that firms can enhance resilience by adopting service-based or outcome-based models. Successful innovation in these sectors requires integrating BMI directly into the broader corporate strategy (Frankenberger et al., 2013). In manufacturing, digital transformation and international model replication have enhanced competitiveness while the construction industry has improved efficiency and sustainability by adopting modular prefabrication and circular economy principles. Similarly, the automotive sector has utilized digitization to shift toward Mobility-as-a-Service and IoT integration, while agriculture firms have evolved through digital platforms and resource optimization (Frankenberger et al., 2013; Das et al., 2023; Ziegler and Abdelkafi, 2023; Sivertsson and Tell, 2015).

Despite these benefits, several cross-industry barriers emerge. Internal resistance to change from established routines, legacy systems, and ingrained mindsets is the most common hurdle. This is often compounded by regulatory complexity, market uncertainty, and the significant investment required for technology and workforce upskilling. Industry fragmentation also frequently hinders the complex partnerships necessary for many BMI initiatives (Das et al., 2023)

Successfully navigating these challenges hinges on consolidated leadership, early stakeholder collaboration, and a culture of continuous learning. Effective innovation requires business alignment and entrepreneurial mindset shifts. While these industrial lessons provide a valuable foundation, translating them into land surveying requires addressing the profession's unique licensing requirements and cultural standing. Consequently, a research gap exists for a practical framework that explains how surveying firms can methodically innovate their models to navigate specific market pressures

4. Research Methodology

This study employed a qualitative, two-phase explanatory design to establish a typology of the land surveying business model and industry followed by a deeper contextual and thematic analysis. This sequence allows the information from Phase 1 to inform the lines of inquiry for the interviews in Phase 2 creating a cohesive set of findings.

4.1 Phase one: Website Content Analysis

The first phase utilized a systematic content analysis of 149 North American surveying firm websites to assess how companies communicate and capture value. Websites can signal unobservable qualities such as expertise and reliability (Connelly et al., 2010; Pollach, 2005). A structured coding scheme was developed by leveraging the BMC framework to enable a systematic comparison of firms across various geographies and sizes (Krippendorff, 2022).

Categories for analysis included value propositions and customer segments, revenue models and channels, service delivery and technology, and professional presentation and credibility markers. This analysis revealed four dominant recurring archetypes: Multi-Disciplinary, Local Surveying, Construction and Engineering, and Geomatics Technology firms. While these archetypes define firm structures, they do not explain the decision-making processes behind innovation, necessitating the second research phase

4.2 Phase two: Semi-structured interviews

The second phase employed semi-structured interviews to uncover nuanced drivers and organizational barriers to BMI (Creswell, 2013). These interviews serve as a flexible tool to explore topics such as decision making, technology adoption, and workforce challenges (Rachinger et al., 2019). Furthermore, this method is useful for engaging executives to understand BMI processes, required collaboration, and steps from ideation to implementation (Richter et al., 2017; Wirtz and Daiser, 2018)

Using purposive sampling, 15 experienced professionals from North America, Europe, and Oceania were selected to ensure geographic and operational diversity. The study utilized the

"expert interviewing" methodology, requiring participants to have a minimum of five years of industry experience and at least one role in ownership or management.

5. Analysis and Findings

The thematic analysis reveals an industry grappling with significant structural challenges to its traditional BM. Applying Braun and Clarke's (2019) process, a system of codes was developed using themes on BMI from established literature. This analysis identified that the primary inhibitor to innovation is an inertia born from short-term profitability, which often masks a long-term risk of encroachment from non-surveying actors like drone service providers. However, the short-term viability hides a long-term risk. A focus on defending against other surveyors leaves the industry vulnerable to encroachment from non-surveying actors, such as drone service providers and construction contractors, who employ technology to offer standardized measurement services at a lower cost.

