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Alternative business models to aid adoption pathways in forest sector contracting

BIOPRODUCTS BUSINESS

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Abstract: The forest sector is undergoing rapid transformation driven by mechanization, automation, and outsourcing, placing financial pressure on contractors who bear the cost of adopting advanced technologies. While the entire forest industry and society at large benefit from improved productivity and safety, contractors face high capital investment and limited support, exacerbated by short-term contracts and low-margin export markets. This conceptual paper explores alternative business models that can rebalance financial risk and reward across the forestry value chain. Drawing on literature review, stakeholder surveys, and exploratory industry workshops, the study identifies via stakeholder engagement three promising alternative business models, outlining how they could be applied to forestry businesses and infrastructure projects: machinery rental schemes, sharelogging (adapted from dairy sharemilking), and alliance partnership bonds. The findings highlight a paradox: contractors are both the primary agents of technological adoption and the most financially vulnerable actors in the value chain. By aligning incentives and enabling more collaborative contracting arrangements, these models present viable solutions for a more resilient and equitable forest sector. We highlight the need for structural reform, improved coordination, and innovative financial instruments to support contractor viability and sector-wide innovation.

Keywords: Business modeling, market forecasting, strategic management, strategic planning, competitive positioning, target market segmentation, clustering, clusterization.

1. Introduction

The forest sector has undergone significant structural transformation over the past five decades, marked by pressure to reduce environmental impacts of operations, the rise of specialized service providers, and the outsourcing of key forestry activities (Štěrbová and Kovalčík 2020; Hansen 2016). The impact of globalization such as reliance on few markets and reduced profit margins forces forest owners and entrepreneurs to seek new forms of competitive advantage (Pek et al. 2017; Kajanus et al. 2019), including through revised models of business operation.

A defining characteristic of many forest management business models is the increasing reliance on outsourcing of operational activities, with timber investment management organizations (TiMOs) opting not to conduct these functions in-house (Štěrbová and Kovalčík 2020), but to engage with forestry contracting services (Benjaminsson et al. 2019). In many areas of the world, including Scandinavia (Eriksson et al. 2015), Brazil (May et al. 2003), Bulgaria and Slovakia (Moskalik et al. 2017), and Australia and New Zealand, most of the silvicultural tending, pest management and harvesting operations are now undertaken through forestry contracting firms. This shift has reduced the level of TiMOs' capital tied up in machinery, lowered liabilities, and provided greater business flexibility to forest owners and managers

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through short-term contracting. However, it has also transferred the responsibility for innovation—particularly in machinery upgrades—onto contractors. Larger-scale harvesting machines are considered essential to achieving the high production rates demanded by forest managers (Ackerman et al. 2022). However, for contractors to remain competitive and secure work, they must take on substantial debt to finance these capital-intensive assets. As a result, contractors now face the dual challenge of financing high-cost equipment and investing in training, upskilling, and system improvements, often without adequate sectoral support.

Moreover, the forestry sector is undergoing a rapid transformation driven by mechanization and automation, with further significant implications for contractors who bear the financial burden of adopting advanced harvesting technologies (Holzinger et al. 2024; Owake and Sato 2020). Systems have moved away from manual falling with mechanized tractor-based extraction systems towards larger dedicated processing units (e.g., feller-bunchers, skidding loaders), as piece sizes have increased, and the load capacity of trucking and haulage units have expanded (Ramantswana et al. 2020). While newer harvesting and forestry technology innovations promise gains in productivity, safety, and operational efficiency (Spinelli et al. 2014), the capital-intensive nature of modern equipment places contractors under increasing financial strain—often without proportional returns (Zenir et al. 2024). Most of the investment (and financial risk) in taking on new equipment is carried by forestry contractors, while many of the benefits accrue to the forest industry and society at large. Examples of benefits include both production rate efficiencies, but also improved health and safety of the forestry contracting workforce and improved logistic efficiencies and quality improvements that benefit downstream activities of the value chain (Palander 2022; Ramantswana et al. 2020; Best and Visser 2024; Brown et al. 2020).

High upfront costs, combined with the sunk investment in existing machinery that may still have operational life, create significant barriers to adopting newer, more efficient harvesting systems and forestry technologies. Contractor reluctance to adopt is not merely financial—it reflects a rational hesitation to abandon functioning equipment in favor of uncertain returns, especially in an environment where contract terms are short and margins are tight (McConnell 2021; McEwan et al. 2020). Short-term contracting models, limited downtime support (i.e., allowing for certain periods of system or service unavailability without incurring penalties or breaches of contract), and low-margin export markets exacerbate this pressure, threatening the long-term viability of contractor businesses (FICA 2023; Benjaminsson et al. 2019). Recent industry surveys highlight a growing disconnect between risk and reward, underscoring the urgent need to re-evaluate business models and risk-sharing mechanisms between forest owners, management entities, and contractors. Finnish harvesting contractors have reported losing 20%–25% losses each year (Penttinen et al. 2011); in Sweden, median profit margins were 2% for harvesting contractors (Kronholm 2020). In 2023, just 26% of New Zealand forestry contractors felt they could survive in business at an 80% production rate for a year, feeling locked into an "unsustainable model" (FICA 2023). The prevalence of short-term contracts has created a boom-and-bust dynamic across the New Zealand forestry sector, compounded by low margins driven by New Zealand's dominant log export model (Forest Enterprises 2023). The forest investment landscape, shaped by international investors seeking flexibility and minimal long-term liability, further limits the stability of contractor partnerships. While forest management entities depend heavily on contractors to deliver operational outcomes, regional disparities in contractor availability mean that collaboration is essential to sustaining forestry operations.

Firm-level competition has given way to supply-chain level competition in that companies no longer compete solely as individual entities, but as members of interconnected supply chains. A firm's ability to compete in the market becomes dependent on the overall effectiveness, agility, and performance of the entire network of partners it belongs to, rather than just its own internal capabilities, requiring greater coordination between partners and more selection in terms of which supply chain(s) the firm is a part of (Li et al. 2006; Ronchi et al. 2007). Such dependence limits contractors' freedom to provide services to different supply chains. This complex environment underscores the need to build trust in the industry by more resilient and equitable business models

that support contractor viability and sector-wide innovation as a source of competitive advantage (Benjaminsson et al. 2019). There is an identified need to balance the risks and benefits between TiMOs and contractors given large, automated machinery purchases and to identify how benefits accrue back to the contractor and the TiMO differently under an automated harvesting environment. Innovative financial models, improved access to credit, and negotiated outcome-based contracts are increasingly necessary to enable contractors to adapt and thrive. This paper explores the economic and structural challenges posed by automation in forestry operations and proposes alternative conceptual business model pathways from a New Zealand forestry context to ensure a more equitable and sustainable financial future for forestry contractors.

2. Theoretical background

2.1 Business models

Business models have gained prominence in the forestry literature since the early 2000s (Benjaminsson et al. 2019) as a way to explain how enterprises innovate to deliver value to customers. Zott et al. (2011) state business models are the means to bring technologies to market. Their main mission is to solve structural problems inhibiting value delivery, through a new form of business arrangement (Osterwalder et al. 2010). A business model is therefore a conceptual tool containing strategic elements and describing how their interaction enables co-creation of value in supply chain partnerships by generating profitable and sustainable revenue streams from one or several segments of customers, while retaining and improving the value of a single firm in the arrangement (Osterwalder et al. 2005; Rusanen et al. 2024).

Richardson (2008) states there are three functions of a business model: value proposition, value generation, and value capture. The value proposition can include not only economic but also social and environmental benefit. Reim et al. (2017) found that forest-based business strategies strongly emphasize the value proposition, but often fail to fully optimize value generation and capture.

