

Delivering Sustainable Surveying Engineering Business in the 21st century - The Entrepreneurial Approach

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ABSTRACT

This paper examines how an enterprise within the field of geomatics engineering can continue to be in business by leveraging the entrepreneurial approach. The paper illustrates how an entrepreneurial approach is imperative for prosperity in the 21st century. Drawing analogies from vehicles and drones, it underscores the necessity of maintaining a diversified project portfolio, akin to a vehicle's dependence on four wheels and a drone's requirement for four propellers. The paper emphasizes a cyclical cash flow model, ensuring that the loss of a single project does not jeopardize the stability of the surveying engineering business.

Key actionable strategies are outlined: client identification, inclusion in vendor lists, proposal writing, expressing interest in capital projects, forming versatile surveying teams, and adeptly managing value and risk across multiple projects. We underscore the significance of understanding the client's value matrix, ensuring alignment of services to highlight the firm's relevance and value addition.

The merits of this sustainable approach are manifold, offering clients optimal value for money, reducing unemployment rates among surveying engineering graduates, enhancing the visibility of surveying engineers in capital projects, ensuring the availability of geospatial solutions, and guaranteeing sustainable employment within the sector. Moreover, an emphasis on technological advancements ensures timely, cost-effective, and high-quality service delivery.

However, the journey is not without challenges. The paper identifies contractual bottlenecks and funding insufficiencies for technology acquisition as primary impediments. By adopting a strategic, informed approach, surveying engineering businesses can navigate these challenges, ensuring long-term sustainability and significant contributions to the industry and broader economy.

1. Introduction

The U.S. Bureau of Labour Statistics (BLS) data reveals that around 20% of new businesses fail in the first two years, 45% in the first five years, and 65% in the first 10 years. Only 25% reach 15 years or more (Deane, 2022). This data from the U.S. Bureau of Labour Statistics

reveals a consistent pattern of business failure since the 1990s, where a notable percentage closes within specific periods (e.g., 20% within the first two years, 45% within the first five years). This challenges the perception that business success, particularly in terms of longevity, is more prevalent than actuality. Despite advancements, a substantial number of enterprises annually closing in the United States emphasizes the inherent challenges and risks in sustaining a business. If that is the case in the United States, what may be happening in other regions, especially in developing countries is anybody's guess.

Sustaining a business through societal changes is no easy feat - a feat, perhaps, made much more difficult when that business find itself in a highly technical field like geomatics engineering, and in an era where the spate of technological changes is occurring at break-neck speed (Sahare & Thampi, 2010; Zamora, 2017). What even make matters worse is the disruptive impact of this technological changes. As a result, it is no surprise that the geomatics engineering of yesteryears appears quite different from what now prevails. In the historical past, examples of geomatic engineering tools used for surveying were the ropes and plumb bobs (by the Egyptians), the lodestone (by the Chinese), the diopter (by the Greeks), the theodolite and the sextant (created between the 16th and the 18th century) (CourthouseDirect, 2018). In contrast, geomatic engineering in this modern era, the 21st century, is characterized by digital mapping, geographic information systems (GIS), global positioning systems (GPS), drones, aerial surveys, electronic distance meters (EDMs), automation, artificial intelligence, and the like. These new tools are all offshoots of modernization, products of the current digital revolution, spreading through the fabric of society like wildfire.

Modernization, a key characteristic of the 21st century, is a complex concept, challenging to define due to its varied manifestations (Grasso & Kort, 2015). In the context of this paper, it refers to the societal shift from rural, agrarian settings to urban, industrial structures through the application of science, technology, and rational thinking. Key aspects of modernization include economic growth, labour specialization, improved education, income distribution, extended life expectancy, and a growing dependence on bureaucracy (Grasso & Kort, 2015). Without doubt, these aspects of modernity/21st century have implications for the survival of businesses, including the geomatic engineering business.

In the dynamic realm of geomatic engineering, the multifaceted impacts of modernity may intricately shape the landscape and survival prospects of businesses in this field. Economic growth emerges as a catalyst, fostering opportunities and a heightened demand for geospatial services. The specialization of labour stands as a linchpin, ensuring that professionals possess the specialized expertise crucial for precision-oriented tasks such as surveying, mapping, and spatial analysis. Education's evolution contributes to a pool of skilled workers, equipped to navigate advanced technologies and spur innovation within the geomatic engineering domain.

Income distribution within a society exerts a profound influence, determining the financial capacity of both governmental and private clients. This, in turn, may shape the scale and frequency of geomatic engineering projects. With extended life expectancy, the industry benefits from sustained careers, allowing for the continuous transfer of knowledge and experience across generations. As bureaucracy gains prominence in the 21st century, geomatic engineering businesses are confronted with a growing dependence on regulatory frameworks. Navigating these bureaucratic landscapes becomes integral to project execution, influencing timelines and overall feasibility.

In short, the amalgamation of economic growth, labour specialization, education, income distribution, extended life expectancy, and the evolving bureaucratic landscape may collectively define the challenges and opportunities faced by geomatic engineering businesses, which in turn, may influence their sustainability. Adaptability to these modern dynamics emerges as a critical factor, determining the resilience and long-term success of businesses in this precision-driven sector.

Kubičková & Chudá (2021) conducted a study to examine the critical success factors of engineering businesses in the Czech Republic. Sixteen companies were studied. The study found that key success factors in the engineering business included marketing, particularly pricing and product strategies, high-quality and diverse product offerings, and a strong focus on human resources, emphasizing employee stability, loyalty, and positive work attitudes. There was no mention of the entrepreneurial approach as a key success factor. But then, it is worth noting that the critical success factors cited by Kubičková & Chudá (2021) respond to the entrepreneurial approach. In other words, the success factors highlighted in the study, such as marketing strategies, product quality, and human resources focus, inherently align with principles commonly associated with an entrepreneurial mindset (Moustaghfir et al., 2020; Yadav & Bansal, 2020; Y. Yang & Ju, 2018), even if not explicitly labelled as such in the study. Further lending credence to the preceding assertion is how Kubičková & Chudá (2021) defined success for engineering companies; they defined it as the achievement of satisfaction and stability among internal and external interest groups. Arguably, what better way is there to achieve satisfaction and stability among these internal and external interest groups, than through an entrepreneurial mindset or the entrepreneurial approach, considering the current technological-induced disruptions still underway. According to the National Academy of Engineering in the UK, the pace of these technological disruptions is expected to continue (Allan & Chisholm, 2023).