5.1 Business model divergence

The research highlights a growing gap in operational models, strongly correlated with firm size. 'Multi-disciplinary Firms' target large-scale clients and projects, using their scale to offer integrated "*one-stop-shop*" services. In these contexts, surveying is used as a "*loss leader*" to secure high-value contracts. Conversely, 'Local Surveying Firms' thrive in niche local markets, relying on responsiveness and personal trust. However, this model often prioritizes technical practice over strategic planning, making growth difficult due to high capital requirements.

The data from interviewees highlights a growing gap between sole proprietors and multidisciplinary firms where technology commoditization and pivot of the value proposition could lead to a dissolution of the other firm types in the middle. This speaks to both organizations finding a niche in their respective markets, one being local, cost-sensitive customers and the other larger, more complex projects and clients.

While several interviewees fit into the other two archetypes, it is interesting to note that the 'Engineering and Construction Surveying Firm' is more commonly seen as an internal team entity within an existing general contractor and not as a standalone firm. As one participant highlighted, this pushes firms to offer more specialized services that are not easily replicated that require industry knowledge such as rail and deformation monitoring. This speaks to potential for this firm type to be merged into an internal organization and not as a standalone BM archetype in the future.

In contrast, the 'Geomatics Technology firms' have formed out of necessity, citing competitive pressures or frustration at previous employer business decisions. One consistent theme of these firms was a challenge with pricing related to value. These firms are piloting new BM and services related to consultancy and advisory.

5.2 An eroding value proposition

Interviewees consistently described a 'race to the bottom' on pricing, which is linked to the regulatory environment that allows non-surveying companies to compete on measurement services such as topography mapping and construction layout. While certain services are

legally protected, a "grey area" exists where non-licensed technicians can perform these tasks. Firms often fail to communicate the professional expertise underlying their work, leading to stagnant rates. Furthermore, technology has frequently led to price erosion. For example, when robotic total stations reduced crew sizes from three people to one, competitive bidding forced rates down for the service.

Technology is a mandatory enabler for modern deliverables, yet it poses a threat to firms that treat data collection as a non-unique offering. The shift by manufacturers to subscription-based models for technology complicates cost prediction for long-term, fixed-price contracts. In response, innovative firms are experimenting with value-based pricing, such as charging a percentage of construction costs or tiered fees based on experience levels.

The introduction of technology affects the supply of skilled labor, consequently impacting BM sustainability. The industry faces an aging demographic and declining academic enrolment. Critically, the shift to single-person crews has dismantled the historical apprenticeship model, leaving a void for employee upskilling (Kappia, Dainty and Price, 2007). Innovative firms are treating personnel development as a core area for BMI, creating structured, in-house upskilling programs and recruiting from adjacent trades like carpentry (Gillins, Olsen and Schultz, 2017).

5.3 Emerging innovative archetypes

New models are emerging that align with innovation patterns seen in other industries by shifting the core service away from measurement and toward strategic consultation. The Geomatics Consultant model represents a move toward outcome-based services where the firm’s value proposition focuses on optimizing project execution. By acting as a strategic partner rather than just a provider, these firms provide a *"backstop against scope creep,"* delivering data rapidly late in a project lifecycle when time is most valuable to the client.

Another alternative is the Surveyor as Mediator, which focuses on advisory and conflict resolution processes. In this role, the surveyor shifts from a factfinder to a facilitator who presents evidence impartially to involved landowners. By framing boundary disputes as shared problems to be solved through consensus, this approach prevents costly litigation and transforms the service into high-value risk mitigation.

Firms are also increasingly treating data as a strategic asset, moving away from conventional single-use project deliverables. This framework involves systematically collecting high-resolution data to build a proprietary digital record of project areas over time. This alters the method of value capture, allowing firms to transition from selling professional labor to licensing access to valuable, reusable information.

These innovations reflect a strategic repositioning of the firm as an Ecosystem Coordinator. By recognizing that their core competency lies in expertise and project management rather than data capture, these firms cultivate networks of specialized partners, such as drone operators and other consultants. This allows the firm to move "*upstream*" in the project sequence to a more defensible position focused on quality assurance and strategic integration.

