Te Uru Rākau New Zealand Forest Service

Wood Processing Technology Needs Assessment

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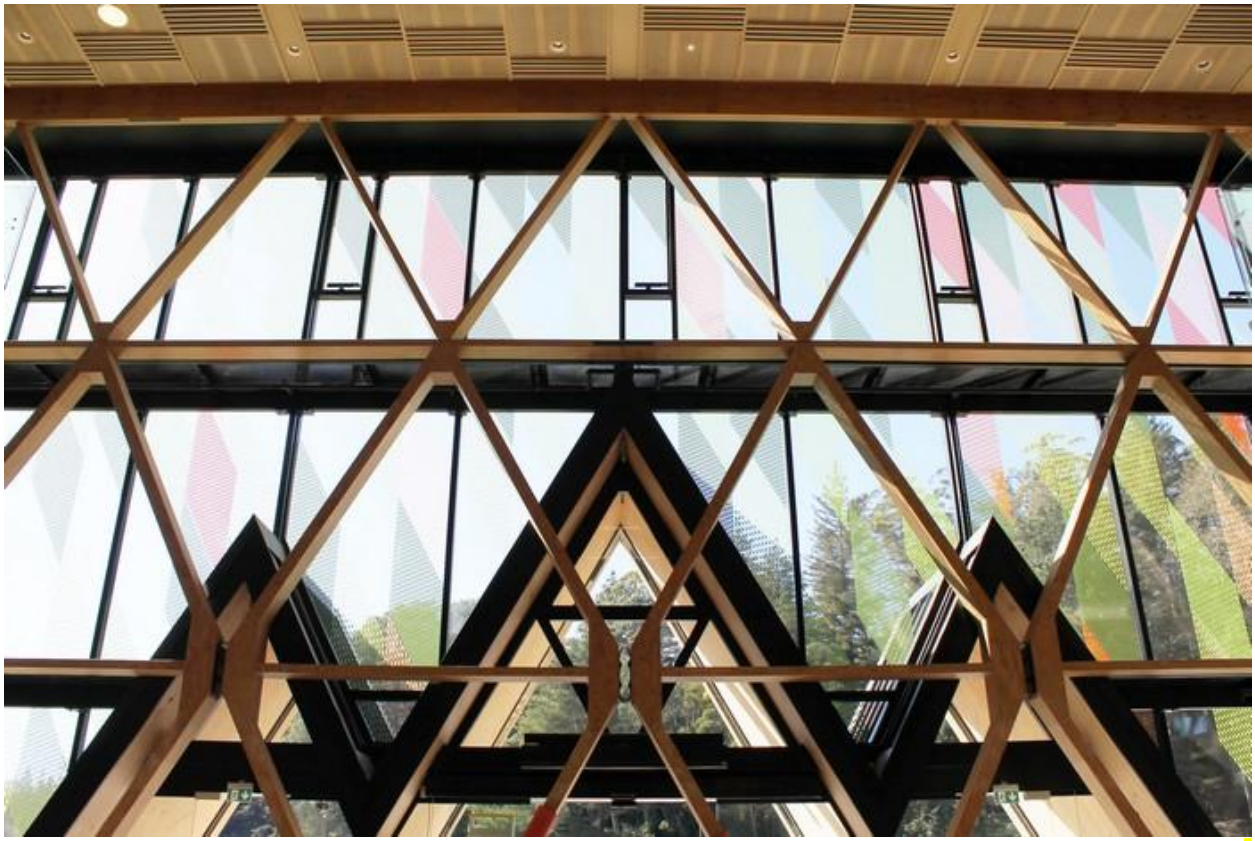
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Wood Processing Technology Needs Assessment – C0037665

Diego Elustondo, Peter Hall, Jeremy Warnes, and Henri Bailleres



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Executive summary

The problem

New Zealand's wood processing sector faces increasing pressure from international competitors who are rapidly embracing Industry 4.0 technologies, while much of the domestic industry remains constrained by aging infrastructure and fragmented uptake of innovation. Despite the ready availability of modern, fit-for-purpose technologies, their adoption is limited by insufficient understanding of the opportunities these technologies offer, as well as by gaps in financial literacy, business case development, and workforce capabilities. Small and medium-sized enterprises (SMEs), which form the majority of the sector, often lack the integrated data systems and strategic planning needed to justify and implement technological upgrades effectively.

Client initiatives

Te Uru Rākau – New Zealand Forest Service (TUR-NZFS) has initiated efforts to support the sector through improved productivity, export growth, and technological innovation. In collaboration with Scion, they commissioned this assessment to better understand the barriers to innovation and identify targeted opportunities for support.

This project

The project involved a preliminary needs assessment of New Zealand's wood processing sector across four key industry clusters: primary processing (sawmills), secondary processing (remanufacturing), posts and poles, and veneer-based manufacturing (plywood and LVL). It combined industry database analysis, a national industry survey, and an international technology scan. The aim was to identify gaps, evaluate the sector's readiness for technology adoption, and provide evidence-based recommendations for future investment, policy development, and capability-building initiatives.

Key results

Findings confirm that while high-performance technology and equipment are widely accessible and competitively priced, adoption is hindered by a lack of robust business cases, limited data usage, and a shortage of skilled talent. Survey participants identified product development, process optimisation, and better use of residues as top growth areas, but also cited capital constraints, uncertain markets, and poor access to decision-making data as key challenges. An international benchmarking at LIGNA 2025 showcased a global shift toward automation, AI integration, and digital manufacturing as key drivers of competitiveness.

Implications of results for the client

For TUR-NZFS and its partners, the findings highlight opportunities for technology promotion as part of coordinated efforts to integrate processes and improve efficiency. Future efforts should focus on enabling SME decision-makers through targeted training in financial and strategic planning, co-investment in demonstration projects, shared data infrastructure, and regional innovation hubs. Based on the evidence gathered, Scion suggested to consider the following opportunities:

- Support capability development
- Co-fund demonstration projects
- Enhance access to market analytics
- Facilitate upgrade of technologies
- Promote talent attraction
- Encourage value chain integration
- Support innovation platforms

Further work

To accelerate innovation across the forest products sector, future work could prioritise the following interrelated streams of activity:

- Comprehensive sector mapping: Undertake a coordinated national effort to assess the specific operating conditions, investment readiness, and innovation potential of small and medium-sized enterprises (SMEs) through expanded surveys and targeted site-level assessments.
- Technology adoption support: Develop resources and decision-support toolkits to assist SMEs in evaluating and implementing new technologies - particularly in areas such as automation, AI-enabled process control, and integrated energy and material recovery.
- Applied research and demonstration: Support targeted research and technology transfer projects in partnership with industry to trial and validate emerging technologies in operational environments, with a focus on improving process integration, efficiency, and overall productivity.
- Digital platforms: Establish accessible, web-based platforms to share market intelligence, enable performance benchmarking, and enhance sector-wide knowledge exchange and capability development.

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MAIN REPORT

Rational

Te Uru Rākau - New Zealand Forest Service (TUR-NZFS) plays a key role in supporting the forestry sector by promoting productivity improvements, export growth, and technological innovation. The New Zealand wood processing industry is increasingly challenged by global competition and constrained by aging capital infrastructure. In contrast, many international competitors are rapidly adopting Industry 4.0 technologies (including automation, artificial intelligence, precision scanning and sensing, and integrated supply chains) as well as incremental changes such as narrow kerf sawing and defect scanning to enhance operational efficiency and competitiveness. This report is a first step to deliver a targeted roadmap to support the adoption of innovation within New Zealand's wood processing sector. It seeks to identify practical opportunities to improve productivity and global competitiveness, while also showing evidence to inform future investments, policy development, and industry support initiatives.

Selected forest products sectors

Using Scion's internal industry database, four strategically significant clusters of forest product companies in New Zealand were identified. Clusters were delineated based on company concentration, production capacity, and their functional roles within the broader end-to-end forestry value chain. These clusters are defined as follows:

- Primary wood processing: Sawmills engaged in the initial conversion of logs into structural and appearance-grade timber.
- Secondary wood processing: Operations focused on remanufacturing, including further machining, treatment, or product assembly.
- Posts & poles: Facilities specialising in the production of roundwood components for infrastructure, horticultural and agricultural applications.
- Veneer, plywood, and laminated veneer lumber (LVL): For the purposes of this study, the focus is on veneer production activities.

In New Zealand, Small and Medium Enterprises (SMEs) are commonly defined by government and business organisations based on the number of employees, typically fewer than 50 full-time equivalent (FTE) staff [1]. However, Scion's internal database does not include employment data. Consequently, for this report we adopt an alternative SME classification based on annual production volume, consistent with definitions used by New Zealand Trade and Enterprise [2], where sawmills producing more than 100,000 m^3 per year are considered large-scale operations. The number of operations, their approximate annual production, and SME status within each cluster are reported in APPENDIX 1.