New technology itself can be a driver towards a new form of business model (IEA DSM 2014). For example, the rise of ICT, FinTech, and servitization (selling services in conjunction with products) has led to new business models such as the product-service system (PSS) (Bröring and Vanacker 2022). Such shifts demand new capabilities in data analytics, remote monitoring, and performance-based contracting, fundamentally altering how businesses deliver and capture value. In the forest-based bioeconomy, servitization is driving systemic change across supply networks. Pelli and Lähtinen (2020) show that servitization operates at multiple levels—from individual firms to socio-technical systems—requiring business models to adapt to evolving customer demands and sustainability goals. These changes necessitate non-technological innovations, such as new forms of collaboration, value co-creation, and gradual reconfiguration of supply networks to support bioeconomy transitions.

Digitization and servitization are reshaping business models by shifting value creation from product-centric to service-oriented strategies, requiring companies to rethink their core operations to combine physical goods with digital services (Baines et al. 2024; Kans and Campos 2025). While conventional forestry management has established contractor-based technology adoption and innovation as suppliers to be the norm, there are many ways that newer technologies can be acquired and employed in a forest setting through alternative coordination and cooperation models. Ronchi et al. (2007) identified three different motives for cooperation through the supply chain, where risks and benefits could be shared: *project-based cooperation* to establish a specific outcome; *logistics-based cooperation* to enhance supply chain efficiency; and *technological-based cooperation* (gaining firms access to new technological advances). New business models allow for technical coordination in order to acquire tools and competencies needed to improve product quality or in the development of new products. These new business model structures are formed through a choice of partners who can bring about such tools and competencies lacking in the current business model. Smaller actors frequently face restricted access to finance, insurance, and other support mechanisms (Ncube 2020; Nambiar 2021), so improved cooperative partnerships could benefit technology access.

While there is broad consensus on the need for new business models to address structural issues

in forestry business arrangements (Štěrbová and Kovalčík 2020; Rusanen et al. 2024 ; Macqueen et al. 2015; Kajanus et al. 2019), and broad application of private public partnership models to share risks and benefits (Mazher 2025), the types of organizational and business model innovations suitable for risk-sharing arrangements in forestry contexts remain underexplored (Azar and Ciabuschi 2017; Kajanus et al. 2019; Benjaminsson et al. 2019). This gap underscores the importance of further empirical research into cooperative structures, digital platforms, and inclusive governance mechanisms that can support sustainable and equitable forest sector transformation.

2.2 The business model canvas

Osterwalder (2008) introduced the business model canvas (BMC) as a framework for understanding the building blocks of a business model and as means to evaluate and design new models. The BMC comprises nine components: the *Value proposition,* as the central tenet of the model arrangement, that outlines the bundle of benefits accruing from enacting the business model. Major internal inputs on the left side of the canvas include the *Key partners* in the arrangement, *Key resources* (usually a list of combined assets and capacities of the partnership), and the *Key activities* the business undertakes to generate value. *External customer segments*, *Customer relationships,* and *Channels* of delivery are shown on the right side of the canvas, outlining how value is captured in the market. Underlying financial components include business *Cost structures* and modes of *Revenue generation* (Figure 1).

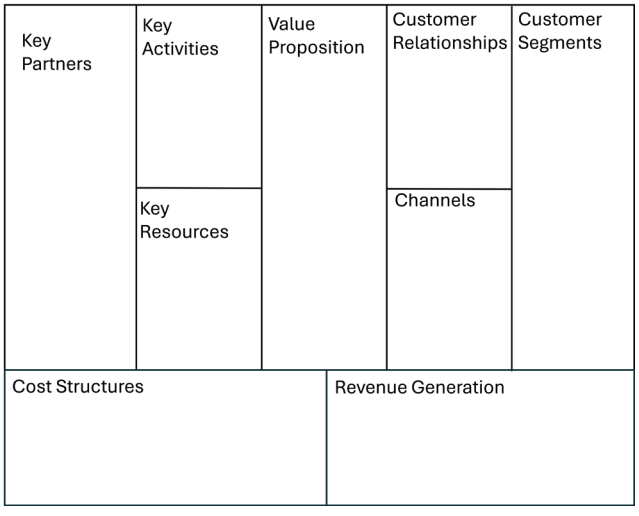

Figure 1. The business model canvas framework as outlined by Osterwalder (2008).

Since its inception and further development (Osterwalder et al. 2010), BMC use has been widespread and successfully applied to design and analyze a range of forestry-related enterprises (Hintz et al. 2022). For example, Benjaminsson et al. (2019) provide a specific BMC framework for the current forestry contractor model, including questions to consider within seven key components.

2.3 Forest sector innovation

Persistent structural and institutional barriers globally within forest innovation systems that inhibit forest sector innovation and adoption have been identified as follows: fragmented actor networks and infrastructural deficiencies (Kilcline et al. 2021); lack of capacity building (Hintz et al. 2022); and limited sources of capital investment (Hintz et al. 2022; Pek et al. 2017). Long breeding cycles of tree stock and high initial investment costs, coupled with the uncertainty as to regulatory conditions when trees mature, also lead to weak vertical integration throughout the chain (Hintz and Pretzsch 2023, Fugeray-Scarbel et al. 2023). These barriers are compounded by cultural legacies and a lack of forest management tradition among new entrants, particularly non-industrial private forest owners, and distant foreign owners (Kajanus et al. 2019) who remain disconnected from established knowledge networks. Rigid institutional structures also inhibit co-innovation (Hintz and Pretzsch 2023; Kilcline et al. 2021), leading to strong path dependence on the dominant regime (Rusanen et al. 2024; Pelli and Lähtinen 2020; Fugeray-Scarbel et al. 2023). Sector fragmentation—where breeding, silviculture, harvesting, processing, and merchandising are often handled by separate entities—has led to diminished trust and power imbalances within the sector (Hongyan et al. 2023), with a lack of dynamic middle-sized firms (Mattila and Roos 2014). These structural and institutional constraints create an unfavorable environment for implementing risk-sharing arrangements across the forest value chain.

Calls for more democratic and locally controlled forest management have emerged in response to these challenges. Macqueen et al. (2015) argue for

the "democratization" of forest business, advocating for increased local decision-making, investment opportunities, and innovation. However, such shifts remain difficult under prevailing legal and cultural frameworks in temperate regions of the Global North. While cooperative models have gained traction in tropical forestry contexts (Hintz et al. 2022), examples from Western temperate environments remain limited. Despite these constraints, certain structural approaches—such as polycentric governance (Grimley and Chan 2023), vertical co-ordination, intermediary roles, and new governance structures—have shown promise in facilitating innovation and risk distribution.

2.4 Business model innovation as a way to bring change to the sector

Azar and Ciabuschi (2017) demonstrate that organizational innovations, particularly those enhancing interaction and knowledge sharing among supply chain partners, can improve export performance. Vertical integration and coordination have been shown to support innovation adoption in forest sectors (Fugeray-Scarbel et al. 2023), while self-assembled farmer knowledge networks offer a bottom-up mechanism for innovation diffusion (Sutherland et al. 2023). With very few exceptions, only larger companies have the capacity to take on the risk in developing new technology through internal financing, not only for capital investment, but in human resourcing of staff to work on a project without revenue stream from the initiative (Benjaminsson et al. 2019; Hatvani et al. 2022). Smaller firms are therefore quite reliant on larger firm support to bring innovations to fruition (Hatvani et al. 2022). Eriksson et al. (2017) found power of negotiation to be a critical requirement for effective collaborative partnerships, where negative opportunistic behaviors and low risk-taking reduce business model optimization. The bargaining power of dominant chain members tends to dictate contractual agreements. The conventional bargaining power in industries is controlled by those with high levels of capital investment (Macqueen et al. 2015). Ronchi et al. (2007) note that large actors can impose contracts on supply chain partners, but supply chain success is dependent on more even bargaining power and high trust.

Previous work by Bayne (2024) outlines two broad categories of business models that are assisting the primary sectors and might enable forestry business in better risk-sharing arrangements. The first is supply chain finance, which is described as "the use of financing and risk mitigation practices and techniques to optimize the management of the working capital and liquidity invested in supply chain processes and transactions" (ICC Banking Commission 2016[1]). Supply chain financing can assist in improving the credit worth of a smaller chain player and increase access to financial arrangements by partnering with or underwriting the costs through larger chain suppliers. Supply chain finance mechanisms like reverse factoring and agricultural value chain finance (AVCF) aim to improve liquidity and access to credit.