6. Discussion

The synthesis of research findings reveals that the primary constraint inhibiting BMI is a *"vicious cycle"* where technology, value perception, pricing, and workforce development reinforce the inertia of conventional practices (Figure 1). This cycle begins with the introduction of technology that, following disruptive technology theory (Christensen, 1997) makes data gathering more efficient but also more accessible to non-specialized actors. Consequently, firms struggle to monetize professional expertise, leading to an eroded value proposition and intense price competition. This decline in pricing power results in stagnant rates (Markides, 2006), which in turn motivates a workforce crisis as low-margin firms cannot offer competitive salaries or invest in the training required to attract talent. This creates a skills gap that forces firms to continue offering commoditized services, perpetuating the decline.

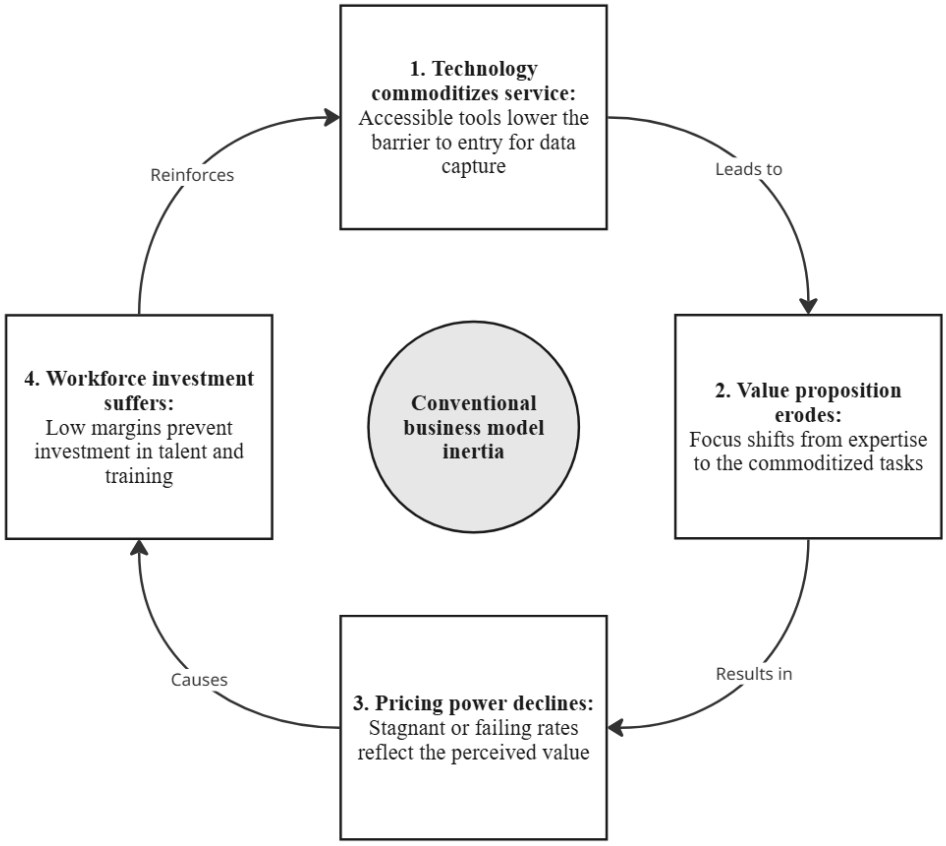

Figure 1. A conceptual model of the feedback loop inhibiting BMI.