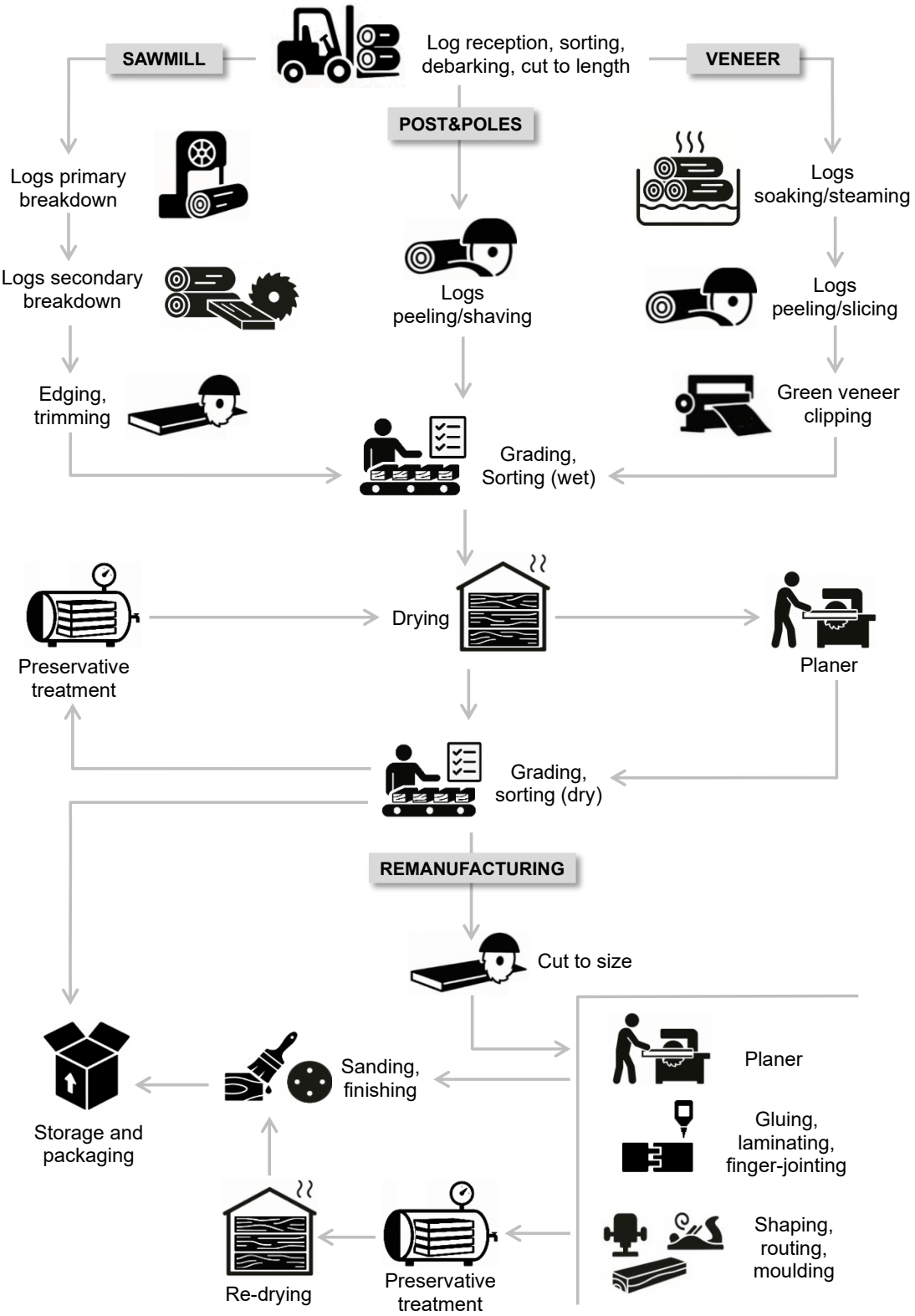
A total of 135 primary processing sawmills were identified in the database, with combined annual production of approximately 4.7 million m^3 of structural and appearance-grade lumber. The nine largest sawmills, all producing over 100,000 m^3 annually, account for approximately 60% of total production. The remaining 126 sawmills fall below the SME threshold. There are 40 secondary remanufacturing operations in the database, collectively producing approximately 596,000 m^3 per year. Production per plant ranges from 4,500 m^3 to 90,000 m^3, with all facilities qualifying as SMEs in this study. Notably, 30% of sector output is concentrated in the three largest plants, with the remaining 37 operations each producing less than 30,000 m^3 annually.

The database reports 43 Post & Poles facilities in New Zealand, producing an estimated 243,000 m^3 of post and poles annually. Individual plant output ranges from 14,000 m^3 to 2,000 m^3, indicating that all operations in this cluster can be classified as SMEs under the adopted production threshold. Only eight plants are reported in the veneer, plywood and LVL combined sector, with total production estimated at 430,000 m^3 per year. This includes three LVL producers, four plywood manufacturers, and one dedicated veneer producer. Of these, two LVL plants and all four plywood plants produce under 100,000 m^3 annually and thus are classified as SMEs. The dedicated veneer plant produces 127,000 m^3 annually according to Scion's database. While not the primary focus of this study, the database also records annual production volumes of approximately 388,000 m^3 of industrial wood and 735,000 tonnes of chips and pellets.

APPENDIX 2 provides an overview of the main products manufactured across the selected industry clusters, while APPENDIX 3 outlines the major unit operations involved in their production. In short, New Zealand's timber manufacturing sector produces a diverse range of wood products, with a strong emphasis on structural applications. Sawmills routinely supply SG6 to SG12 graded framing timber, treated to H1.2 through H5 standards in accordance with New Zealand standards, for residential and commercial construction. Additional products include rough-sawn and merchant-grade timber, as well as specialty structural items for outdoor and landscaping use. High-quality appearance-grade and clear-grade timbers are also produced for applications in furniture, joinery, and architectural detailing.

The typical process for sawmills, secondary manufacturing, post & poles, and veneer production are illustrated schematically in the diagram below. The diagram is indicative only and does not include subsequent processing steps involved in the manufacture of engineered wood products such as plywood, laminated veneer lumber (LVL), glue-laminated timber (glulam), or cross-laminated timber (CLT). All processes begin with log reception, scaling, and sorting based on size and quality. This can include sonic testing of logs for stiffness. Logs are then debarked and fed through the different processes:

- Primary wood processing (sawmill): Logs are run through primary breakdown equipment - often bandsaws or circular saw systems - to produce cants and flitches. These intermediate forms are further processed in secondary breakdown units such as gang saws. Boards are edged, trimmed, and graded while green, using manual or semi-automated systems. Batch or counterflow-continuous kilns are the most widely used for drying, which is followed by planing for dimensional consistency and surface smoothness. Final grading may be carried out visually or using mechanical grading systems. A significant portion of structural and outdoor-use products are then pressure-treated with preservatives such as CCA, ACQ, or boron compounds to meet durability requirements.
- Secondary wood processing (remanufacturing): Processing generally involves grading and sizing of kiln-dried, rough-sawn timber, followed by optional re-drying and precision planing. Common product lines include exterior cladding, decking boards, H3.2 treated fencing, interior mouldings, fascia, soffits, sarking, tongue and groove for wall panels and flooring barge boards, and custom trims. Some operations also produce laminated posts, flooring systems, and edge-glued panels for furniture and cabinetry. Further shaping is achieved via routing, moulding, or CNC machining to form complex profiles. Advanced processes such as finger-jointing and laminating allow manufacturers to produce extended lengths or composite panels from defect-free short lengths. For exterior applications, preservative treatment is commonly followed by finishing with primers, sealants, or coatings.



- Post & Poles: The sector is critical for rural and infrastructure applications, supplying a variety of roundwood products treated for in-ground use. Radiata pine is the primary raw material, although other species are used in specific applications. In these operations logs are debarked using rotary or ring debarkers and crosscut to standard lengths. Many facilities peel the surface to create uniform cylindrical profiles. Depending on operational scale, drying is carried out via air seasoning or steam conditioning prior to treatment. Preservative treatment - typically using CCA, copper azole, or other approved formulations - is performed using pressure impregnation to ensure long-term durability.

- Veneer: The manufacturing process begins with log sorting such as “pruned” and “industrial” grades, followed by debarking and conditioning through soaking or steaming. Logs are rotary peeled or sliced to produce continuous veneer sheets. These are then clipped to size, graded (both visually and mechanically), and dried to target moisture content. Mechanical grading methods such as acoustic resonance testing are often employed to assess stiffness. In most operations, veneer is processed into plywood or laminated veneer lumber (LVL), but this is out of scope in this study. LVL is constructed by laminating veneers in the same grain direction, while plywood is cross laminated for multidirectional strength.

Industry survey

To better understand sector-specific innovation priorities and investment barriers within New Zealand’s forest products industry, a five-question online survey was administered on two occasions: first at the WoodTech Workshop in Rotorua on 14 March 2025, and subsequently via the New Zealand Timber Industry Federation (NZTIF) on 7 April 2025. A total of 18 responses were received. While the response size is modest and does not allow for statistically robust conclusions, the wide-ranging nature of the feedback provides valuable qualitative insight into the sector’s diversity. Notably, the results reaffirm the view that there is no single, universally applicable approach to improving operational efficiency across the industry.

The completed survey results are reported in APPENDIX 4. To identify potential patterns in the feedback, selected excerpts were grouped by thematic keywords and categorised according to their relevance to specific subsectors. The most frequently referenced industry domains were appearance timber, structural timber, and chips and energy, indicating that these areas continue to occupy a central role in industry thinking around growth and performance.