The second category looks instead towards more risk-sharing business models that improve in-chain cooperation, pooling assets and partner networks for delivering an improved value experience, and lowering risks to individual supply chain partners. Bayne (2024) highlights the imbalance in current buyer-driven models and shows how arrangements such as joint ventures, land leases, outgrower schemes, and performance-based contracts are being used to share risk more effectively.

Some risk-sharing business arrangements have been trialed to good success in forestry, such as public-private partnership models and joint ventures (Jamnadass et al. 2014, Nambiar 2021, Weiss et al. 2021), vertical integration (Fugeray-Scarbel et al. 2023), contract farming (Dinh et al. 2024; Ncube 2020), and industry clusters (Aguilar et al. 2009). Other risk-sharing arrangements that are documented specifically for forestry include cooperatives such as farm forest organizations in tropical regions (Hintz and Pretzsch 2023), community-owned log sort yards (Eskandari 2022), small-scale forestry groups (Pek et al. 2017), and hybrid coordination in wood harvesting and transportation (Palander 2022). Kajanus et al. (2019) outline five European cases where novel business models were applied, including collaborative ventures of joint forest owners, high-value wood auctions, and joint forest stock company. Ronchi et al. (2007) noted that often more collaborative ar-

1 ICC-International Chamber of Commerce website, "Cross-industry initiative establishes Standard Definitions for Techniques of Supply Chain Finance" (9 March 2016), https://iccwbo.org/news-publications/news/cross-industry-initiative-establishes-standard-definitions-for-techniques-of-supply-chain-finance/.

rangements require the initiation by larger dominant members in a supply chain, which must see a benefit in providing greater power to smaller players in the chain in order to start such initiatives. An unfortunate side effect of the normal institutions in contracting arrangements means that if no party is dominant in a business partnership, there can be difficulties in initiating and forming a strong collaborative partnership (Ronchi et al. 2007).

Business model innovations that focus on risk-sharing aim to create fairer partnerships by developing structures that allow for the sharing of both risks and rewards among collaborators, often incorporating factors like flexibility in supply chain arrangements, allowance for downtime in contractor operations for training and maintenance, and varying levels of financial risk distribution, as seen in the context of oil and gas operations. Rewards can be financial, but can also raise partner wellbeing, status, equity in decisions, and health and safety through improved working conditions, or training capacity (IEA DSM 2014). The principles can also be applied to other fields, such as ensuring equitable benefit-sharing from bioprospecting and resource management, which involves developing fair and transparent governance frameworks.

3. Methodology

To explore feasible alternative business models for the New Zealand forestry sector, a mixed-method research approach comprising literature review, survey research, and stakeholder workshops was undertaken.

A comprehensive review of academic and industry literature identified existing and emerging business models relevant to forestry and other primary sectors that might be applied to forestry business (see Bayne 2024). In conjunction, an online survey was conducted with both forest management firms and forest contractors in New Zealand to evaluate the largest barriers to obtaining finance and to sharing the risk from technology adoption through the value chain. The survey instrument for contractors was developed in collaboration with the Forest Industry Contractors Association (FICA), whose membership represents 60% of the New Zealand forest-based contractors. This consisted of 11 questions (Appendix 1) covering barriers and enablers to adoption, and perceptions of risk-sharing and influence of supply chain partners in adoption decisions.

The survey was undertaken during January 2024 and targeted harvesting and silvicultural contracting businesses operating within New Zealand, with contractor recruitment via FICA's 240-member database and with a personalized message from the FICA president (Appendix 2). In addition, forest managers were targeted for recruitment via an internal Scion contact database of management company representatives. The dual-stakeholder survey approach enabled comparative analysis between contractors and broader industry perspectives from the 30 survey responses received.

The literature review and survey results informed the development of alternative business model concepts. To assess the viability of alternative business models, two industry workshops were held at separate city locations within New Zealand during June 2024. These workshops presented the survey findings and introduced 13 alternative business models (Table 1). The workshops targeted contractors, forest managers, and business partners with recruitment via a flyer (Appendix 3) sent to industry personnel via the Forest Growers Research (FGR) contact database. In total, 43 participants attended the workshops. Participants included forest managers, harvesting managers, contractors, financial partners, and other forest sector representatives. At each workshop, the day began with a presentation of the survey results, followed by a short presentation from a harvesting contractor discussing the state of technology uptake in their firm and the present business environment. Given the low response rate to the survey, it was important to ensure that the survey results correctly represented the current situational assessment from the industry, and to note any concerns. Participants at the workshops felt the results were a fair reflection, but may be more representative of those in a better financial position to adopt technology in the future. The researchers then outlined each of the 13 models in turn, providing an example case of the type of industry and firm in which the business model is being applied, and also the risk-sharing benefits that had been enabled through the application of the business model. Participants were then placed into smaller groups and asked to consider 3 (randomly selected) of the 13 business models and discuss the

viability of each business model in turn within the New Zealand forestry context; which models they saw had the greatest potential for adoption by firms in the New Zealand forestry sector; and how applying each business model could support the adoption of emerging silvicultural and harvesting technologies. To facilitate discussion, a set of A3 laminated sheets were used at each table, which provided an overview of the alternate business models under discussion. The groups were firstly asked to discuss the suitability of each alternate business model for forest-based business in New Zealand, and then in a second session, to discuss how the business model might work under current business institutions, and which institutions would need to change to accommodate implementation of the model effectively. A final small-group session provided participants with a technology under development within the suite of the FGR research programmes, and respondents were asked how the applications of an alternate business model might be used to enable and smooth adoption of the technology.

Feedback from these sessions was used to refine the adaptation of business models in New Zealand and assess their practical viability in the current business environment.

4. Results

Although many respondents to our contractors' survey acknowledged the limitations of the current business model in New Zealand's forestry sector, many expressed the lack of clarity around who might lead efforts to restructure the industry. This suggests a gap not in awareness or capability, but in leadership and coordination. Contractors generally demonstrated strong business acumen and negotiating confidence, supported by access to standardized contract terms through FICA. Most were satisfied with their contractual arrangements, aside from concerns about contract length.

A significant concern raised by contractors was the limited leverage they have in negotiating daily rates, which are widely viewed as an inadequate basis for contracting. Over 85% of surveyed contractors

Table 1. Alternative business models for consideration in forestry business.

Sharemilking	A shared equity and cost model between land-owner and operator that is common in the NZ dairy sector.
Land lease	Allowance for uneven rental payments that account for adverse events, or offset improvements to land/ infrastructure
Outgrower services	Provision of skills, materials and technology to a landowner to derisk diversified operations.
Vertical coordination	A vertically integrated value chain cooperative, owned collectively by the chain members, which occurs in the US cotton gin industries.
Joint venture	Where separate entities are created from individual assets of parent firms, and a new company formed between parties for a certain timeframe, to achieve an objective.
Farm producer cooperatives	Producers band together under a collective model to supply the bulk market. In most cases profits are shared. Common in dairying sector, although Fonterra had to change to a Fair Price Share model in 2001 to avoid single-desk/monopoly status.
Collaborative tendering	Where contractors band together to tender or fill contracts. Can lead to subtrade specialization (as in construction).
Contractor pools	Similar to a relieving teacher pool, or a tradesman pool, a head contracting firm can hold a long-term contract, but sublet work to available contractors through a pool system, guaranteeing work only for very short-term contracts.
Supply chain financing platform	An IT platform where an intermediary supply chain financing platform is used to forward payments and utilize buyers credit ratings.
Machinery rentals	Although rentals are commonly employed, the Stora Enso "Harvesting Partner" scheme in league with bank SEB could potentially be employed in New Zealand for harvesting machinery lease.
Social and environmental bond schemes	Mechanism to monetize the ecosystem service and other forestry outcomes of new technologies, using public investment.
Performance based contracts	Using a similar model to Europe, the base contract is higher rate than standard, with guaranteed payment for 80% of the rate, and a 20% payment based on safety and environmental performance outcomes.
Alliance partnerships	A relationship-style arrangement that brings together the client and one or more parties to work together within a special venture agreement to deliver the project, sharing project risks and rewards with a no-blame policy

reported having moderate, little, or no leverage in price negotiations, and only 30% considered daily rates to be a suitable mechanism for determining contract terms. This reflects a broader perception of systemic power imbalances, rather than interpersonal or relational issues, as relationships with forest companies were generally rated positively.