As such, the geomatics engineering sector, characterized by rapid technological advancements and evolving market dynamics, requires a progressive business model that is both adaptive and innovative. The entrepreneurial approach in this field is essential to cater to the shifting paradigms of the 21st-century market (Altan et al., 2019; Kotler & Keller, 2016). The

entrepreneurial approach is not just about business agility but also involves strategic risk management, capitalizing on emerging trends, and constantly enhancing service quality to meet client expectations (Morris et al., 2011). This paper delves into the strategic methodologies vital for the establishment and nurturing of a successful surveying engineering enterprise within this context.

An entrepreneurial mindset is a blend of foresight, innovation, and strategic planning. In the realm of geomatics engineering, this involves the anticipation of future trends in geospatial data acquisition, management, analysis, and utilization. Given the rapid pace of change in geospatial technologies and the increasing reliance on geomatics data across various industries, firms must be proactive in adopting new technologies and methodologies (Cramer, 2018). The shift from traditional surveying methods to contemporary practices, such as the use of unmanned aerial vehicles (UAVs), light detection and ranging (LiDAR), and Global Navigation Satellite Systems (GNSS), exemplifies the type of entrepreneurial thinking that is necessary for a firm's sustainability and growth (Remondino et al., 2011).

Market adaptation involves understanding and responding to changes in economic conditions, customer needs, and the competitive landscape. For surveying engineering firms, this means staying informed about the latest developments in software and hardware, as well as regulatory changes that could affect how surveying services are provided and consumed. The adoption of Building Information Modeling (BIM) and Geographic Information Systems (GIS) in construction and urban planning is a clear indicator of the market's shift towards integrated, data-driven solutions (Schofield & Breach, 2007).

In an industry where precision and accuracy are paramount, technological advancements are not just beneficial but critical. The entrepreneurial approach encourages the early adoption of cutting-edge technologies to provide high-quality services (Dale & McLaughlin, 1988). In recent years, there has been a significant focus on automation and machine learning to process and interpret large datasets more efficiently, which can give firms that embrace these technologies a competitive edge (Brigham & Ehrhardt, 2013).

Understanding client needs and adapting service offerings to meet these needs is a core tenet of the entrepreneurial approach. It necessitates an acute awareness of the client's value matrix and a commitment to delivering services that not only meet but exceed expectations. This is particularly important in geomatics engineering, where the end-use of data can vary greatly across different sectors. As such, client relationship management and customized service delivery become crucial components of business operations.

The diversification of services is another key strategy for risk mitigation and business growth. Surveying engineering firms can no longer rely on a narrow range of services but must instead offer a portfolio that caters to a wide array of industries and applications. From land surveying

to aerial mapping and from GIS services to environmental monitoring, the expansion of service offerings ensures a broader market reach and reduces dependence on any single revenue stream (Porter, 1985). Effective risk management is central to entrepreneurial success in geomatics engineering. By identifying potential risks, whether they be technological, financial, or operational, firms can implement strategies to mitigate them. This could involve diversifying the client base, investing in staff training, or adopting new business models that are more resilient to market fluctuations (Hopkin, 2017).

Despite the clear benefits of adopting an entrepreneurial approach, there are challenges that surveying engineering firms face. One of the primary obstacles is the financial aspect of acquiring and implementing new technologies (Yescombe, 2007). Additionally, firms must navigate the complex web of regulations and standards that govern the collection and use of geospatial data (Dale & McLaughlin, 1988). The entrepreneurial approach is not just a business strategy; it is a comprehensive model for operating in the dynamic field of geomatics engineering. It involves constant learning, adaptation, innovation, and strategic planning. By adopting this approach, surveying engineering firms can ensure they not only survive but thrive in the 21st-century business environment. Through foresight, adaptation, and client-centric operations, these enterprises can contribute meaningfully to industry and the broader economy.

The aim of the present paper, therefore, is to make a case for the use of the entrepreneurial approach in delivering sustainable surveying engineering business in the 21st century. The remaining portion of this paper is divided into three sections: Section 2 emphasizes a cyclical cash flow model, ensuring that the loss of a single project does not jeopardize the stability of the surveying engineering business; Section 3 will look at key actionable strategies; Section 4 will discuss the merits of delivering a sustainable surveying engineering business in the 21st century; Finally, Section 5 will look at the elements that impede sustainable surveying engineering business.

2. Diversified Project Portfolio and Cyclical Cash Flow Model

Diversification of project portfolio and the creation of a cyclical cash flow model is one of the vital pillars in the delivery of a sustainable surveying engineering business, and these strategies are entrepreneurial in nature. Some of these entrepreneurship approaches are innovation and adaptability, risk-taking and experimentation, market research and opportunity identification, flexible business models, portfolio management strategy, multiple revenue streams, and customer-centric approach. In the context of this study, surveying engineers who use the entrepreneurship approach shall be referred to as “surveying entrepreneurs.”

2.1 Innovation and Adaptability

Entrepreneurs in surveying engineering demonstrate a fundamental drive for innovation, compelled by an intrinsic motivation to continually seek novel solutions and adapt to the evolving market dynamics. In a sector traditionally focused on precision and accuracy, these entrepreneurs recognize the necessity of embracing innovation to stay competitive (Al-Khatib & Al-ghanem, 2021; Azeem et al., 2021). Their proactive approach involves viewing challenges as opportunities for creative problem-solving within the realm of surveying and geospatial technologies. This mindset fosters an environment where experimentation and out-of-the-box thinking become integral to the surveying engineering process.