When asked which areas hold the most potential for future growth, respondents most commonly identified product development, followed by process optimisation and improved use of wood residues. These themes reflect a continued interest in adding value to existing product lines while maximising the utility of by-products. In terms of technologies with potential to improve operational efficiency, the strongest emphasis was placed on equipment upgrades. Respondents also highlighted the promise of energy generation technologies, as well as emerging solutions such as artificial intelligence and thermal modification - both recognised for their potential to lift productivity and product performance.

Despite strong interest in new technologies, many participants cited barriers to investment. Capital costs were identified as the leading constraint, followed by competing internal priorities and the influence of uncertain or underdeveloped markets. These findings suggest that, even where technical solutions are known, the business case for adoption remains fragile in many parts of the sector. An uncertain market often means there is no viable business case for new investment.

Finally, the survey revealed several recurring challenges seen to be limiting growth. Market access was the most frequently cited concern, followed by broader business uncertainties and a lack of access to reliable data to support decision-making. Together, these insights paint a picture of a sector that is aware of its innovation needs, but constrained by both economic and informational limitations. While not statistically representative, the findings provide empirical evidence that improving efficiency in New Zealand’s forest products sector is a complex, multidimensional challenge shaped by a network of interdependent factors - including the pace of market

development, the availability of targeted investment, the adoption of advanced technologies, and the sector's capacity to collect, analyse, and apply data effectively.

Reflections on the Survey

The initial industry survey was designed with open-ended questions to allow respondents to provide insights based on their own understanding of the sector. This approach helped minimise researcher bias and uncovered valuable perspectives on commonly perceived barriers and opportunities. However, the open-ended format also limited our ability to produce a quantifiable overview of the broader industry landscape.

To address this, a more extensive and structured survey is needed - one that can capture a wider range of industry voices, map barriers and opportunities in greater detail, and identify concrete pathways for technological innovation. We also see value in using the next phase of the survey not just as a diagnostic tool, but as a platform to actively engage companies on emerging technologies - seeking feedback on their relevance, feasibility, and potential for adoption.

We therefore recommend undertaking a more comprehensive, nationwide industry survey to systematically assess sector-wide constraints, evaluate innovation readiness, and inform opportunities for targeted technology uptake.

Technology scan

A defining characteristic of the solid wood products industry is that its core manufacturing processes are generally based on well-established, mechanically driven operations rather than highly advanced or novel technological principles. As such, the potential for breakthrough innovation is more incremental than disruptive, focusing on optimizing existing practices rather than reinventing them.

As illustrated in the previous diagram, the typical production workflow involves a sequence of relatively straightforward mechanised steps designed to cut, shape, and process logs into a variety of dimensional and specialty products. For each of these steps, a wide range of commercial equipment is available, often designed to operate as self-contained units functioning independently of other stages in the process. While this modularity provides flexibility, it also presents a significant challenge for the implementation of digital process optimisation technologies, which require integrated data monitoring and coordinated control across the entire production chain.

A Quattro moment

In 1981 Audi introduced its 4-wheel drive rally car, the Quattro, to the World Rally Championship. It won the WRC for the next 4 years and was so dominant all the other manufacturers competing in the WRC had to move to making 4WD cars.

Question: What are the Quattro moments for wood processing? Possibly broken down into segments. For example; in timber drying a major shift happened with the development of counterflow kilns as an alternative to batch kilns, improving efficiency and productivity by around 20%. In mouldings and machining automatic knife changing significantly improved productivity (up to 24%).

New areas of technology development may or may not be specifically in any of the unit operations in the list below, but in technologies that can be applied across unit operations such as automation, scanning, optimisation, AI and machine learning based decision making

Equipment suppliers for SMEs

A wide range of equipment suppliers - some of which are listed in APPENDIX 5 - offer various solutions tailored to the diverse operational scales and budgets found across the sector. Rather than representing unique or disruptive technologies, equipment offered by different suppliers should be viewed as alternative configurations suited to specific business contexts and technical requirements. However, the scope of this exploratory study was limited, and it did not involve direct engagement with equipment suppliers or industry users to validate and adapt the findings to the New Zealand context. Further investigation, in collaboration with both suppliers and end users, is necessary to develop a more targeted and useful resource that can effectively facilitate forest products SMEs across New Zealand to adopt new technology.

International technology exposition

As part of this study, a Scion representative attended the LIGNA 2025 Technology Exposition in Hannover, Germany, held in May 2025. LIGNA is globally recognised as the leading trade fair for forestry, woodworking, and wood-processing technologies. Hosted biennially at the Hannover Exhibition Grounds. It brings together the full spectrum of international industry stakeholders - from forestry equipment manufacturers and primary processing technology providers to suppliers of engineered wood, finishing systems, and digital manufacturing solutions. An independent report has been submitted alongside this document to record the visit: **ScanTec report: LIGNA 2025**.

In this report, APPENDIX 6 provides a summary of selected innovations sourced from LIGNA 2025's official website [3]. The 2025 event strongly emphasised automation, digitalisation, and smart manufacturing systems, reflecting the industry's broader transition toward more intelligent, flexible, and sustainable production models. Automation and robotics were prominent across the exhibition floor. Fully automated solutions were demonstrated for timber machining, sub-assembly of wall panels, door and frame manufacturing, CNC sawing, coating, sanding, and materials handling. Vision-based quality control systems and AI-guided robotic arms for sanding and finishing were also featured, offering significant improvements in precision, repeatability, and labour efficiency.

Digital integration and AI are becoming central to next-generation manufacturing. LIGNA showcased comprehensive cloud-based platforms integrating Enterprise Resource Planning (ERP), Computer-Aided Design and Manufacturing (CAD/CAM), Manufacturing Execution Systems (MES), and predictive maintenance tools. AI-driven systems for sawmill optimisation, resin dosing, press control, and condition monitoring were presented, with demonstrable benefits in yield optimisation, cost efficiency, and product quality.

Process monitoring advancements included wireless sensor arrays for kiln drying optimisation, multi-sensor platforms combining vision and X-ray for automated grading, and smart fastening tools that enable real-time tracking of tool performance and joint quality. These developments support enhanced process control, reduced downtime, and improved product consistency. Innovations in core woodworking machinery were also evident, including high-speed nailing systems, advanced CNC routers, precision vacuum lifters, and next-generation sanding and coating equipment. Complementary developments in diamond tooling, laser engraving systems, and high-performance abrasives aim to improve processing accuracy and material efficiency.

Collectively, LIGNA 2025 illustrated the sector's ongoing evolution toward interconnected, autonomous, and data-rich production environments. These trends respond to global challenges such as skilled labour shortages, the need for mass customisation, and environmental sustainability in wood product manufacturing. Nonetheless, the visit reaffirmed the broader industry observation that most technological advancements remain evolutionary rather than revolutionary. While digital tools, AI integration, and enhanced automation are progressively improving system performance and reliability, the sector has not yet witnessed a disruptive breakthrough capable of fundamentally reshaping the business model or processing paradigms of forest-based industries.

To understand the meaning of "innovation" in the forest products sector, APPENDIX 7 provides a brief history of Industrial Revolutions 2.0 to 5.0, highlighting their defining concepts, technologies, features, and impacts.

Talking to New Zealand suppliers

To conclude this study, we met with Richard Jack and Neil Dodunski of Jacks, a highly regarded New Zealand-owned and operated supplier of woodworking and timber processing machinery. With over 75 years of continuous service, Jacks has built a strong reputation for supporting both small and large-scale wood processors across the country. The company represents several globally recognised manufacturers, including Weinig and Weinmann (Germany), the Felder Group (Austria), and KDT (China). Its equipment portfolio spans a broad range of technologies, including CNC routers, moulders, optimising crosscut saws, edgebanders, finger jointers, panel saws, and advanced prefabrication systems.

The insights provided by Jacks align closely with the findings of this study. Based on their experience, the current lag in efficiency and productivity within New Zealand's forest products sector is not primarily due to a lack of technology awareness or insufficient access to capital. This perspective contrasts with some survey respondents who identified capital costs as a key barrier to improvement. Jack argues that the core issue is typically the absence of a viable business case - whether due to unclear market demand or an inability to compete on cost within those markets. In most cases, they suggest that capital is available, but investors and lenders are reluctant to commit funds without a clear and commercially sound business case.

Modern equipment is readily accessible and relatively affordable, but many operators lack formal training in financial management, and investment decisions are often not underpinned by rigorous business case analysis. Additionally, the sector struggles to attract skilled talent and tends to underutilise data-driven decision-making tools. Performance metrics are not consistently monitored across operations, which hampers the identification of inefficiencies and strategic investment opportunities. Overall, Jacks highlighted that there is no one-size-fits-all solution. Improvement will require tailored strategies that address both capability development and operational culture. There is a need for targeted data collection aligned with market analysis and Cost Benefit Analysis of relevant technology uptake opportunities.

New Zealand's competitive advantage

In assessing New Zealand's position within the global wood-processing sector, there is ongoing discussion about where our competitive advantage truly lies - particularly when compared with low-wage economies. Many Asian countries, including China, benefit from significantly lower

labour costs. New Zealand does not have a cost advantage in labour or electricity, and our cost of capital is only marginally lower than that of other developed nations.