6.2 Insights from Disruption in Adjacent Professions

The challenges facing land surveying are mirrored by other professional services. The legal industry provides a clear parallel, as the introduction of automation has begun to dismantle the billable hour model by removing manual routine tasks like contract review. In response, innovative firms have shifted to strategic advice, recognizing that time-based billing for non-

specialized services is an unsustainable strategy (Susskind and Susskind, 2018). Similarly, the accounting industry has evolved from historical record-keeping to proactive advisory roles as bookkeeping and tax filing became automated (Emsley, 2005). These parallels suggest that the most viable path forward for surveyors is to escape the "commodity trap" by shifting focus from the deliverable to the professional judgment and risk mitigation that underlie it.

6.3 A New Resilient Land Surveying Business Model

The proposed framework for a resilient BM represents a pivot from valuing time and measurements to expertise and outcomes (Figure 2). The core value proposition must shift toward providing client advisory, data management, and quality assurance for spatial data across the project lifecycle. This involves the surveying firm acting as a *"broker"* or *"quarterback"* between partners to fulfill complex client demands. To achieve this, firms must transition to becoming *"preferred, sole-source partners"* by getting *"in front of the project before it is even announced to the public".* This targets clients who are *"more willing to look at value and quality of service as opposed to just the cost".*

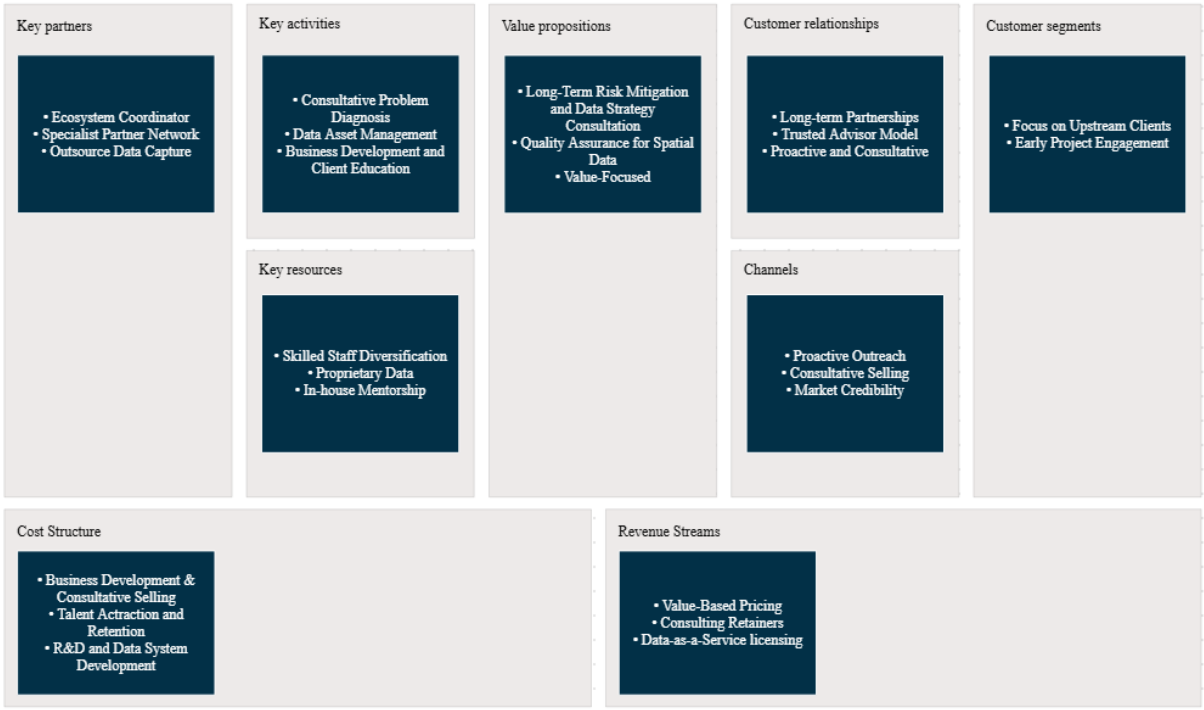

Figure 2. A proposed resilient business model for land surveying firms.