This commitment to innovation is not merely a reaction to market changes but a proactive effort to shape the industry itself. Surveying engineers who use the entrepreneurship approach are often pioneers in identifying gaps and opportunities (Chen et al., 2020), leading them to conceptualize and implement projects that not only meet current client demands but also anticipate future trends. Staying attuned to shifts in surveying methodologies, advancements in geospatial technology, and changes in regulatory environments positions these entrepreneurs as trailblazers, consistently introducing pioneering projects that distinguish them in the marketplace.

Diversity in project exploration naturally stems from this innovation-centric approach. Kock & Gemünden (2021) in an empirical analysis involving 257 firms showed that both innovativeness and risk-taking, as dimensions of entrepreneurial orientation, positively moderate the relationship between managerial practices and performance in innovation project portfolio management (IPPM). The study findings suggest that firms with higher levels of innovativeness and risk-taking tendencies will experience enhanced performance outcomes when implementing managerial practices in IPPM.

Innovation Project Portfolio Management (IPPM) refers to the systematic process of selecting, prioritizing, and managing a collection of innovation projects within an organization. The term encompasses the strategic approach to overseeing and optimizing the entire portfolio of projects that contribute to the innovation and research and development (R&D) goals of a company. Recognizing that a one-size-fits-all strategy is ineffective in a dynamic market, surveying entrepreneurs actively diversify their project portfolios. This strategic move ensures a mix of initiatives that cater to various surveying needs and preferences. Beyond meeting client demands, this diversity serves as a risk mitigation strategy, spreading entrepreneurial efforts across different geomatic engineering services, industries, or markets.

Additionally, under the entrepreneurship approach, surveying entrepreneurs go beyond viewing each project in isolation; instead, they see them as integral components of a broader strategic framework (Müller et al., 2023). By strategically connecting diverse surveying projects, they create synergies that enhance the overall impact of their endeavours. This

interconnected approach allows for the cross-pollination of surveying ideas and resources, fostering an environment where the success of one project positively influences and supports others (Neumann, 2021).

In essence, the entrepreneurial commitment to innovation and adaptability in surveying engineering transcends mere responses to market changes. It involves actively shaping and influencing the surveying landscape. This proactive stance, combined with a willingness to explore diverse surveying projects, positions surveying entrepreneurs as dynamic agents of change, continually propelling their enterprises toward success in an ever-evolving business environment.

2.2 Risk-taking and Experimentation

The entrepreneurial approach is marked by a fundamental willingness to take calculated risks, a quality that distinguishes entrepreneurs in this specialized field. This risk-taking mentality is far from impulsive decision-making (Isles et al., 2018); rather, it reflects a strategic orientation toward navigating uncertainties inherent in the surveying engineering landscape while capitalizing on opportunities for portfolio diversification.

The calculated risk-taking aspect within surveying engineering entrepreneurship is deeply grounded in a comprehensive understanding of the potential benefits and drawbacks associated with specific ventures. The distinct functions of engineering firms, in comparison to other corporations, impact the intrapreneurial abilities of their employees (Blanka, 2018). The inherent characteristics of engineering positions occasionally hinder employees from taking risks, primarily driven by a fear of failure (Alam et al., 2020). Surveying entrepreneurs in the geomatics engineering sector meticulously evaluate the risk-return profile, considering factors such as market dynamics, competition, and financial implications before committing to a new surveying project or business opportunity. This strategic evaluation enables informed decisions to be made that align with the overarching goals of their surveying enterprises.

Surveying entrepreneurs embrace the spirit of venturing beyond their comfort zones, recognizing that innovation and growth often necessitate exploration into uncharted territories within the surveying engineering domain. This willingness to take calculated risks is particularly relevant when considering project portfolios. Entrepreneurs in the surveying engineering business will acknowledge that a diversified portfolio serves as a potent risk mitigation strategy (Reinholtz et al., 2021). By diversifying their surveying projects, surveying entrepreneurs ensure that the success of one project can offset potential challenges in another, fostering resilience and sustainability.

In their pursuit of diversification, entrepreneurs in the surveying engineering business may also actively seek out and experiment with new business opportunities. This may involve testing innovative surveying technologies, entering untapped markets, or adopting novel approaches

within the surveying industry. The diversification of project portfolios in surveying engineering is not a haphazard process; rather, it results from deliberate and calculated risk-taking strategies. For instance, a surveying entrepreneur may diversify their portfolio by integrating cutting-edge surveying equipment into their services while simultaneously exploring opportunities in emerging markets with high demand for advanced surveying solutions.

2.3 Market Research and Opportunity Identification

In the field of surveying engineering business, entrepreneurs stand out for their remarkable ability to discern market opportunities and gaps (Rosado-Cubero et al., 2022), a skill crucial for success. This proficiency, likely honed through rigorous market research, becomes a cornerstone of entrepreneurial endeavours, facilitating the identification of current market needs and the foresight to anticipate future trends. This proactive approach ensures that new surveying projects align seamlessly with the evolving dynamics of the business landscape.

Market research is a fundamental aspect of the entrepreneurial toolkit in surveying engineering, involving a thorough analysis of market conditions, customer behaviors, industry trends, and competitive landscapes (Gilmore, 2010). Surveying entrepreneurs delve into both quantitative and qualitative data, utilizing surveys, interviews, and literature studies to gain profound insights into the intricacies of the surveying market. This meticulous examination allows them to comprehend the pulse of the market, uncover patterns that may not be immediately apparent, and position themselves strategically for informed decision-making.

The proactive nature of surveying entrepreneurs in market research extends beyond mere data collection. It embodies a forward-thinking mindset that anticipates shifts in consumer preferences, technological advancements, and regulatory changes. By strategically positioning themselves to recognize emerging trends and seize opportunities before they become mainstream, surveying entrepreneurs ensure that their projects are not only relevant in the present market but also strategically positioned for enduring success in the future (Blank & Dorf, 2020).