	Labour (US$/month)	Electricity (US$ kWh)	Cost of capital (interest rates%)
NZ	4,000	0.14	6 to 9
Malaysia	700	0.10	5 to 8
Vietnam	400	0.08	8 to 10
Philippines	350	0.07	7 to 11
Indonesia	300	0.08	9 to 12
China	1,100	0.16	6 to 9

However, New Zealand's key strength is its abundant and reliable supply of softwood logs, which are well suited for processing. Our feedstock costs are comparatively low, and international shipping costs from New Zealand to Asia - typically in the range of US$30 to $35 per cubic metre - reinforce this advantage. These factors point to the need for strategic investment in automation to reduce labour intensity, and for further exploration of energy-efficiency solutions such as combined heat and power (CHP) generation.

Conclusions and recommendations

This study highlights that efficiency improvement in New Zealand's forest products sector is a complex, multi-faceted challenge. A combination of survey feedback, industry engagement, site visits, and international technology scanning reveals that while modern, fit-for-purpose technology is readily available and relatively affordable, but its uptake is constrained by a limited understanding of the opportunities it presents and how to apply it effectively.

Survey responses from industry stakeholders underscore that there is no universally applicable path to increasing productivity across the sector. Instead, the diversity of responses reflects an equally diverse set of operational environments, capabilities, and market conditions. Insights from LIGNA 2025 exposition confirm that innovation in the wood processing sector remains primarily evolutionary. Automation, AI, digital integration, and data-driven process optimisation are advancing steadily but incrementally. Finally, feedback from suppliers confirms that the sector's challenges are less about the availability of tools and knowledge of those tools and more about the readiness, capacity and business opportunity to implement them strategically.

Modern technologies offer significant potential benefits, yet their full value will only be realised through complementary investments in workforce capability, business acumen, and data systems. To accelerate innovation across the forest products sector, future work could prioritise the following interrelated streams of activity:

- Comprehensive sector mapping: Undertake a coordinated national effort to assess the specific operating conditions, investment readiness, and innovation potential of small and medium-sized enterprises (SMEs) through expanded surveys and targeted site-level assessments.
- Technology adoption support: Develop resources and decision-support toolkits to assist SMEs in evaluating and implementing new technologies - particularly in areas such as automation, AI-enabled process control, and integrated energy and material recovery.
- Applied research and demonstration: Support targeted research and technology transfer projects in partnership with industry to trial and validate emerging technologies in

operational environments, with a focus on improving process integration, efficiency, and overall productivity.

- Digital platforms: Establish accessible, web-based platforms to share market intelligence, enable performance benchmarking, and enhance sector-wide knowledge exchange and capability development.

In addition to technology and innovation, there are other areas requiring focused attention to support growth and competitiveness. Firstly, there is a need for comprehensive market research, including analysis of global megatrends and their implications for future wood product markets, as well as the identification of specific existing demands and growth opportunities. Secondly, targeted data capture and analysis is essential to inform business development strategies. This could be facilitated through secondments of Scion staff or student internships embedded within industry operations. Thirdly, there is growing interest in evaluating the energy potential of wood residues, both at individual processing sites and across regional clusters, to assess opportunities for heat and power generation. Lastly, increased investment in automation is seen as critical to improving productivity, addressing labour challenges, and enhancing product consistency across the value chain.

APPENDIX 1: Selected company clusters

As part of this study, four strategically significant clusters of forest product companies in New Zealand were identified using data from Scion's internal database. The selection criteria included company concentration, production capacity, and the functional role of each cluster within the broader end-to-end forest industry value chain. The clusters are categorized as follows:

- Primary wood processing: encompassing sawmills engaged in the initial conversion of logs into structural and appearance-grade timber
- Secondary wood processing: focused on remanufacturing operations that add value through further machining, treatment, or assembly
- Posts and poles: representing facilities dedicated to the production of roundwood components for infrastructure and agricultural use.
- Veneer, plywood, and laminated veneer lumber (LVL): with this study concentrating specifically on veneer production activities

Primary wood processing

Figure 1 presents the number and annual production volumes of structural and appearance-grade sawmills in New Zealand. According to Scion's internal database, a total of 135 sawmills have been identified, collectively producing an estimated 4.7 million cubic meters of structural and appearance lumber annually. The annual production per sawmill ranges from a maximum of approximately 620,000 m^3 to a minimum of 1,600 m^3, with an average production of around 35,000 m^3 per sawmill. It is important to note that these figures are indicative, as they are derived from production volumes reported at the time each company entry was added to or last updated in the database:

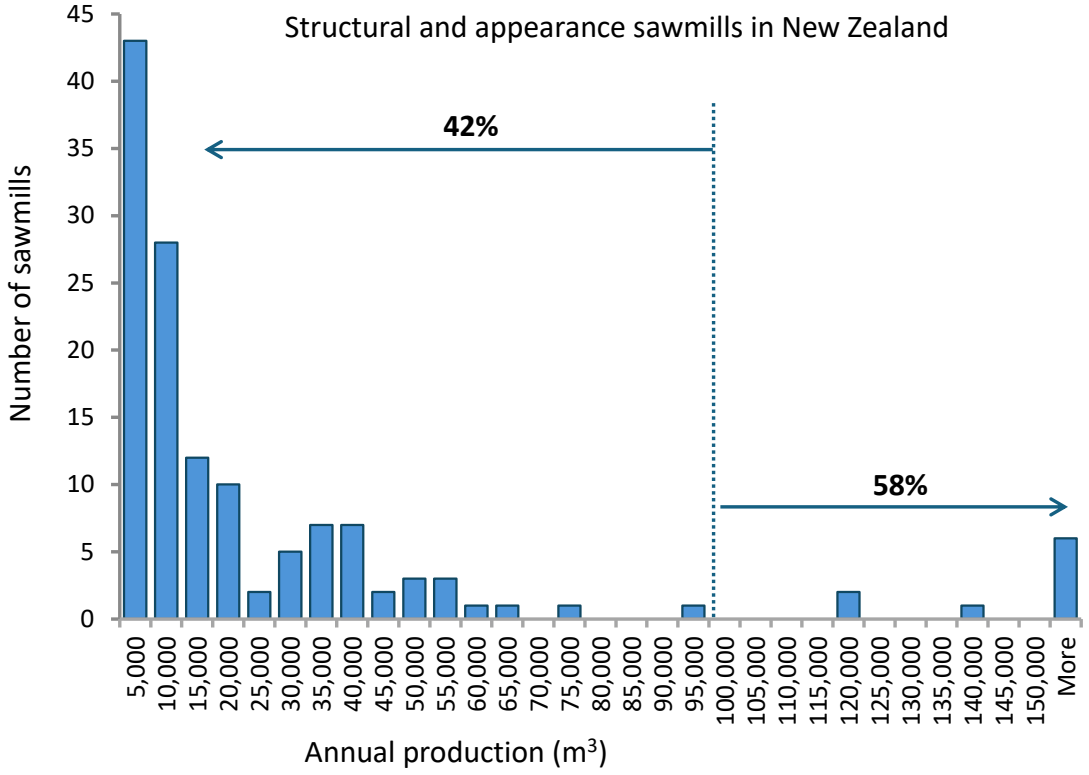


Figure 1: Number and annual production of structural and appearance sawmills

Approximately 60% of the national sawn timber production is accounted for by the nine largest sawmills. The remaining 126 sawmills each have an annual output below 100,000 cubic meters. For the purposes of this study, an annual production threshold of 100,000 m^3 is applied as an indicative criterion to define small and medium enterprises (SMEs) within the New Zealand forest products sector. Figure 2 illustrates the geographic distribution of small and medium-sized sawmills (SMEs) across New Zealand, along with their comparative total annual production volumes, represented by green bars:

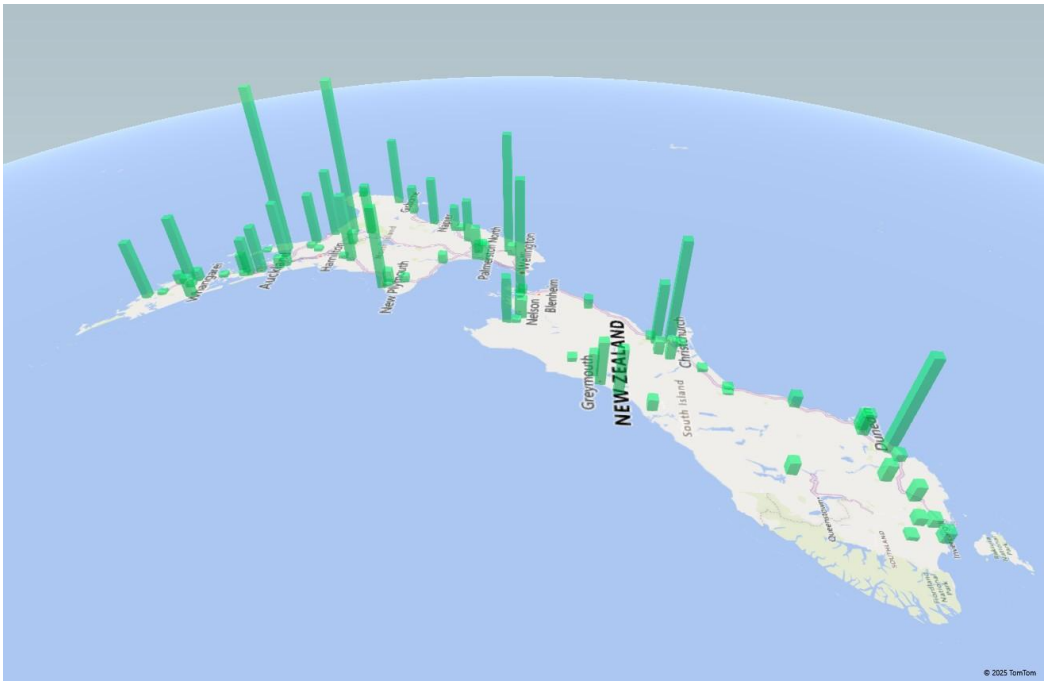


Figure 2: Geographical locations and comparative production of SMEs sawmills

Secondary wood processing

Figure 3 presents the number and annual production volumes of remanufacturing plants in New Zealand. According to Scion's internal database, a total of 40 operations have been identified, collectively producing an estimated 596,000 cubic meters of remanufactured wood products annually. The annual production per operation ranges from a maximum of approximately 90,000 m^3 to a minimum of 4,500 m^3, with an average production of around 15,000 m^3 per plant. It is important to note that these figures are indicative, as they are derived from production volumes reported at the time each company entry was added to or last updated in the database:

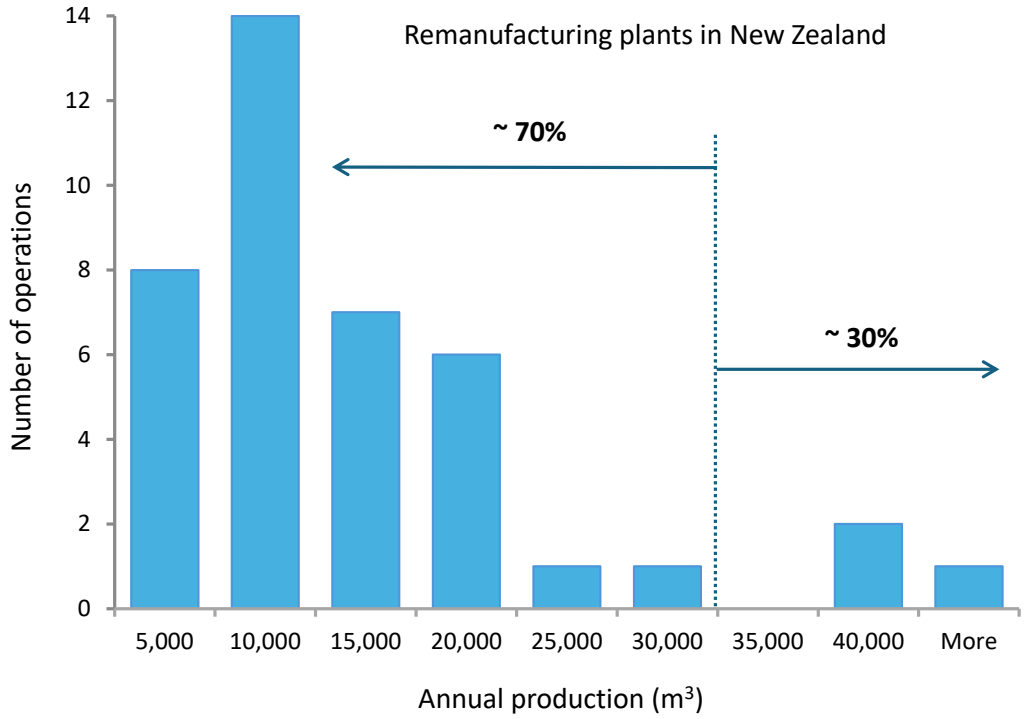


Figure 3: Number and annual production of remanufacturing plants

Approximately 30% of the national remanufactured wood production is accounted for by the three largest plants. The remaining 37 plants each have an annual output below 30,000 cubic meters. All remanufacturing plants included in this study are classified as small and medium enterprises (SMEs), based on the defined annual production threshold of 100,000 m^3. Figure 4 illustrates the geographic distribution of remanufacturing plants across New Zealand, along with their comparative total annual production volumes, represented by green bars:

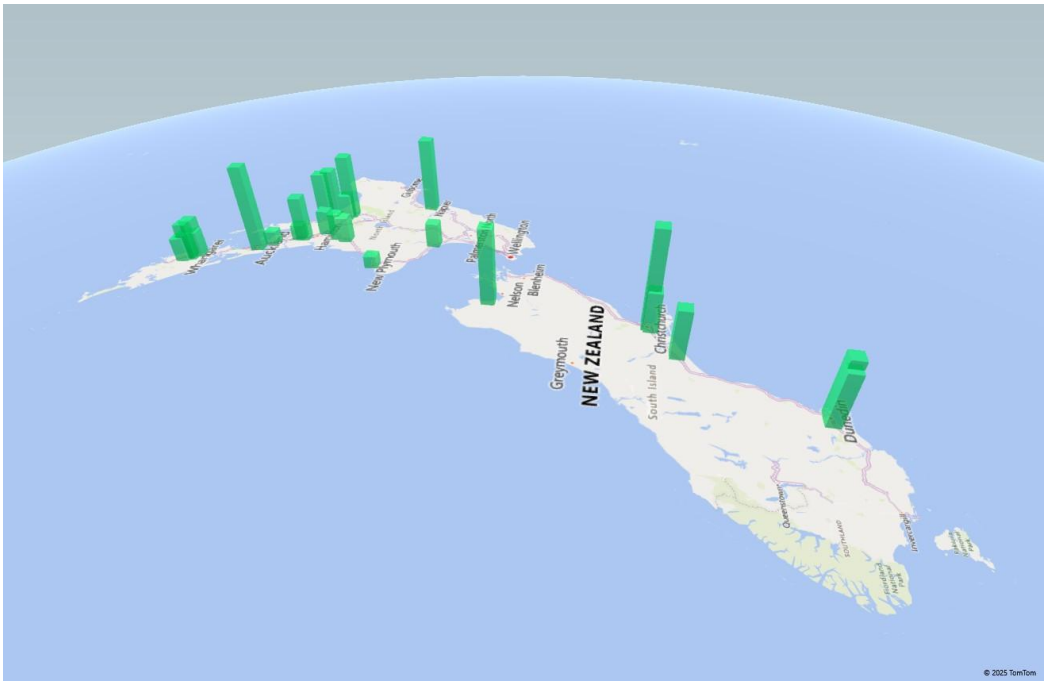


Figure 4: Geographical locations and comparative production of remanufacturing plants

Posts and poles

According to Scion's internal database, a total of 22 operations have been identified, collectively producing an estimated 369,000 m³ of posts and poles annually. Twenty of these operations are classified as small, with annual production per operation ranges from a maximum of approximately 14,000 m³ to a minimum of 2,000 m³, with an average production of around 7,000 m³ per plant. Two operations - PermaPine and Goldpine - are at the upper threshold of what is considered small and medium-sized enterprises (SMEs) in this study, with annual production volumes of approximately 100,000 m³ and 130,000 m³, respectively. It is important to note that these figures are indicative, as they are derived from production volumes reported at the time each company entry was added to or last updated in the database. Approximately 63% of the national posts and poles production is accounted for by the two largest plants.

Veneer, plywood, and LVL

Table 1 presents location and annual production volumes of veneer, plywood, and laminated veneer lumber (LVL) in New Zealand. According to Scion's internal database, a total of 9 plants have been identified, collectively producing an estimated 465,400 m³ of veneer, plywood, and LVL annually. The annual production ranges from a maximum of approximately 127,000 m³ to a minimum of 10,000 m³, with an average production of around 52,000 m³ per plant. It is important to note that these figures are indicative, as they are derived from production volumes reported at the time each company entry was added to or last updated in the database. Approximately 49% of the national veneer, plywood, and LVL production is accounted for by the two largest plants. The remaining seven plant each have an annual output below 100,000 m³ and are considered SMEs based on the defined annual production threshold of 100,000 m³:

Table 1: Locations, company names and production of veneer, plywood, and LVL

Owner	City	Product	Production (m^3)
Millari Group	Gisborne	LVL	35,000
CHH Wood Products	Madsen Point	LVL	36,000
Juken NZ Limited	Masterton	LVL	55,000
Nelson Pine Industries	Nelson	LVL	100,000
Juken NZ Limited	Masterton	Plywood	10,000
Millari Group	Gisborne	Plywood	10,400
International Panel and Lumber	Greymouth	Plywood	17,000
CHH Wood Products	Tokoroa	Plywood	75,000
Juken NZ Limited	Kataia	Veneer	127,000

APPENDIX 2: Main wood products

Primary wood processing

A significant portion of New Zealand's primary timber output is dedicated to structural applications. Sawmills across the country produce various grades of structural timber, such as SG6, SG8, SG10, and SG12, adhering to standards like NZS 3604:2011 for timber-framed buildings. Typical finished sections range from approximately 70×45 mm up to 290×45 mm, in lengths of up to 6.0 metres. Treatments ensure durability: boron-based H1.2 for interior framing, and copper-based treatments (e.g. CCA or azole at H3.2, H3, H4, H5) for exterior or ground-contact timbers. Specialty structural items - for instance, SG8 100×100 mm veranda posts or top-plate packers - are also produced with appropriate H5 treatment where required.