Contractors also highlighted the financial risks associated with machinery investment. Nearly 85% reported purchasing or replacing machinery every five years or less, with motivations centered on improving crew health and safety and enhancing operational efficiency. Despite widespread mechanization in post-harvest operations, contractors typically bear the full financial risk of equipment upgrades. One illustrative example involved the purchase of a $CAD 1.5 million mulching machine, with no risk-sharing from the forest owner, despite a strong business relationship. This scenario was not seen as exceptional but rather as indicative of standard industry practice.

While contractors are generally confident in securing finance for technology upgrades—more than three-quarters indicated they could apply for financing—the lack of long-term contracts poses a significant barrier. Without contract longevity and support in downtime periods, contractors face increased financial vulnerability, particularly during market downturns or other production constraints, when equipment may be idle or underutilized, but loan obligations persist. This underscores the importance of contract duration as a critical factor in enabling innovation and investment. The Australian government has an instant asset write-off scheme [2] for small businesses where a 100% depreciation is provided on any innovation (no tax on machines until the viability is proven). This assists contractors when upgrading or adding smaller improvements to existing machinery.

From the analysis and stakeholder engagement in our industry workshops, three core business models emerged as having strong potential for further exploration within New Zealand's silvicultural and harvesting operations. These models—machinery rental schemes, sharelogging (adapted from the dairy sector's sharemilking model), and the Social and Environmental Bond Model—were consistently rated highly by participants across both industry workshops. In addition to these, two further models were proposed during the workshops: the Alliance contracting approach (used in major construction and infrastructure programs within New Zealand, mainly for government procurement programs) and the European Contracting Model (a version of performance-based contract which has been used by one forestry company in New Zealand for many years), both of which also received strong support.

Taking the models which the sector felt showed the greatest potential at the workshop, we outline how such schemes might operate in a New Zealand forest-based business context.

4.1 Machinery rental models

Machinery rental schemes were seen as a promising avenue for reducing capital burden and improving operational flexibility for forest contractors. Renting specialized equipment—particularly for short-term or seasonal tasks—was seen as a practical solution to reduce the time when machines are parked and not used, and to avoid the accumulation of redundant machinery at the end of contracts. Full-contract equipment rental also enables contractors to upgrade more frequently and access machinery without the need for substantial upfront capital or equity. Additional benefits include supplier-led maintenance and technical support under service agreements.

Despite these advantages, the prevailing culture in New Zealand forestry favors contractor ownership of machinery. While isolated lease arrangements exist, widespread adoption remains limited.

Stora Enso introduced its "Harvesting Partner" concept in late 2022[3] to attract skilled operators and new entrepreneurs to the forest industry. Initially launched in Sweden, the program has since expanded to Finland, Norway, and Lithuania. It offers four-year contracts that include machinery financing, business services, training, and integration into Stora Enso's

2 Australian Government, Australian Taxation Office, "Instant asset write-off for eligible businesses" (9 December 2025). https://www.ato.gov.au/businesses-and-organisations/income-deductions-and-concessions/depreciation-and-capital-expenses-and-allowances/simpler-depreciation-for-small-business/instant-asset-write-off

3 Stora Enso, "Stora Enso and SEB offer a new financing model to attract new entrepreneurs to the forest industry" (6 March 2024). https://www.storaenso.com/en/newsroom/news/2024/3/stora-enso-and-seb-offer-a-new-financing-model-to-attract-new-entrepreneurs-to-the-forest-industry

operational networks. In partnership with SEB bank, a tailored financing model allows entrepreneurs to rent machinery with fixed monthly payments, returning the equipment after the contract period for reuse or training purposes. Unlike the Swedish model, where forest companies actively rent machinery to contractors, such practices are rare in New Zealand. Historical examples involved forest companies —such as the New Zealand Forest Service and JNL Gisborne—owning and leasing equipment to contractors. However, these arrangements were discontinued due to issues with machinery care and maintenance, underscoring the importance of contractors retaining some equity or stake in leased equipment.

Workshop participants identified two viable pathways for implementing machinery rental models in New Zealand:

1. ***Forest company-leased equipment***
   In this model, forest companies would finance and retain partial ownership of machinery, leasing it to contractors under low-equity, high-access arrangements. This approach mirrors the Harvesting Partner model used by Stora Enso and SEB. It is best suited to long-term partnerships, potentially involving exclusive contractor relationships. Rental rates would be determined by production volumes and contract duration, offering support in regions facing productivity constraints due to regulatory changes.
2. ***Super contractor-leased equipment***
   Alternatively, a large contractor—acting as a "super contractor"—could partner with machinery suppliers and financial entities to acquire equipment and lease it to smaller contractor firms. The super contractor would hold partial equity (typically 20%–80%) while the supplier retains the remainder. This model enables smaller contractors to access specialized or high-cost equipment for short-term use, facilitating skill development and operational scaling. It also benefits machinery suppliers by reducing the risk of direct-leasing to small contractors who have limited credit worth, and expanding market reach through coordinated regional deployment.

These models offer scalable solutions to address financial and operational barriers faced by contractors, particularly those entering the forest industry or operating in dispersed woodlots. They also present opportunities for more collaborative and flexible equipment management across the forestry supply chain.

Figure 2 outlines machinery rental schemes as a business model canvas.

4.2 Sharelogging

The sharelogger model presents a novel approach to contracting in the forestry sector, drawing inspiration from the dairy industry's sharemilking structure. Sharemilking has been used in New Zealand since the late 1880s and is now the nationally dominant form of business model in the sector. A sharemilker operates a farm on behalf of the owner in exchange for a share of the income. There are two main types: herd-owning (50/50 sharemilking), where the sharemilker provides the herd and pays many costs in exchange for 50% of the profits, and variable order sharemilking (VOSM), where the sharemilker is paid a percentage of the milk income without owning the herd. Applied to forestry, it enables contractors to build equity and progress their careers by purchasing shares in a crew business, with the potential to transition into head contractor roles. The model also enhances the bankability of capital investments by leveraging forest company credentials, thereby improving access to finance.

While the model shifts greater contractual control to contractors, it provides both parties with improved transparency around operational costs, pricing, and margins, fostering long-term trust between partners. However, its success depends heavily on selecting the right partners and maintaining durable relationships—an aspect that may be challenged by the multinational ownership structures common within New Zealand forestry. Recognizing forest assets such as standing timber, infrastructure, and existing equipment as equity contributions from forest companies is essential to balance investment inputs, and show a fairer outline of shared contributions to the overall forestry scheme. Figure 3 shows the inputs and decisions relating to individual partners, as well as shared decisions and negotiations required in the business arrangement for sharelogger success.

Business Model Canvas – Machinery Rental Scheme

Key Partners

Forest management companies
- May underwrite or co-own machinery

Contractors
- Rent and operate machinery
- May be key supplier franchisee, as head contracting agency

Financial Institutions
- Facilitate leasing and rent-to-own agreements

Machinery Suppliers
- Provide and maintain equipment

Supplier contractors
- Act as intermediaries, leasing machinery to smaller firms

Key Activities
- Equipment leasing and scheduling
- Maintenance and technical support
- Contract negotiation and management
- Upskilling and training on new machinery
- Less sunk costs in machinery-easier to upgrade
- Co-ordination in harvest machine configurations needed between contractors and forest management companies.