The inclusion of new projects in the entrepreneurial portfolio within surveying engineering is a direct outcome of this rigorous and forward-looking market research (Blank & Dorf, 2020). When armed with a profound understanding of the market's intricacies, surveying entrepreneurs can conceptualize and implement projects that fill existing gaps or cater to unmet needs in surveying and geospatial technology. This strategic alignment with emerging trends has a way of positioning surveying projects to capture market share, gain a competitive edge, and respond effectively to evolving customer demands.

By staying attuned to and integrating the latest developments, surveying projects can capture a significant share of the market. Surveying projects that incorporate cutting-edge technologies,

methodologies, or address emerging challenges may be more likely to stand out in a crowded market. This competitive advantage is sure to enhance the project's visibility, attractiveness to clients, and overall market positioning (Al-Ali & Musa, 2020). As customer needs and preferences change over time, projects that are adaptable and reflective of these shifts will be better positioned to meet and exceed client expectations (Droga & Shah, 2022). This responsiveness will enhance customer satisfaction, fostering long-term relationships and increasing the likelihood of project success in a dynamic and evolving industry landscape.

Furthermore, surveying entrepreneurs leverage market research not only to identify opportunities for new projects but also to refine and innovate existing ones (Blank & Dorf, 2020). Insights gained from understanding customer preferences and market dynamics enable entrepreneurs in surveying engineering to enhance the value proposition of their offerings, ensuring that their projects remain at the forefront of industry trends and meet the evolving needs of the surveying market.

2.4 Flexible Business Models

The application of the entrepreneurial approach, in surveying engineering, is also marked by dynamic adaptability, a trait synonymous with successful entrepreneurial ventures. This adaptability is facilitated by the implementation of flexible business models, designed to swiftly adjust to market feedback (Chesbrough, 2007). This strategic element plays a crucial role in effectively navigating the ever-changing market landscape, ensuring a balanced and resilient project portfolio aligned with emerging opportunities and challenges.

The flexibility of business models within surveying engineering is deeply rooted in their responsiveness to market feedback. Establishing a continuous feedback loop through active communication with customers, suppliers, and other stakeholders serves as a valuable real-time information source. Surveying entrepreneurs leverage this feedback to assess project performance, identify areas for improvement, and seize new opportunities in the rapidly evolving surveying and geospatial technology landscape.

Recognizing the need to evolve strategies in response to shifts in consumer preferences, technological advancements, or economic changes, a surveying entrepreneur could implement flexible business models that empower them to appropriately respond to changes emanating from the external environment, thereby allowing them to stay ahead in a competitive market. Flexible business models in surveying engineering encompass strategies that allow for rapid adjustments based on market dynamics, technological advancements, and client needs. Some specific examples are proposed and briefly discussed below:

- a) **Subscription-based Services:** this has to do with offering surveying services on a subscription basis rather than one-time projects. This model will allow clients to access

ongoing surveying support, fostering long-term relationships and providing a steady revenue stream for the surveying engineering business.

- b) **Technology Integration and Upgrades:** entails implementing a business model that readily integrates new surveying technologies and software. This flexibility will ensure the business stays at the forefront of industry advancements, offering clients the latest and most efficient surveying solutions. This model could either be B2C (business to consumer) or B2B (business to business).
- c) **Agile Project Teams:** this involves structuring the business with agile project teams that can be quickly assembled or adjusted based on project requirements. This model allows for efficient resource allocation, ensuring that the right expertise is applied to specific projects without unnecessary overhead.
- d) **Hybrid Project Approaches:** involves adopting a flexible approach to project execution, combining traditional surveying methods with innovative technologies such as drones or LiDAR. This hybrid model may allow the business to cater to a diverse range of client needs and adapt to the evolving landscape of surveying techniques.
- e) **Data Analytics and Insights Services:** entails offering data analytics and insights services alongside traditional surveying. This business model involves leveraging collected surveying data to provide clients with actionable insights, adding value beyond the conventional scope of services.
- f) **Outcome-Based Pricing:** implementing pricing models based on project outcomes rather than fixed fees. This approach aligns the interests of the surveying engineering business with the success of the client's project, encouraging a results-oriented and collaborative working relationship.

In sum, the implementation of flexible business models in surveying engineering ventures, as emphasized by Chesbrough (2007), is not just a strategic choice but a necessity in the face of the dynamic business environment. This adaptability ensures that surveying projects remain responsive to market feedback, adept at navigating changing conditions, and capable of maintaining a balanced and resilient project portfolio."

Yang et al. (2020), in a study, investigated the impact of both responsive market orientation (RMO) and proactive market orientation (PMO) on business model innovation. The study findings revealed that both RMO and PMO exert positive effects on business model innovation. Importantly, the effects of these orientations were found to be contingent on the level of resource flexibility, specifically coordination flexibility, in distinct ways. The study found that

resource flexibility plays a crucial role in moderating the impact of RMO and PMO on business model innovation. It was observed that resource flexibility enhances the positive effect of RMO, indicating that when an organization possesses adaptable and flexible resources, the influence of responsive market orientation on business model innovation is strengthened. On the other hand, it was also observed that resource flexibility tended to weaken the positive effect of PMO, implying that excessive flexibility may potentially diminish the positive impact of proactive market orientation on business model innovation.

Hence, in a nutshell, the research by Yang et al. (2020) suggests that for a business to come up with innovative ways of doing things (i.e., flexible business models), it will not just be about being responsive or proactive but also about having the right level of flexibility in how the company's resources can adapt and work together. Finding the right balance seems to be the key to successfully innovating in the business world, which further suggests that which of the proposed flexible business model surveying entrepreneurs settle on would have a lot to do with their resource flexibility.