Rough-sawn and merchant-grade timbers are supplied in bulk. Lower-grade pine boards and battens (e.g. 25 mm thick boards, 75-300 mm wide) are sold as merchant or boxing grade, typically treated to H3 or H4 for durability. These are used for pallets, crates, formwork, and general construction backing. Even small specialty items - weatherboard strips, pickets, trellis battens, and the like - are available in the product range.

Beyond structural applications, New Zealand's sawmills also specialize in producing appearance-grade and clear-grade timber. These higher-quality products are ideal for furniture, joinery, and decorative purposes. Appearance-grade and finishing timbers include clear and quartersawn boards. High-grade radiata pine from pruned logs yields straight-grained, knot-free lumber, which is precision-sawn and dressed on all four sides. These "clear" boards are ideal for furniture, interior trim, window joinery, and other visible applications. Pine mouldings, skirtings, architraves, and weatherboards (in bevelled or shiplap profiles) are produced in primed or coated forms for façades and exterior trim.

Clear boards and mouldings are also produced from logs with small knots, where the knotty sections are docked out, creating short lengths of clear wood which are finger-jointed together to produce long clear bords and mouldings. The offcuts are often used as firewood or boiler fuel as the knotty sections have higher calorific value than the clear wood sections and in some cases they have been kiln dried before the processing occurs.

The industry also caters to various industrial needs by producing specialty timber products, which add variety to the market. Cypress macrocarpa (New Zealand-grown) is offered in several grades. Clear macrocarpa (free of knots) is available in most board sizes up to approximately 300×50 mm. A "landscaping" grade (rustic) with small knots is sold for exterior use, with larger sections (from 150×50 mm up to 300×100 mm or more) supplied in green-sawn form. Cypress macrocarpa beams and square posts are produced in cross-sections up to 300×200 mm, with lengths of 6 to 7.5 metres. Other specialty species include Western Red Cedar (used for exterior joinery, cladding, and mouldings) and Douglas-fir (used in high-strength structural members).

There is also a small but expanding Redwood (Sequoia sempervirens) resource developing in the North Island. There is some niche processing of Eucalyptus species into dimensional lumber, with some interest in using Eucalyptus veneers or laminates in engineered wood products such as LVL, possibly mixed with Pinus radiata, with the goal being to produce products with higher stiffness than can be achieved by P. radiata alone.

In conclusion, New Zealand's primary timber manufacturing industry showcases a robust and diversified portfolio of wood products, ranging from structural timber to high-grade appearance lumber and industrial specialties. New Zealand sawmills produce SG-graded structural frame timber (H1.2/H3.2 treated), clear and appearance-grade lumber, specialty hardwoods and conifers, as well as outdoor landscaping boards and basic industrial timber stocks.

Secondary wood processing

New Zealand's secondary timber manufacturers produce a wide range of solid wood building and finishing products. These include exterior cladding and weatherboards, decking and outdoor boards, fencing and landscape timbers, and interior finishings and mouldings. Common items are radiata pine boards, planed and profiled for specific uses (often pre-primed or treated), such as bevel-back or shiplap weatherboards, square-edged boards, decking planks, fence rails/palings, and decorative trim (e.g. architraves, skirtings).

Manufacturers market a variety of cladding boards (e.g. weatherboards, vertical wall cladding), along with associated exterior boards such as fascia, trimmed boards, and soffit or panelling. A distinct category is decking and outdoor flooring. Many secondary mills supply ready-to-install decking boards in radiata pine (often H3.2 treated) as well as specialty products. Solid timber decking remains a common offering. Retailers also stock treated radiata pine decking boards and grooved balustrades for outdoor living spaces.

Fencing and landscape timber is another key product line. Retaining wall timbers (such as sleepers and grooved retaining boards) and other landscape timbers are frequently listed under "outdoor" categories. Rails, palings, battens, and sleepers are standard products for fencing and landscaping applications.

Interior decorative trim and joinery profiles form another major category. These include skirtings, architraves, door/window jamb liners, cornices, and moulded trim. Many companies offer a broad range of mouldings, often using finger-jointed or clear-grade radiata pine, in primed or unprimed form. Some small processing companies specialize in cut-to-length componentry and custom timber mouldings - bespoke trim profiles used in detailed interior finishes.

Other timber finishing components complete the product spectrum. These include fascia boards, barge boards, box corners, cladding accessories, and decorative pickets or balusters. Secondary mills typically kiln-dry, treat (using light organic pressure treatments or CCA), and prime-coat these products to ensure they are ready for installation. Some companies also produce laminated products for posts, rails and beams, as well as flooring systems and laminated cladding. Edge glued panels for furniture is also a popular product from radiata pine.

In summary, common solid timber building products beyond framing lumber include weatherboard and cladding profiles, decking and outdoor boards, fencing components (rails, palings, sleepers), decorative mouldings and interior trim, and other finishing boards (fascias, panelling, box corners). Each manufacturer offers variations on these themes. For example, many advertise pre-primed bevel-back weatherboards, profiled skirtings and architraves, or treated decking and landscaping timber.

Posts and poles

New Zealand's wood post and pole sector supplies a wide range of treated radiata pine products essential for rural animal fencing, horticulture trellises, construction, and utility infrastructure. These products are typically vacuum pressure-treated with CCA preservatives to durability classes H4 (ground contact), H5 (structural use), and H6 (marine environments). Key sectors served include agriculture (farm fencing, stockyards, gates), horticulture (trellising for kiwifruit and vineyards), construction (pole sheds, barns, foundations), and infrastructure (utility lines, marine pilings, retaining walls, urban fencing).

Fence posts include standard round posts, half-rounds, and quarter-rounds, widely used on farms for boundary and internal fencing. Strainers and stays are larger-diameter posts used at corners or gateways where additional strength is required. Utility and structural poles are longer and used in applications such as construction and power transmission. Horticulture and viticulture poles, designed for orchards and vineyards, are thinner, more uniform, and precision graded. Foundation and ground poles are often treated to higher durability levels (e.g. H5 or H6) to resist decay in wet or challenging environments.

Most poles and posts are treated in accordance with New Zealand standards, using preservatives such as CCA (Copper Chrome Arsenate) or newer, environmentally sensitive alternatives such as Alkaline Copper Quat (ACQ). Treatment classes vary from H3.2 (above-ground exposure) to H5/H6 (in-ground or freshwater contact). In conclusion, New Zealand's post and pole manufacturing industry is robust, regionally diverse, and critical to the rural economy. The sector collectively produces a comprehensive range of treated roundwood products tailored to meet the needs of fencing, farming, construction, and horticulture.

Veneer, plywood, and LVL

New Zealand's wood industry hosts several manufacturing plants that specialize in veneer-based products, notably laminated veneer lumber (LVL) and structural plywood. These facilities begin by processing logs into thin sheets of rotary-peeled veneer. Peeled from sustainably grown plantation logs, the veneer is dried and graded for stiffness before being bonded into structural products. Each plant produces veneer with specific technical specifications (thicknesses, strength grades, preservative treatment levels) tailored to their end-use applications and target markets.

In some cases, veneer itself is produced as an intermediate product for use by other mills. Veneer sheets are manufactured in various thicknesses and sizes depending on the intended end use. For example, thinner veneers may be used for decorative plywood or overlays, while standard 3 mm thick veneers are typically used for structural LVL or plywood cores. Excess or specialty veneers are sometimes sold to other wood product manufacturers - both in New Zealand and overseas - who require high-grade radiata pine veneer for their own laminated products.

Laminated Veneer Lumber (LVL) is a high strength engineered wood product made by bonding multiple layers of thin veneer with the grain all oriented in the same direction. All of New Zealand's LVL manufacturers use rotary-peeled, stiffness-graded pine veneers that are glued together into large billets, which are then sawn to the required dimensions. This process produces structural members with excellent strength, stiffness, and consistency. LVL is widely used as a direct substitute for traditional lumber or even steel, in applications such as beams, rafters, joists, lintels, truss chords, scaffold planks, and formwork panels.

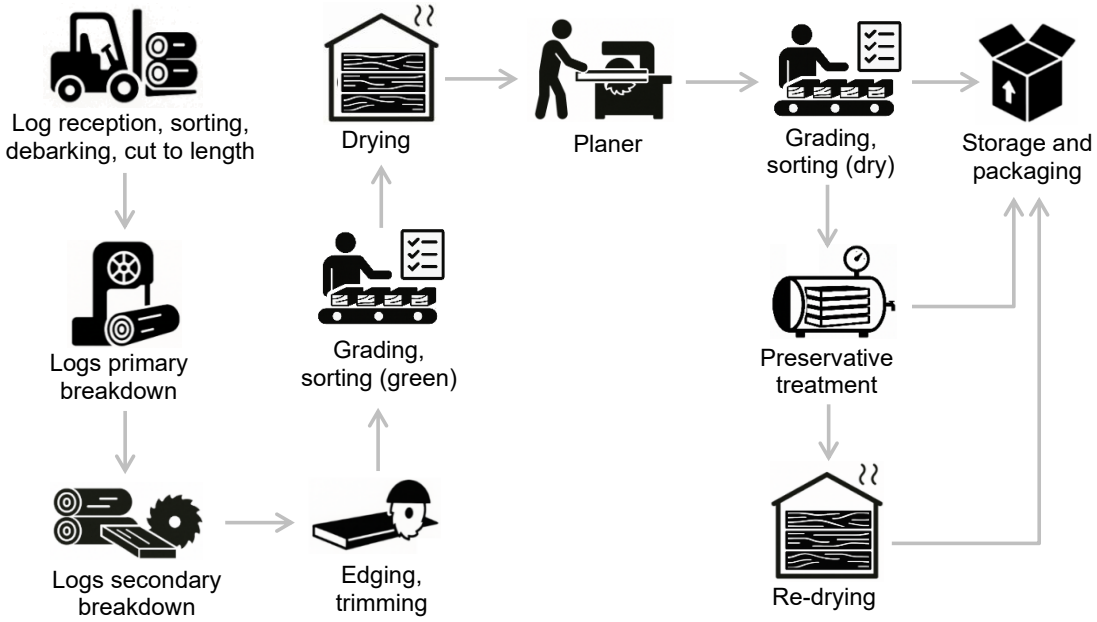
Plywood manufacturing is another major use of rotary-peeled veneer in New Zealand. Structural plywood is made by arranging veneer sheets in a cross-laminated stack - with each layer's grain at right angles to the next - and bonding them under heat and pressure. This cross-lamination, using radiata pine veneers, gives the panels strength and dimensional stability in both directions. Several plants manufacture plywood panels for construction, furniture, and industrial applications, all beginning with the same base material of peeled veneer.