Key Resources
- Machinery and equipment inventory
- Rental contracts and leasing platforms
- Technical support, maintenance teams
- Contractor networks

Value Proposition

Contractors
- Reduced capital burden
- Access to high tech equipment
- Flexibility in operations
- Can implement short-term operations without large capital outlay

Companies
- Improved productivity and safety
- Reliable long-term contracting system
- More nuanced operations through complex harvest machinery configurations

Machinery Suppliers
- Higher equipment utilisation
- Broader market reach
- Newer stock to service

Customer Relationships
- Long term rental agreements
- Performance-based incentives
- Maintenance and support partnerships
- Upskilling of crews into wider range of equipment
- Franchisee partners

Supplier contractors
- New revenue stream
- Regional co-ordination role

Customer segments
- Small-mid size contractors
- Forest companies seeking reliable operators
- Machinery suppliers seeking broader distribution
- Financial institutions offering equipment finance

Channels
- Direct leasing from forest companies or super contractor
- Equipment rental platform
- Industry associations for model promotion
- Training institutes
- Financial intermediaries for rent-to-own schemes

Cost structures
- Equipment acquisition and depreciation
- Maintenance and insurance
- Contract administration and logistics
- Training and support services

Revenue
- Rental fees from contractors
- Rent-to-own payments
- Performance bonuses tied to productivity or safety
- Maintenance service contracts.

Figure 2. The business model canvas for machinery rentals business models in forestry contracting.

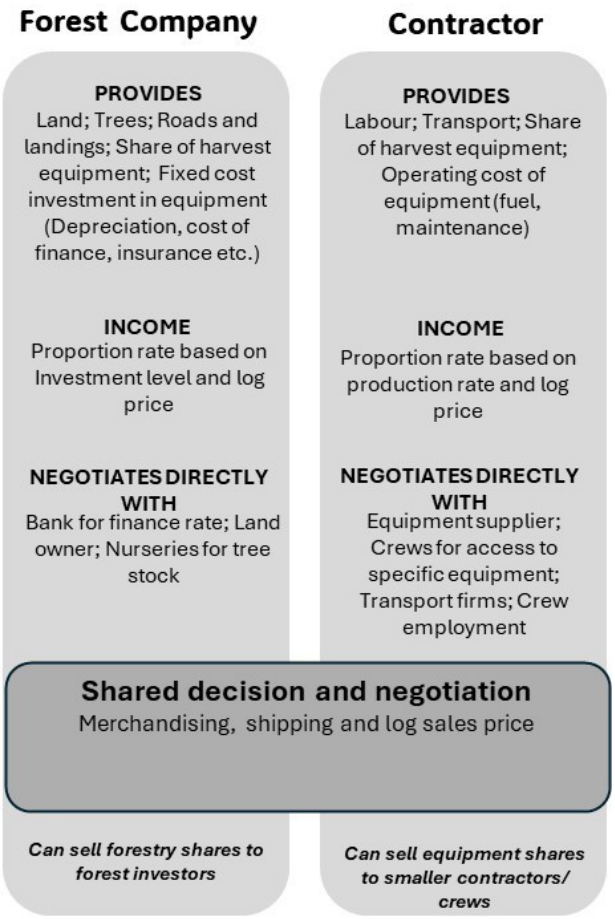

Figure 3. Outline of how a logging business venture might apply the sharemilker business model principles (after Bayne et al. 2024).

The sharelogger model is best suited to partnerships between large contractors and forest management companies, with returns linked to contractor investment levels and log prices. In regions with existing equity-sharing arrangements, the model may be more readily adopted. To further stabilize contractor returns, the concept could be strengthened by introducing coordinated log marketing mechanisms, similar to New Zealand's dairy sector "single-desk" approach through a dominant exporter in Fonterra™ .

Establishing equity-sharing earlier in the forest rotation—such as during silvicultural operations—would require mechanisms to account for future value fluctuations and risks (e.g., fire, disease, market downturns). Figure 4 outlines the business model canvas for the sharelogger concept. Overall, the sharelogger model offers a promising framework for more resilient and equitable contracting relationships in New Zealand forestry, though its implementation will require careful adaptation to local conditions and stakeholder motivations.

4.3 Alliance partnership bonds model

Social and environmental impact bonds (SEIBs) are innovative financing mechanisms designed to attract private investment into projects that will deliver measurable public benefits. These bonds typically

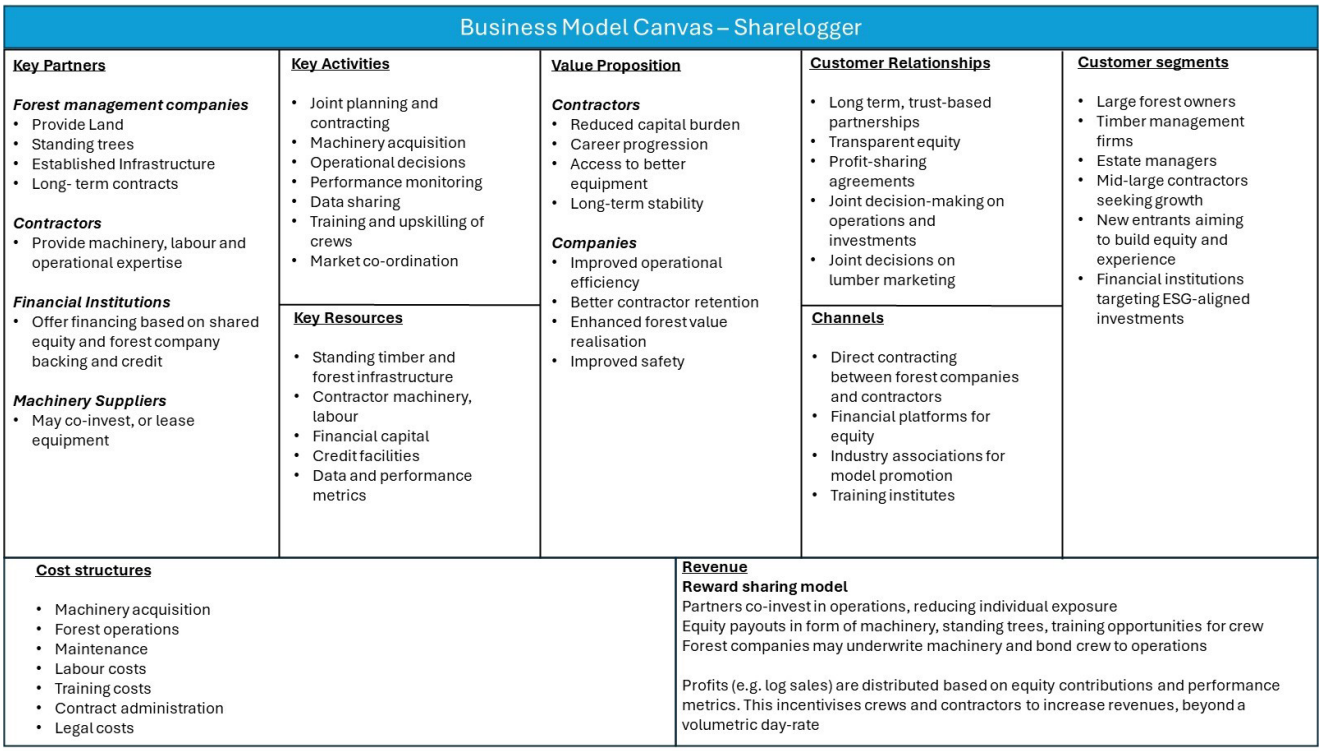

Figure 4. The business model canvas for the sharelogger business model.

involve a private investor or broker who provides upfront capital to projects

These bond schemes could be applied to forestry projects with positive social and environmental outcomes, such as afforestation, erosion control, or carbon sequestration. Repayment is contingent on the achievement of predefined outcomes—such as improved water quality, increased carbon storage, or reduced sedimentation—with funds returned from public sector savings or avoided costs. A notable example is the Forest Resilience Impact Bond in the northwestern United States, where private investors fund forest management activities that reduce wildfire risk and enhance water yield, with repayments made by government agencies and utilities upon verified success.