Other dimensions of the entrepreneurship approach are portfolio management strategy, multiple revenue streams, and customer-centric approach. Strategic portfolio management is a critical element in entrepreneurial ventures (Cooper et al., 2001), involving a thorough evaluation of each project's risk and return. Entrepreneurs strategically balance high-risk, high-reward projects with more stable ones, creating a diversified portfolio. This intentional mix serves as a risk mitigation strategy, ensuring resilience to market fluctuations. The result is a cyclical cash flow model that combines the potential for substantial returns with a reliable and stable foundation, fostering sustained growth in entrepreneurial endeavours. Moreover, Entrepreneurs excel in creating multiple revenue streams (Sahlman, 2008), diversifying income sources. This strategic approach helps the surveying entrepreneur reduce reliance on a single revenue stream, thus contributing to a more stable cash flow. Furthermore, entrepreneurs prioritize a customer-centric approach, understanding customer needs and preferences. This leads to the development of projects that cater to different market segments, contributing to the diversification of the portfolio, and by extension diversified cashflows (Figure 1).

2.5 Conceptual Framework

Figure 1 is basically a pictorial summary of the issues discussed in Section 2. This depicts a proposed entrepreneurship approach-based model for delivering a sustainable surveying engineering business in the 21st century. The diagram in Figure is made up of three elements namely the dimensions of entrepreneurship approach block, Project portfolio and cyclical cashflow block, and the long-term sustainability of surveying engineering business. From Figure 1, the entrepreneurship approach dimensions are hypothesized to wield some level of influence on the project portfolio and cyclical cashflow, as have been earlier discussed and alluded to throughout this section. Thus, the diversified project portfolio and cyclical cash flow

are conceptualized as products of the applications of the dimensions of the entrepreneurship approach. Based on the cyclical cashflow, cashflow (C.F.1) from project 1 feeds into project 2, while cashflow (C.F.2) from project 2 in turns feeds into project 3 and so on. In event of the loss of Project 1 and Cashflow 1, Projects 2, 3 and 4 will support the business until Project 1 gets reinstated. The project portfolio is akin to a vehicle running on 4 wheels, or a motor rotor drone needing 4 propellers to be functional and effective in air. Hence for sustainable surveying engineering business a minimum of four Surveying engineering projects is required.

The loss of Project 1 creates a gap in the project portfolio. Application of the dimensions of the entrepreneurship approach ultimately leads to the filling of the gap in the project portfolio, thereby ensuring a cyclical cashflow. This project portfolio and cyclical cashflow block is expected to generate long-term sustainability of the surveying engineering business. However, because of external shocks and market dynamics, from time to time, modifications, by way of what dimension of entrepreneurship approach gets most prioritized, are made to ensure optimal cashflow.

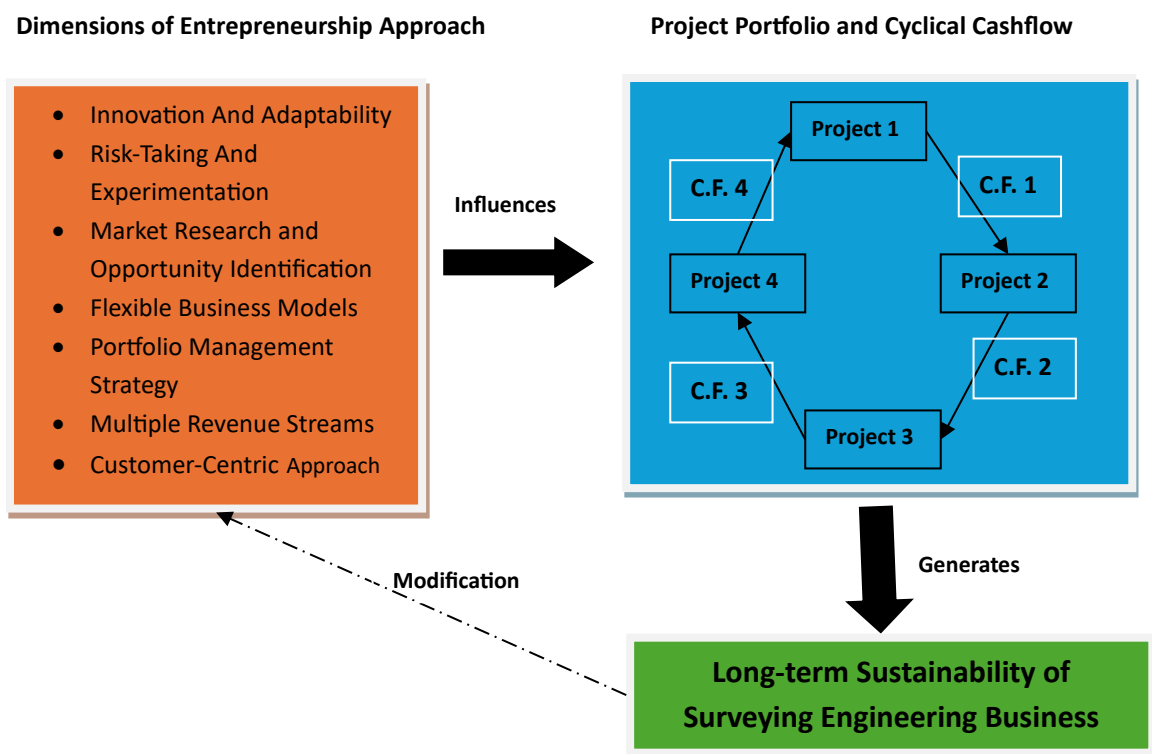


Figure 1: Proposed Entrepreneurship Approach based Model for Delivering a Sustainable Surveying Engineering Business in the 21st Century. C.F.1 to C.F.4 represent cashflows from projects 1 to 4 respectively.

3. Key Actionable Strategies for delivering a sustainable engineering business

Establishing and sustaining a successful surveying engineering business requires a strategic and multifaceted approach. In navigating the dynamic landscape of the surveying industry, entrepreneurs must adopt key action strategies that not only identify opportunities but also build lasting client relationships and ensure the effective execution of projects. This section looks at seven pivotal strategies aimed at delivering a sustainable surveying engineering business.