6.4 Strategic Repositioning

Implementing this model requires a decisive shift in how firms reach and interact with customers. Outreach must move from reactive to proactive, with firms focusing on *"consultative selling"* and strategic discussions about the project lifecycle. Measurement tasks are ceded to an ecosystem coordinator model (Figure 3), where the firm integrates providers and manufacturers into a partner network to *"connect technology, process, and outcome for*

the clients". This reorientation moves the firm *"upstream"* in the project value chain to a more defensible position.

Figure 3. Ecosystem coordinator position for land surveying firm.

Critical resources in this model shift from equipment fleets to human and intellectual assets. Because *"replicating the process is the best way to go about scaling the operation,"* firms must develop standard operating procedures that allow for knowledge transfer independent of traditional mentorship. Finally, the revenue model moves away from the *"unsustainable"* billable hours' approach toward value-based pricing and *"as-a-service"* models. By treating data as an asset, firms can create recurring revenue streams that increase economic power *"from selling labor to selling information"*

7. Conclusion

This study concludes that the primary constraints for BMI in land surveying are a cycle where technology commoditizes services, which erodes the value proposition, subsequently suppressing pricing power which hinders workforce upskilling investment. In response, this research proposes a framework from interviewed companies that demonstrates how firms can overcome this constraint by pivoting from traditional services to consultation, data management, and risk mitigation. While much of the literature provides generic lists of drivers and barriers, this research offers a dynamic feedback loop model that explains how these factors interconnect within a specialized professional service industry. Furthermore, the proposed resilient BM advances BMI theory by synthesizing current practices into a coherent framework applicable to other niche professions operating in the built environment.

This dissertation provides firms with tools to assess their strategic market position in relation to four BM archetypes. Identifying the firm's place in the market can highlight vulnerabilities and hidden advantages. A practical first step is to re-evaluate client engagements to understand what the biggest risks are and how geospatial data can mitigate them. This can help firms transition to a trusted consultant approach. Using the proposed business model framework, owners can implement new tactics for creating value, addressing personnel gaps, and building a sustainable competitive advantage in a changing market.

The limitations of this study stem from its qualitative methodology and sample of a limited number of participants and easily accessible websites. The reliance on self-reported data also introduces possibilities for recall or interpretation bias. Additionally, the study represents a snapshot in time that is unable to capture long-term dynamics or rapid market changes, and variations in cultural and regional dynamics. The absence of quantitative comparisons further constrains the scope of analysis.

Future research should utilize quantitative surveys to identify prevalence of trends, such as pricing strategies, technology adoption rates, workforce demographics, and the impact of regulatory burdens. Equally important is understanding the client's viewpoint on the land surveying value proposition. This would validate the value clients associate with services such as traditional measurement versus advisory services as proposed in this research.

Additionally, detailed case studies from firms implementing BMI (e.g., DaaS, mediation, advisory services) could demonstrate pathways for adaptation and scalability and determining long term profitability. Regarding the BM, comparative studies could analyze regulation impact on firm structure and market competition, evaluate the effectiveness and scalability of mentorship solutions, and time-based studies tracking how surveying firms evolve in response to market, technological, and client pressures.

This research indicates the future of land surveying lies not in doing the same work more efficiently, but in redefining the work itself: from capturing data to creating strategic value.

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BIOGRAPHICAL NOTES

Riley Smith is a Director at Trimble, managing product development and marketing for the Monitoring, Mining, and Tunneling groups. His 15 year geospatial career is built on practical experience as a field surveyor and supervisor. Now at Trimble, Riley leverages this domain knowledge to develop technologies that are transforming how professionals in construction,

mining, and surveying work. A graduate of the University of New Brunswick with a BSc. in Geomatics Engineering, he is currently pursuing an MSt. in Construction Engineering Management at the University of Cambridge. When he's not advocating for technology innovation, Riley pushes his own limits through hiking, biking, snowboarding, and endurance challenges like triathlons and Spartan races.

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