The Alliance Contracting Model, as outlined by New Zealand Government Procurement[4], is a collaborative delivery framework used for complex infrastructure projects. It brings together the client and delivery partners under a shared-risk, shared-reward arrangement. In this model, a special purpose vehicle (SPV) is established to manage project delivery, with private sector debt financiers exposed only to project-specific risks. Key features include open-book pricing, joint decision-making based on project outcomes, and pain/gain share mechanisms. This model fosters trust and transparency, reduces disputes, and enables more flexible responses to project uncertainties—making it particularly suitable for high-risk or innovative ventures.

Hayford (2020) proposes a hybrid financing structure that integrates public bond schemes with alliance contracting principles, in a bond-based alliance financing approach. To mitigate equity risk—typically a barrier for private investors—government-issued bonds provide the contingent equity to the SPV. This buffer reduces financing costs by leveraging government borrowing rates and enables the undertaking of higher-risk projects that would otherwise be unviable under traditional fixed-price contracts. Figure 5 illustrates the evolution from conventional private investment alliance-based structures into one supported by public bond financing.

This integrated model offers significant potential for forestry sector innovation. Public bond schemes

4 New Zealand Government Procurement, Construction Procurement Guidelines, "Alliance Delivery Model" (October 2019). https://www.procurement.govt.nz/assets/procurement-property/documents/alliance-delivery-model-construction-procurement.pdf

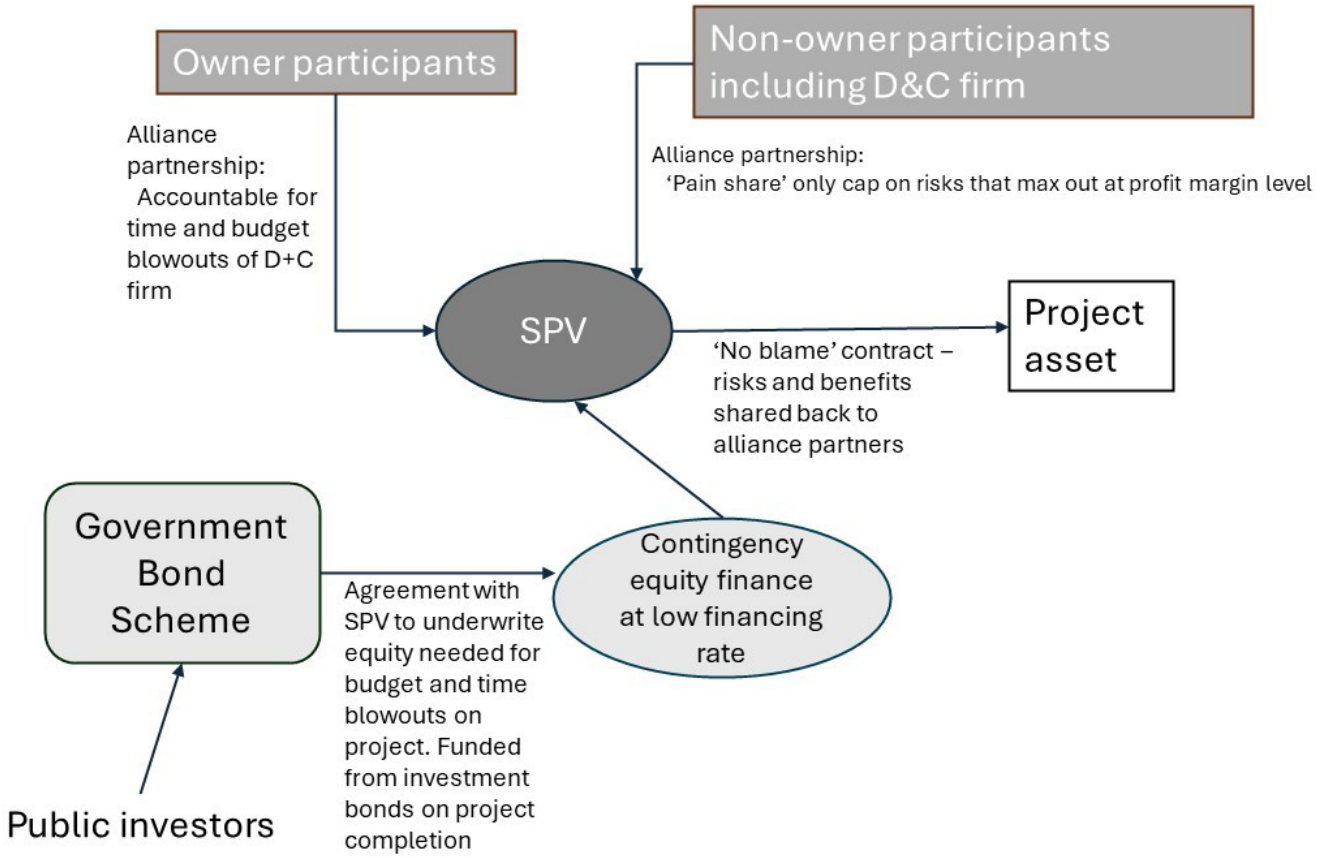

Figure 5. The Alliance construction model, incorporating Hayford (2020) government contingent equity solution, using a public bond scheme (after Bayne et al. 2024).

could be used to finance infrastructure such as biorefineries, processing plants, or the deployment of specialized planting equipment. In afforestation projects, carbon sequestration income could be channeled into the bond structure, replacing traditional dividend models. The alliance framework would allow forest companies, contractors, and government agencies to collaboratively manage project delivery, share financial risks, and align incentives around long-term environmental outcomes via the SPV. For example, planting of erosion-prone slopes or establishing native forests for biodiversity could be financed through SEIBs, with repayments tied to avoided environmental degradation or future carbon credit revenues. Figure 6 outlines the business model canvas for the alliance partnership bonds model.

By combining the accountability and flexibility of alliance contracting with the capital access of bond financing, this model presents a viable pathway for scaling up forestry interventions that deliver both commercial and public value.

5. Discussion

This research contributes to the literature on business model innovation in primary sectors by demonstrating how institutional innovations—such as new contracting arrangements, financial instruments, and governance structures—can unlock technological adoption and resilience. It also highlights the value of participatory design in developing context-appropriate solutions in supply chains. The workshop methodology enabled stakeholders to engage with abstract concepts through concrete examples, fostering a sense of ownership from lived experience.

From a policy perspective, the study underscores the need for targeted interventions that go beyond subsidies or tax incentives. For example, adapting Australia's instant asset write-off scheme to forestry could provide immediate relief, but without structural reform such measures risk entrenching existing inequalities. Instead, policies should aim to de-risk collaboration and support enhanced coordination.