A. Identification of Potential Clients

In the pursuit of a sustainable surveying engineering business, the initial step involves a comprehensive identification of potential clients (Bruno, 2020). This necessitates conducting rigorous market research to discern organizations and projects that demand surveying engineering services. In-depth analysis of industry trends, upcoming developments, and the unique needs of potential clients becomes imperative to pinpoint lucrative opportunities in the market.

B. Being on the Vendor List

Being on the vendor list of potential clients is crucial for visibility and consideration in upcoming projects (Bracken et al., 2001; Richards, 2005). To achieve this, entrepreneurs must establish robust networking channels with potential clients, ensuring that their surveying engineering services are well-recognized. Active pursuit of inclusion in the vendor lists of identified clients enhances the probability of being considered for their surveying engineering needs, establishing a foundation for sustainable client relationships (Bracken et al., 2001; Richards, 2005).

C. Writing Proposals

Crafting compelling and tailored proposals is an essential strategy for delivering a sustainable surveying engineering business. Surveying entrepreneurs need to develop proposals that not only showcase their expertise and relevant experience but also demonstrate a clear understanding of the unique requirements of each potential client (Lines & Kumar, 2018). Emphasizing the unique value proposition of surveying engineering services in addressing specific client needs becomes paramount for successful proposal writing.

D. Expression of Interest (EOI)

The proactive expression of interest (EOI) in becoming an independent consultant for capital projects and ongoing operations is a strategic move. Surveying entrepreneurs must articulate how their surveying engineering services can add substantial value to the client's projects, contributing significantly to their overall success (Mangini & Pelli, 2003). Effectively communicating this value proposition enhances the chances of being considered for independent consulting roles, fostering long-term business sustainability.

E. Forming Composite Engineering Surveying Teams

Assembling skilled and versatile surveying engineering teams is critical for project execution. Surveying entrepreneurs must ensure effective collaboration and synergy among team members, promoting a comprehensive approach. This involves integrating professionals with diverse expertise to enhance the overall capability of the surveying engineering teams (Azmy et al., 2012).

F. Applying Value and Risk Management

Implementing robust value and risk management practices is essential for optimizing project outcomes. Entrepreneurs must systematically evaluate potential risks associated with surveying engineering projects and develop strategies to mitigate them while maximizing the delivery of value. This ensures the sustainability of project initiatives and long-term success in the field (Bissonette, 2016).

G. Understanding the Client Value Matrix

Deepening the understanding of the client's perspective and priorities is crucial in the context of capital projects. Surveying entrepreneurs must align surveying engineering services with the client's value matrix (Austin & Thomson, 2005), demonstrating a commitment to delivering outcomes that resonate with their goals and expectations. This strategic alignment strengthens client relationships and contributes to the overall sustainability of surveying engineering businesses.

Incorporating these key action strategies provides a comprehensive roadmap for entrepreneurs in surveying engineering, ensuring sustainable business practices and long-term success in a dynamic and competitive market.

4. Merits of Delivering a Sustainable Engineering Business

In the dynamic landscape of engineering, the merits of embracing sustainability extend far beyond the immediate project outcomes. A sustainable engineering business not only serves the interests of its clients but also plays a pivotal role in shaping the future of the industry and its professionals. This section of the paper 1 the advantages associated with delivering a sustainable engineering business.

Characterized by efficiency, resource optimization, and a focus on long-term benefits, survey engineering business when made to be sustainable form the foundation of value-driven outcomes for clients. As clients seek not just immediate results but enduring returns on their investments, sustainable approaches, such as streamlined project management and resource efficiency, promise optimal value over the entire project life cycle.

Moreover, the commitment to the sustainability of the survey engineering business extends a helping hand to the next generation of surveying engineers. By actively contributing to the reduction of the graduate unemployment rate, sustainable engineering businesses also create an environment that supports the absorption of newly graduated professionals into the workforce. This not only aids individual career paths but also fosters the growth and sustainability of the surveying engineering industry.

Sustainability goes beyond project completion—it intertwines with the entire capital project life cycle. A sustainable engineering business ensures the continuous and meaningful involvement of surveying engineers at every stage, from initial planning to execution and maintenance. This enhanced visibility allows professionals to contribute their expertise comprehensively, promoting a holistic approach to project management.

In the area of geospatial solutions, sustainability is synonymous with accessibility. Sustainable engineering businesses, particularly in surveying, prioritize the integration of geospatial solutions, providing clients with readily available and accurate data. This not only empowers clients in their decision-making processes but also enhances the efficiency of their operations. Accessible geospatial solutions contribute to improved project planning, robust risk management, and effective resource allocation.

Furthermore, sustainability in engineering is arguably inseparable from the assurance of stable and well-paid employment for surveying engineers. By creating an environment that aligns with long-term viability, entrepreneurship approach-based surveying engineering firms are positioned to attract skilled professionals. This ensures a workforce that is not only stable but also highly proficient. This guarantee of sustainable, well-paid jobs enhances the overall expertise and efficiency of the surveying engineering business.

Lastly, at the forefront of sustainable engineering is a commitment to technological advancement. Surveying engineers working in a sustainable business environment are inherently motivated to stay abreast of the latest technologies. This dedication to technological innovation ensures that projects are delivered with optimal quality, within budget, and on time, reinforcing the business's competitiveness in the ever-evolving industry. In sum, the merits of delivering a sustainable engineering business transcend immediate project success; they lay the groundwork for a resilient, proficient, and forward-looking industry.

5. Elements impeding Surveying Engineering Business

One significant impediment to the success of surveying engineering businesses lies in the failure of varying contract types to recognize the pivotal role of surveying engineers. Particularly, the oversight of not acknowledging surveying engineers as key consultants

immediately after the development consultant in all capital projects can hinder their effective contribution. In some contractual arrangements, the importance of surveying expertise might not be adequately emphasized, leading to potential misunderstandings regarding the essential role these professionals play in the project's success. This oversight may result in a lack of alignment between the scope of work expected from surveying engineers and their actual contributions, impacting project outcomes.