In conclusion, from LVL beams to structural plywood panels, the cohesive narrative across these operations is that the rotary-peeled veneer sheet serves as the fundamental building block. This enables efficient use of plantation pine while delivering consistent, high-performance materials for the building industry. Through lamination, thin veneers are transformed into thick, strong sections, with precise control over grades (e.g. E-grade for LVL, F-grade for plywood), thicknesses, and treatment levels (e.g. H1.2 for framing, H3.2 for exterior panels) to suit diverse applications.

APPENDIX 3: Main unit operations

Primary wood processing

The following list provides an overview of the primary unit operations typically found in small and medium-sized primary wood processing facilities. A corresponding process flow diagram is included below to illustrate the sequence of material flow (the diagram is indicative only):



- Log Reception and Sorting: Incoming logs are unloaded - often by rubber tyred front-end loaders, hydraulic loaders (excavator based) or cranes - and assessed for size and quality. They are scaled (measured for volume) and then sorted in the log yard by diameter class or grade before sawing. Small and medium New Zealand sawmills typically use simple log decks or bunkers for this stage, with front-end loaders or grapple cranes placing logs into sorted piles. A conveyor-fed log deck presents the sorted logs one by one into the mill for processing, and sonic testing for segregations of logs by stiffness is also used
- Debarking: Each log passes through a debarker to strip off bark and dirt. Small and medium mills commonly use a mechanical ring debarker, which has multiple hardened cutting arms on a rotating ring that scrape the bark away at the cambium layer. This prevents debris and gravel in the bark from dulling the saws and allows a clear view of the log's surface. Older or alternative debarker types with abrasive rotating (Rosser) heads are also seen in New Zealand. Logs are fed on rollers through the debarker and emerge clean and ready for sawing.
- Primary Breakdown: Debarked logs are cut into large timber sections. A headrig - typically a band saw on a moving carriage in New Zealand small or medium mills - makes the first cuts. The sawyer turns and advances the log to open up flat faces. These cuts first produce a central cant (a squared beam) and flitches (rough boards with at least one flat face) from the outer portions. Bandsaw headrigs are common, though some mills use canters (which chip the outer log to leave two or four flat sides), chip-and-saw systems (a combination of chipping and sawing), twin saws (two parallel circular or band saws), quad saws (a set of four circular saws), gang saws (a variation on a quad saw using multiple blades), or scragg mills (a simple twin circular saw system often used in pallet-grade production).
- Secondary Breakdown: The thick cants from primary breakdown are further processed into boards by secondary machines. In many small operations, this is done with a resaw or gang saw - for example, a multi-blade circular gang saw or a band resaw - that cuts the cant into

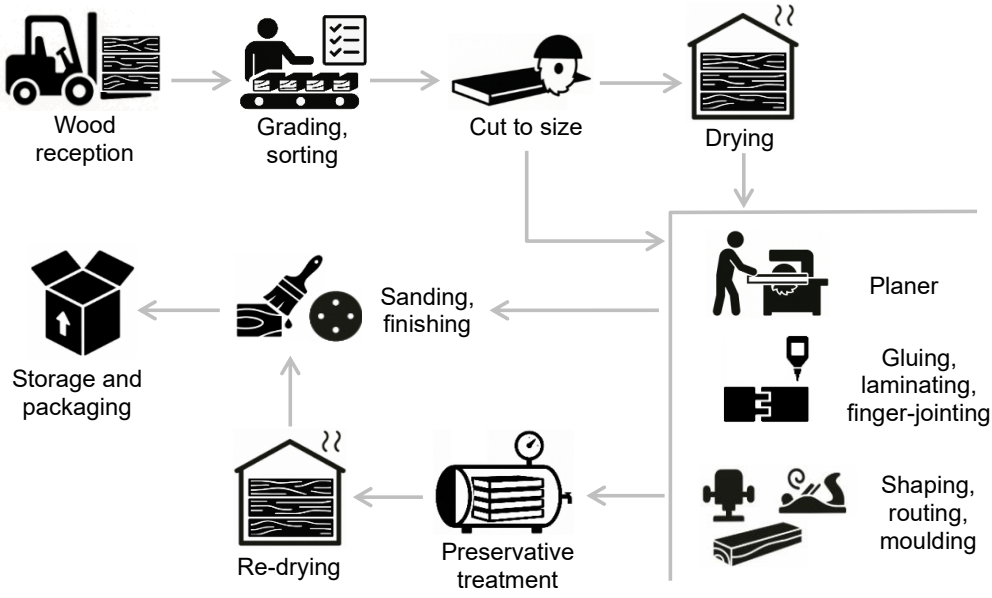
multiple thinner boards in one pass. A common setup is a multiple circular resaw (gang edger) manually fed by an operator using laser guides to position the cant for the desired board thickness. The unit slices the cant into several flitches or boards.

- Edging and Trimming: The boards (flitches) have rough edges with bark or wane. An edger machine trims the irregular, waney edges to create parallel, square sides. Typical edgers in small New Zealand mills have two or three circular saw blades whose positions can be adjusted to remove only the waste edges, resulting in clean, rectangular lumber. Operators often align each board under laser projections to determine the optimal cutting width before feeding it through. Following edging, a trimmer saw station crosscuts the boards to standard lengths. The trimmer typically consists of multiple circular saws or a single moveable saw.
- Grading and Sorting (green): The freshly sawn and trimmed lumber is then graded and sorted while still green (wet). Small and medium sawmills typically use a green chain - a slow-moving conveyor or set of chains - where workers visually inspect and hand-sort the lumber by size and quality. As boards move down the line, operators (or a grader) pull and stack pieces into designated sorting bays or bins according to dimensions (thickness/width) and visible grade criteria. Modern high-volume mills may use automated drop-sorters. The sorted green lumber is then sticker-stacked for drying.
- Drying: New Zealand's small and medium sawmills typically dry their timber in kilns, though some may use air drying as a preliminary step. Conventional lumber kilns (batch or continuous-counterflow - heated by steam from a wood-waste boiler or gas burners - are common (although for large operations continuous kilns have an efficiency advantage over batch kilns). Kilns are large, insulated chambers with circulating fans that remove moisture from the stacked boards. Radiata pine is well-suited to high-temperature drying processes, which can reduce drying times to less than one day for certain products - making it one of the more efficiently dried commercial softwoods. Drying typically reduces moisture content to 10–20%, depending on product requirements. Once kiln-dried, the lumber is referred to as "rough dry."
- Planing: Rough dry boards are planed (surfaced) to precise dimensions and a smooth finish. A planer machine - often a four-sided planer/moulder in small mills - shaves each board on all faces to achieve uniform thickness and width. These machines have multiple cutter heads (top, bottom, and both sides), enabling planing on all four sides in one pass. Feed rollers move boards through at a controlled speed, with cutting depth set by table adjustments. Planing also reveals any remaining defects, preparing the timber for final grading.
- Grading and Sorting (dry): The lumber undergoes final grading to assign it to market categories (e.g., structural or appearance grades). In small New Zealand mills, this is often done by visual grading - a qualified grader inspects each piece for defects such as knots, grain slope, and dimensions, and then stamps or marks the appropriate grade. For structural radiata pine, some medium-sized mills use mechanical stress testers or acoustic/bending machines to assess stiffness, though fully computerized grading systems are rare in smaller operations. The graded lumber is then sorted - by hand or using basic mechanical sorters - into bundles by grade, size, and length.
- Chemical Treatment: Many New Zealand pine products - especially those for outdoor or structural use - are pressure treated after drying and planing to enhance durability. In this process, lumber is loaded onto tram carts and rolled into a long cylindrical treatment vessel (autoclave). The chamber is sealed, and preservative chemicals (e.g., CCA, ACQ, or LOSP) are introduced. For boron treatment, dipping is still used as a cost-effective and simple method for treating small volumes of timber. However, it provides limited penetration and requires extended diffusion periods to achieve sufficient treatment levels.
- Packaging: Lumber is bundled and prepared for dispatch. Boards of the same size and grade are stacked into packs, which are tightly strapped with steel or plastic bands. Small mills may use manual or pneumatic strapping tools, while medium mills often employ automatic

strapping machines. Timber packs are typically wrapped with plastic sheeting or Kraft paper on the top and sides to protect them from weather and ensure stability during handling. The packaged lumber is then ready for storage or shipping.