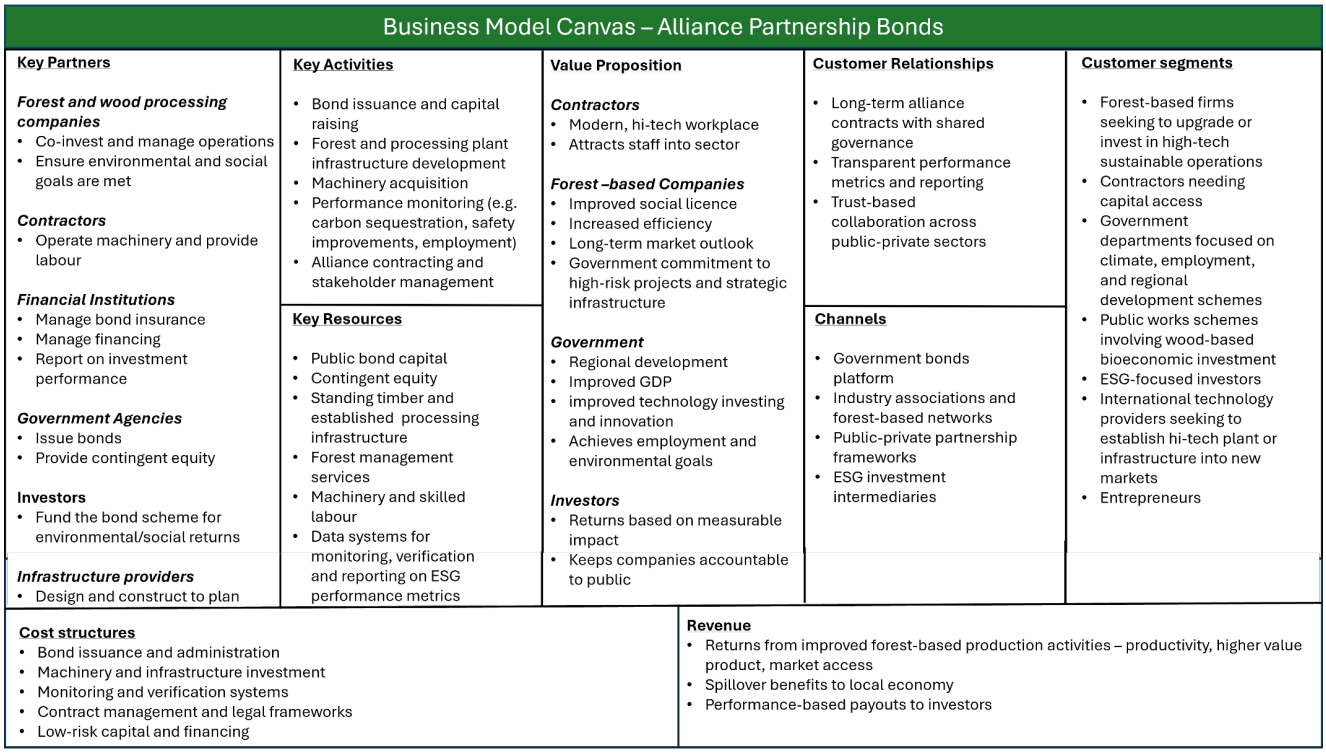

Figure 6. The business model canvas for the alliance partnership bonds business model.

While the sector is undergoing rapid technological transformation, the prevailing business models have not evolved at the same pace, leaving contractors disproportionately exposed to risk. The findings highlight a paradox: contractors are both the primary agents of technological adoption and the most financially vulnerable actors in the value chain.

The current model, which places the burden of capital investment on contractors, while forest owners and management entities reap many of the benefits, reflects a misalignment of incentives. This misalignment is not unique to New Zealand; it echoes global trends in primary sectors where outsourcing and short-term contracting dominate. However, the forestry sector's high capital intensity and long investment horizons exacerbate these tensions.

The three models differ across value dimensions. The machinery rental value proposition emphasizes accessible equipment, and provides usage-based rental fees to capture value, whereas sharelogging focuses on shared equity and long-term partnership, creating value through aligned incentives and transparent cost structures, while capturing value via profit-sharing. Alliance partnership bonds deliver public-private funding, create value through collaborative governance, and capture value through outcome-based repayments tied to proven environmental or social benefits of public interest.

The **machinery rental business model**, for instance, offers a pathway to decouple innovation from ownership. By enabling access to advanced equipment without requiring full capital outlay, it lowers the barrier to entry for smaller contractors and supports more agile responses to market and regulatory shifts. Yet, its success depends on overcoming cultural norms that equate ownership with professionalism and control. The Stora Enso model demonstrates that such schemes can work, but only with strong institutional support and long-term contractual frameworks.

The **sharelogging business model** introduces a more radical reconfiguration of contractor-forest owner relationships. By embedding equity-sharing into operational arrangements, it aligns incentives and fosters longer-term commitment. This model resonates with Richardson's (2005) emphasis on value co-creation and capture, and with Macqueen et al.'s (2015) call for democratized forest business.

However, it also raises questions about governance, partner selection, and the valuation of non-cash contributions such as standing timber or infrastructure.

The **alliance partnership bonds** business model extends the conversation beyond firm-level arrangements to sector-wide innovation ecosystems. By integrating public finance, private investment, and outcome-based governance, it offers a blueprint for financing high-risk, high-reward forestry interventions. Bryson et al. (2018) note the historical role of personal philanthropy in funding schemes during the industrialization era, citing public works schemes such as Admiralty Arch and The Mall in London, with crowdfunding becoming the modern equivalent philanthropic funding model. Bryson et al. (2018) reminds us that citizen Bond Schemes which are now deemed "alternatives" to private and public financing, were once the dominant conventional models for raising capital. The Alliance Forestry Partnership Bond model is particularly relevant in contexts where environmental and social outcomes—such as erosion control or carbon sequestration—are not adequately valued in more traditional investment markets. However, its implementation requires sophisticated coordination mechanisms, robust metrics for outcome verification, and a willingness among public agencies to engage in non-traditional ESG procurement.

6. Conclusion

The findings of this study underscore the urgent need for structural reform in New Zealand's forestry contracting sector, particularly in light of increasing mechanization, capital intensity, and the uneven distribution of risk and reward. While contractors demonstrate strong operational capability and business acumen, their limited leverage in contract negotiations and exposure to financial risk—especially regarding machinery investment—highlight systemic imbalances that constrain innovation and long-term viability.

The appeal of these alternative business models lies in their ability to redistribute financial risk, enhance access to capital, improve long-term stability and foster more collaborative relationships between contractors and forest owners. Importantly, these models also align with international trends in servitization, supply chain finance, and outcome-based contracting, suggesting their relevance beyond the New Zealand context. Although this paper focuses on how alternative business models could alleviate pressures on New Zealand forestry contractors, similar patterns are evident internationally. In Scandinavia, the UK, and Slovakia, contractors face risk-reward imbalances and persistently thin margins, suggesting the potential applicability of sharelogging-type models (Kronholm 2020; Benjaminsson et al. 2019; Štěrbová and Kovalčík 2020). In tropical regions, persistent barriers to accessing finance highlight the value of exploring super-contracting or cost-sharing arrangements (Macqueen et al. 2015; Ncube 2020). Across Scandinavia and Europe, rising mechanization and automation costs place contractors under capital pressure, where models such as Stora Enso's integrated contracting approach may already offer partial relief (Kronholm et al. 2021; Benjaminsson et al. 2019). Meanwhile, in these same regions, the prevalence of short-term contracting presents further scope for sharelogging-based long-horizon partnerships (Benjaminsson et al. 2019). Finally, accelerating servitization and digitization trends internationally suggest opportunities for public-private Alliance Bond frameworks to manage investment, risk, and value creation (Azar and Ciabuschi 2017).

However, successful implementation will require more than techno-economic feasibility. Cultural norms, institutional inertia, leadership, coordination, and fragmented governance structures remain significant barriers. For example, the entrenched expectation that contractors own their machinery may hinder uptake of rental models, while the multinational ownership of forest assets may complicate the formation of trust-based equity-sharing arrangements like sharelogging. Similarly, the Alliance Forestry Partnership Bonds model, while innovative, demands a level of cross-sector coordination and public-private alignment that is currently rare in forestry.

The workshops revealed an industry willing to explore new models but lacking clear leadership to drive change. This leadership vacuum suggests that intermediary organizations—such as industry associations, government agencies, or financial institutions—may need to play a catalytic role in piloting and scaling these models.

Although forest companies are perceived as the most influential actors in setting contract terms, they

are not widely seen by contactors as willing to share financial risks, support crew training, or offer leniency in downtimes. Contractors are expected to maintain highly skilled teams independently, despite limited external support. Encouragingly, forest companies in this study did express some willingness to share risk, which contrasts with contractor expectations and may signal a shift in industry dynamics.

Overall, the findings suggest that while there is broad recognition of the benefits of adopting new technologies across the sector, systemic barriers—particularly around risk-sharing and contract structures—continue to inhibit progress. Addressing these issues will require not only new business models but also a rethinking of the roles and responsibilities within the supply chain.