Another notable challenge confronting surveying engineering businesses is the insufficient funding available to invest in new technologies that enhance their work (Brown & Clark, 2019). The domain of surveying engineering is experiencing swift evolution, where technological progress is pivotal in enhancing efficiency, precision, and the range of services provided. Nevertheless, financial limitations confronted by businesses in obtaining cutting-edge technologies can hinder their capacity to maintain competitiveness. Deprived of access to the most recent tools and equipment, surveying engineers might encounter difficulties in meeting ever-changing industry standards, delivering services of superior quality, and adjusting to the dynamic requirements of the market. The lack of funding for technological advancements represents a barrier to the optimal performance and growth of surveying engineering businesses in the 21st century.

In addressing these impediments, surveying engineering businesses may need to advocate for contract structures that duly recognize the expertise of surveying engineers and actively seek avenues for securing adequate funding to embrace technological innovations. Overcoming these challenges is crucial for ensuring the sustainable growth and success of surveying engineering businesses in the contemporary business landscape.

6. Conclusions

In conclusion, the entrepreneurial approach not only redefines how surveying engineering is practiced but also forms a robust foundation for delivering sustainable businesses in the 21st century. It transcends conventional boundaries, fostering innovation, adaptability, and strategic alignment that position surveying entrepreneurs as dynamic agents of change, propelling their enterprises towards long-term success in an ever-evolving business environment.

The paper, therefore, suggests that surveying entrepreneurs will do well to actively pursue a diversified project portfolio by strategically selecting initiatives that cater to various surveying needs and preferences. It is also recommended that survey engineers implement flexible business models that align with the dynamic nature of the surveying engineering industry.

References

- Al-Ali, M. S. M., & Musa, H. (2020). Competitive advantage toward construction project development in the United Arab Emirates. *Religación*, 5(23), Article 23.
- Alam, M. Z., Nasir, N., & Rehman, Ch. A. (2020). Intrapreneurship concepts for engineers: A systematic review of the literature on its theoretical foundations and agenda for future research. *Journal of Innovation and Entrepreneurship*, 9(1), 8.
<https://doi.org/10.1186/s13731-020-00119-3>
- Al-Khatib, A. W., & Al-ghanem, E. M. (2021). Radical innovation, incremental innovation, and competitive advantage, the moderating role of technological intensity: Evidence from the manufacturing sector in Jordan. *European Business Review*, 34(3), 344–369.
<https://doi.org/10.1108/EBR-02-2021-0041>
- Allan, M., & Chisholm, C. U. (2023). The Formation of the Engineer for the 21st Century—A Global Perspective.
- Altan, O., et al. (2019). *Geomatics Engineering: A Practical Guide to Project Design*. CRC Press.
- Austin, S., & Thomson, D. (2005). Briefing: Delivering value in construction design—a new approach. *Proceedings of the Institution of Civil Engineers - Civil Engineering*, 158(4), 148–148. <https://doi.org/10.1680/cien.2005.158.4.148>
- Azeem, M., Ahmed, M., Haider, S., & Sajjad, M. (2021). Expanding competitive advantage through organizational culture, knowledge sharing and organizational innovation. *Technology in Society*, 66, 101635. <https://doi.org/10.1016/j.techsoc.2021.101635>
- Azmy, N., Shane, J. S., & Shelley, M. C. (2012). Implementation of Survey Method in a Construction Team Effectiveness Study. 1471–1480.
<https://doi.org/10.1061/9780784412329.148>
- Bissonette, M. M. (2016). *Project Risk Management: A Practical Implementation Approach*. Project Management Institute.
- Blanka, C. (2018). An individual-level perspective on intrapreneurship: a review and ways forward. *Review of Managerial Science*, 13(5), 919–961.
- Bracken, D. W., Timmreck, C. W., & Church, A. H. (2001). *The Handbook of Multisource Feedback*. John Wiley & Sons.

- Brigham, E. F., & Ehrhardt, M. C. (2013). *Financial Management: Theory & Practice*. South-Western Cengage Learning.
- Bruno, G. (2020). Identification of Potential Clients, Providers, and Competitors in Supply Chain Networks. In *Supply Chain and Logistics Management: Concepts, Methodologies, Tools, and Applications* (pp. 1228–1245). IGI Global.
<https://doi.org/10.4018/978-1-7998-0945-6.ch058>
- Chen, P.-C., Chan, W.-C., Hung, S.-W., & Lin, D.-Z. (2020). How entrepreneurs recognise entrepreneurial opportunity and its gaps: A cognitive theory perspective. *Technology Analysis & Strategic Management*, 32(2), 223–238.
<https://doi.org/10.1080/09537325.2019.1648790>
- Chesbrough, H. (2007). Business model innovation: it's not just about technology anymore. *Strategy & Leadership*, 35(6), 12-17.
- Cooper, R. G., Edgett, S. J., & Kleinschmidt, E. J. (2001). Portfolio management for new product development: Results of an industry practices study. *R&D Management*, 31(4), 361-380.
- CourthouseDirect. (2018). The History of Land Surveying.
<https://info.courthousedirect.com/blog/history-of-land-surveying>
- Cramer, M. (2018). The Future of Geospatial Data. *Journal of Spatial Science*, 63(2), 211-223.
- Dale, P. F., & McLaughlin, J. D. (1988). *Land Information Management*. Clarendon Press.
- Deane, M. T. (2022). Top 6 Reasons New Businesses Fail. Investopedia.
<https://www.investopedia.com/financial-edge/1010/top-6-reasons-new-businesses-fail.aspx>
- Droga, D., & Shah, B. (2022, September 27). Keeping Up with Customers' Increasingly Dynamic Needs. Harvard Business Review. <https://hbr.org/2022/09/keeping-up-with-customers-increasingly-dynamic-needs>
- Gilmore, A. (2010). Reflections on methodologies for research at the marketing/entrepreneurship interface. *Journal of Research in Marketing and Entrepreneurship*, 12(1), 11–20. <https://doi.org/10.1108/14715201011060876>
- Grasso, J., & Kort, M. G. (2015). *Modernization and Revolution in China*. M.E. Sharpe.