Across all proposed models, three critical conditions were identified as needing to be addressed to effectively de-risk contractor participation: (1) ensuring consistency and predictability in production volumes; (2) improving flow and reducing bottlenecks within the supply chain; and (3) enabling longer-term, stable contractual commitments between contractors and forest companies. These factors are essential for fostering innovation and supporting the adoption of new technologies.

To support further dialogue, each model was outlined with practical considerations for implementation. These outlines are intended to serve as a starting point for contractual discussions between forest companies and contractors, encouraging exploration of new approaches to risk-sharing and business model innovation within the sector.

While the study offers a robust theoretical foundation, the models were assessed in workshop settings, rather than real-world trials, focused primarily on New Zealand. Future research should focus on piloting these models in real-world settings, evaluating their performance, and refining them to suit diverse regional and operational contexts.

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Appendixes

Appendix 1: Survey instrument

1. How do you identify yourself in this value chain?	Forest owner Harvesting contractor Equipment manufacturer Harvesting worker Scientist/ Researcher Forest industry organisation Other
2. What do you think are the main incentives for **harvesting contractors** to replace forestry machinery? - Multiple choice	Contractor's preference for new technology Contractor's client's requirements Financial benefits for the individual contractor Improve health and safety of their crews Improve contractor's competitiveness Smoothing out production Making products more consistent Other
3. What do you think stops **harvesting contractors** from getting new technology*? * ***New technologies*** *- We are defining* ***new technologies*** *in a general sense and therefore it is open to interpretation. However, whether is new machinery, equipment, or electronic gadgets, adopting them would require a significant commitment by* ***individual harvesting contractors****, either by the size of the financial investment required, development of new skills, or by adjusting or transforming existing practices.*	If it's too complex If it's not compatible with existing gear If it's not easy to trial Hard to finance Existing gear is still competitive Contractual arrangements Other
4. How likely is it for supply chain players to **benefit** from **harvesting contractors** upgrading to new technology? • Individual harvesting contractor • Harvesting contractors as a collective • Harvesting workers • Forestry companies • Equipment manufacturers • The industry as a whole	Very likely Likely Unlikely Very unlikely
5. How likely is it for supply chain players to help **carrying the risk** from **harvesting contractors** upgrading to new technology? • Individual harvesting contractor • Harvesting contractors as a collective • Harvesting workers • Forestry companies • Equipment manufacturers • The industry as a whole	Very likely Likely Unlikely Very unlikely
6. In general, how do you rate your relationships with other players in your industry? •Harvesting contractors • Harvesting workers • Forestry companies • Equipment manufacturers • Industry organisations	Excellent Good Average Poor Very poor
7. How do you rate the influence of industry players in establishing terms and conditions of contracts, including the **use of new technologies**? • Harvesting contractors • Harvesting workers • Forestry companies • Industry organisations	Highly significant influence Significant influence Moderate influence Little influence No influence
8. How adequate are **day rates** as the main driver for contracts in the industry?	
9. Do you work under non-traditional arrangements with others in the supply chain that work for you in terms of technology adoption and want to share?	
10. What are the biggest opportunities for your business in your region in the next 10 years?	
11. What are the biggest challenges faced by your business in your region in the next 10 years?	
12. If you are willing to be contacted for a more in-depth conversation on the topics we're covering in this survey, please provide either an email address or phone number.	

Appendix 2: Recruitment email from FICA president.

Risks and benefits of new technology in harvesting operations

You are invited you to participate in this survey

This survey was developed by Scion as part of a Forest Growers Research project. SCION are partnering with FICA to complement their current work with their network of harvesting contractors.

Our objective is to better understand what can be done to make it easier to adopt new technologies for those **harvesting contractors** who wish to do so.

Your participation is voluntary and confidential. The data collected will be stored with password protection. All results from this study will be presented as averages or aggregates. It will be impossible to identify individual responses. Your answers will be completely anonymous, and your identity will not be revealed in any publication arising from this project.

Once we compile the information, we will send you a summary of the results of the survey. It will contain:

- Perceptions on the balance between benefits and risks of new technologies amongst industry players
- The main barriers to adoption and what can be done about it
- Further steps in the project

We will also ask you to indicate if you're interested in having a more in-depth conversation on the topics we're covering in this survey

The survey consists of 13 questions. It will take approximately 10 minutes to complete. As an incentive to complete the survey, you'll go on the draw for a $100 prezzie card when all surveys are collected.

COMPLETE SURVEY – CLICK HERE

Many thanks

Prue Younger
CEO, Forest Industry Contractors Assoc.

Appendix 3: Workshop invitational flyer

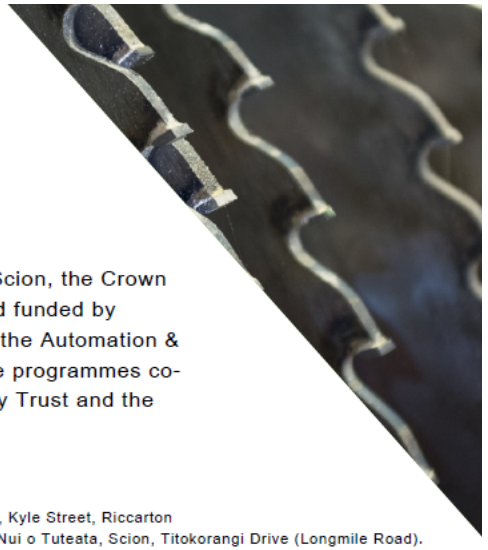
Wednesday 5th June (Christchurch) Friday 7th June (Rotorua)

As harvesting and silvicultural technologies move towards mechanisation and automation, much greater financial burden will be placed on the forestry and harvesting contractor to remain competitive and financially secure when investing in upgraded equipment.

FGR, in association with Scion, is holding two workshops to explore the adoption of forest technologies, with a focus on alternate business models that adjust the timing of payments, realise non-monetary value of forest operations, or share skills and assets. Group sessions will explore financing models that might be able to be applied in a forestry context, to better share the risks and benefits of any capital purchase or new technology change.

Workshop attendees will gain a better idea of how alternative business models from other sectors could be applied in the wider forest industry. The workshop is open to those working in the forestry supply chain, particularly forest contractors, their financial managers or business partners, equipment suppliers and forest management companies.

FOREST GROWERS RESEARCH



Two workshops. No cost to attend.

The workshops are organised by Scion, the Crown Research Institute for forestry, and funded by Forest Growers Research Ltd, via the Automation & Robotics and Precision Silviculture programmes co-funded by the Forest Growers Levy Trust and the Ministry for Primary Industries.

Time: 9.00am-2.00pm

CHRISTCHURCH: Wednesday 5th June, Scion, Kyle Street, Riccarton
ROTORUA: Friday 7th June, Scion, Te Whare Nui o Tuteata, Scion, Titokorangi Drive (Longmile Road).

SPACES LIMITED. RSVP BY THURSDAY MAY 30TH

Numbers are limited to 30 people per workshop. If you wish to attend, please register on this link:

WHO SHOULD ATTEND?

- Forestry company staff
- Forestry and harvesting contractors and staff
- Financial managers or business partners of contractors
- Equipment suppliers
- FGR Technical Steering Team Members
- FGR Researchers
- FGR Programme Governance Group Members

WORKSHOP AGENDA

Time	Activity
8:45am	Tea / coffee / registration
9:00am	Welcome, introduction and project background
9:15am	Purpose and scene setting: - Contracting adoption environment- recent survey - Presentation from industry
9.50am	Outlining alternate funding business models
10:05am	Morning tea
10:15am	Group discussion 1: Applying alternative business model options.
11.00am	Group discussion 2: Technology overview
12:00pm	Lunch
12:45pm	Group discussion 3: Sharing risk and benefits more equitably
1:45pm	Conclusions/ next steps
2:00pm	Workshop close

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