- Hopkin, P. (2017). *Fundamentals of Risk Management: Understanding, Evaluating and Implementing Effective Risk Management*. Kogan Page.
- Isles, A. R., Winstanley, C. A., & Humby, T. (2018). Risk taking and impulsive behaviour: Fundamental discoveries, theoretical perspectives and clinical implications. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 374(1766), 20180128. <https://doi.org/10.1098/rstb.2018.0128>
- Kock, A., & Gemünden, H. G. (2021). How entrepreneurial orientation can leverage innovation project portfolio management. *R&D Management*, 51(1), 40–56. <https://doi.org/10.1111/radm.12423>
- Kotler, P., & Keller, K. L. (2016). *Marketing Management*. Pearson Education.
- Kubičková, L., & Chudá, B. (2021). Key success factors of engineering company (Case of Czech engineering industry). *Journal for East European Management Studies*, 26(1), 73–99. <https://doi.org/10.5771/0949-6181-2021-1-73>
- Lines, B. C., & Kumar, G. G. R. (2018). Developing More Competitive Proposals: Relationship between Contractor Qualifications-Based Proposal Content and Owner Evaluation Scores. *Journal of Construction Engineering and Management*, 144(5), 04018030. [https://doi.org/10.1061/\(ASCE\)CO.1943-7862.0001479](https://doi.org/10.1061/(ASCE)CO.1943-7862.0001479)
- Mangini, M., & Pelli, F. (2003). eBusiness scheme for engineering consulting services. *J. Inf. Technol. Constr.*, 8, 309–318.
- Morris, M. H., et al. (2011). *Entrepreneurial Strategies*. Wiley.
- Moustaghfir, K., El Fatihi, S., & Benouarrek, M. (2020). Human resource management practices, entrepreneurial orientation and firm performance: What is the link? *Measuring Business Excellence*, 24(2), 267–283. <https://doi.org/10.1108/MBE-12-2019-0119>
- Müller, S., Kirst, A. L., Bergmann, H., & Bird, B. (2023). Entrepreneurs' actions and venture success: A structured literature review and suggestions for future research. *Small Business Economics*, 60(1), 199–226. <https://doi.org/10.1007/s11187-022-00644-3>
- Neumann, T. (2021). The impact of entrepreneurship on economic, social and environmental welfare and its determinants: A systematic review. *Management Review Quarterly*, 71(3), 553–584. <https://doi.org/10.1007/s11301-020-00193-7>

- Porter, M. E. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*. Free Press.
- Reinholtz, N., Fernbach, P. M., & de Langhe, B. (2021). Do People Understand the Benefit of Diversification? *Management Science*, 67(12), 7322–7343.
<https://doi.org/10.1287/mnsc.2020.3893>
- Remondino, F., et al. (2011). UAV for 3D Mapping Applications: A Review. *Applied Geomatics*, 3(1), 6-35.
- Richards, F. (2005). Managing the Client-Vendor Partnership. In J. M. Walker, E. J. Bieber, & F. Richards (Eds.), *Implementing an Electronic Health Record System* (pp. 101–107). Springer. https://doi.org/10.1007/1-84628-115-6_13
- Rosado-Cubero, A., Freire-Rubio, T., & Hernández, A. (2022). Entrepreneurship: What matters most. *Journal of Business Research*, 144, 250–263.
<https://doi.org/10.1016/j.jbusres.2022.01.087>
- Sahare, S., & Thampi, G. (2010). Blended Learning: Current Trends and Issues. 3970–3977.
<https://www.learntechlib.org/primary/p/34484/>
- Sahlman, W. A. (2008). *How to Write a Great Business Plan*. Harvard Business Press.
- Schofield, W., & Breach, M. (2007). *Engineering Surveying: Theory and Examination Problems for Students*. Elsevier.
- Yadav, A., & Bansal, S. (2020). Viewing marketing through entrepreneurial mindset: A systematic review. *International Journal of Emerging Markets*, 16(2), 133–153.
<https://doi.org/10.1108/IJOEM-03-2019-0163>
- Yang, D., Wei, Z., Shi, H., & Zhao, J. (2020). Market orientation, strategic flexibility and business model innovation. *Journal of Business & Industrial Marketing*, 35(4), 771–784. <https://doi.org/10.1108/JBIM-12-2018-0372>
- Yang, Y., & Ju, X. F. (2018). Entrepreneurial Orientation and Firm Performance: Is Product Quality a Missing Link? *Entrepreneurship Research Journal*, 8(1).
<https://doi.org/10.1515/erj-2017-0091>
- Yescombe, E. R. (2007). *Public-Private Partnerships: Principles of Policy and Finance*. Butterworth-Heinemann.

Zamora, J. (2017). Programming business models through digital density. *IESE Insight*, 33, 23–30. <https://doi.org/10.15581/002.ART-3013>

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Currently fronting and leading Multigeomatics in Geomatic Engineering Business. I have been working assiduously and extensively as a Consulting Surveying Engineer within the past 20 years to date in the Mining and Non-Mining Infrastructure development sectors mainly in the UK, Ghana, South Africa, Sierra Leone, Democratic Republic of Congo and Liberia. Highly involved in the Execution Phase in building diverse world class mineral processing plants with DRA Mineral Projects and DRA Mining in and out of South Africa under the umbrellas of FT Prinsloo Mining and Engineering Surveyors and Multigeomatics. My Exposure in the United Kingdom on Site Infrastructure Projects with Enka Site Engineering Services is worth mentioning, including Surveying Engineering duties on large projects in Ghana such as the New American Embassy in Accra under the immense supervision of the Overseas Building Operations US Department of State, Accra Mall Retail development and a host of others. Currently holds a Masters of Science Degree in Construction Project Management from Heriot-Watt University. Delivering excellence in Modern Surveying Engineering practice will and continually be my passion coupled with Construction Project Management leadership.

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