Secondary wood processing

The following list provides an overview of the primary unit operations typically found in small and medium-sized secondary wood processing facilities. A corresponding process flow diagram is included below to illustrate the sequence of material flow (the diagram is indicative only):

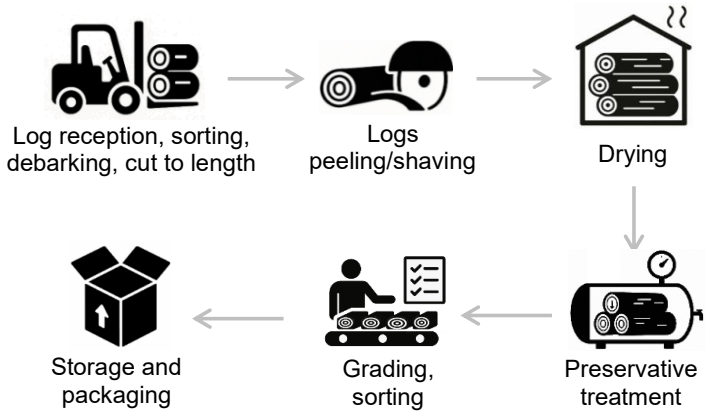


- Grading and Sorting: Incoming boards (typically rough-sawn and kiln-dried) are first graded for quality, size, and moisture content. Small-to-medium New Zealand remanufacturers often rely on visual grading to remove defects and categorize timber (e.g., clear vs. knotty grades), although larger operations may use optical scanners to detect defects and optimize yields. Graders sort boards by dimension and quality, ensuring only suitable pieces proceed to further processing.
- Cutting (Sawing): Timber is cut to the required lengths and widths, often removing defects in the process. Common equipment includes cross-cut saws - manual radial arm or pneumatic chop saws for small shops, and automated optimizing saws in advanced plants. Rip saws or band resaws are used when boards need to be split to narrower widths or thinner sections. The result is a stock of cut pieces in standardized lengths, ready for subsequent profiling or jointing.
- Drying (if applicable): While most remanufacturers source timber that is already kiln-dried (typically to 10–15% moisture content), some operations include in-house drying. This is particularly important if the wood has been exposed to moisture during processes like chemical treatment. In such cases, timber is reconditioned in a kiln to reach a stable moisture content before final machining. Small-to-medium New Zealand plants may use electric or gas-heated batch kilns or dehumidifier kilns to ensure gentle drying and avoid warping.
- Planing (Surfacing): Planing - also known as dressing - is the process of truing and smoothing timber to consistent dimensions. Machines such as four-sided planers are commonly used to dress all faces of the board in one pass. Rough-sawn lumber is passed through these cutters to produce “dressed” timber with uniform thickness and width. Accurate planing is critical for appearance-grade products and for ensuring strong glue bonds in later lamination steps.

- Shaping or Routing: Some products require additional shaping or cut-outs beyond what standard planers can provide. In these cases, spindle moulders, routers, or CNC machining centres are used to create complex features. For example, a CNC router or template router might cut decorative grooves (such as anti-slip grooves in decking), notch posts, or create custom joinery. Small New Zealand manufacturers often use routers for intricate patterns or manual spindle moulders for tasks such as bevelling edges or shaping curved profiles.
- Moulding (Profiling): Moulding involves cutting the final profile or shape along the length of the wood, transforming a flat board into products like weatherboards, tongue-and-groove decking, or interior trim, sometimes with curved sides. This is performed using a high-speed multi-head moulder - a machine with four to six cutter heads that shape all sides of the board. Each head has knives ground to the negative of the desired profile (e.g., bevels, laps, or ornate details). As the board passes through, it emerges with a precise, finished profile in one pass.
- Gluing (Lamination): In many secondary manufacturing plants, a gluing stage is used to laminate wood pieces into larger components. This may involve edge-gluing boards to form wider panels or face-gluing (stacking) to create thicker posts or beams. Surfaces are first planed smooth for tight joints, and an adhesive - typically PVA or single component polyurethane - is spread using rollers or glue spreaders. The coated pieces are assembled and clamped under high pressure in presses or clamp racks. Smaller New Zealand firms may use manual or pneumatic clamp racks with cold-setting adhesives, while larger operations use hydraulic or RF (radio frequency) presses to accelerate curing.
- Finger-Jointing: Finger-jointing is a specialized process used to create long, continuous lengths from shorter, defect-free pieces of wood, typically 250 - 400 mm long (known as “shooks”). The ends of these blocks are machined with precision interlocking “fingers” using high-speed finger-jointing machines. An adhesive - such as polyvinyl acetate (PVA) for interior use, melamine-formaldehyde (MF), or polyurethane (PUR) for more demanding applications - is applied to the mating surfaces, which are then pressed together under controlled pressure to form a strong end-to-end bond.
- Preservative Treatment (if applicable): For exterior products such as cladding, decking, or fencing, preservative treatment is commonly applied to enhance durability. In this process, timber (often after profiling or finger-jointing) is loaded into a pressure treatment vessel and impregnated with chemical preservatives. Boron treatment can also be carried out by dipping. Following treatment, the wood may be kiln-dried again to reduce its moisture content to optimal finishing levels. Required equipment includes sealed treatment cylinders, vacuum/pressure pumps, and chemical storage tanks.
- Sanding: For panels, sanding is used to achieve a smooth surface and precise thickness. Using wide-belt sanders for flat panels or profile sanders for shaped pieces, manufacturers remove raised grain, mill marks, or excess glue. This step is usually done before finishing, preparing the surface for paint or stain. Proper sanding - often to 150 grit or finer - improves coating adhesion and provides a uniform surface appearance.
- Finishing (Coating): In this final stage, wood products receive a protective and aesthetic coating. For exterior cladding and boards, it is common in New Zealand to apply a factory-applied primer or sealer. This is done using industrial equipment such as spray booths, vacuum coaters, or flow coat machines. Coated boards are dried to set the finish. Interior mouldings may be primed, fully painted, or clear-coated depending on the product line. Finishing may also include detail work such as branding or end-sealing with wax or paint.
- Packaging: Finished boards or mouldings are typically stacked into bundles of uniform length and profile. Plants can use manual or automated outfeed stackers to align and accumulate pieces into packs, which are then tightly strapped using plastic or steel bands to maintain straightness and protect edges. Weather-sensitive products may be wrapped in plastic. Each pack is labelled with product information and quantity for shipping and tracking.

Posts and poles

The following list provides an overview of the primary unit operations typically found in small and medium-sized posts & poles processing facilities. A corresponding process flow diagram is included below to illustrate the sequence of material flow (the diagram is indicative only):



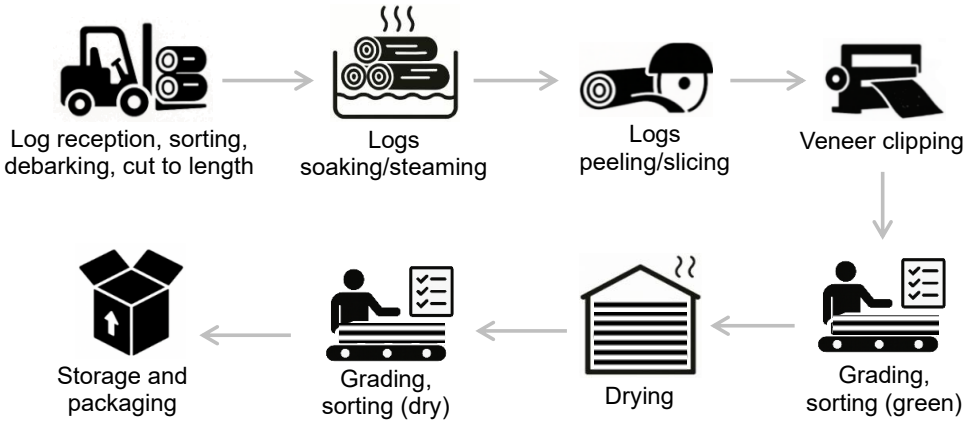
- Harvesting: Trees - predominantly Pinus radiata (which accounts for approximately 90% of New Zealand's plantations) - are felled by chainsaw crews or mechanised harvesters and skidded to the roadside or yard. Logs are typically cut into transportable lengths (usually 6 to 8 m), either in the forest or delivered as long tree stems and then "bucked" to size on-site. Equipment ranges from handheld chainsaws to purpose-built harvesters and skidders or forwarders. While radiata pine is the primary species, many growers also harvest durable hardwoods such as Eucalyptus bosistoana and Cupressus macrocarpa for specialty posts.
- Debarking: Smaller plants commonly use rotary or ring debarkers, or stationary disk-style machines that spin the log against knives to remove bark. Many commercial post-peeling machines combine debarking with end-pointing in a single pass.
- Trimming / Cutting to Length: Debarked logs are crosscut to finished lengths using saw benches or hydraulic swing saws. This process typically employs a circular or band saw on a moving carriage, often with log clamps or bunks to secure the timber. Operators measure and cut poles to standard sizes based on customer specifications. Some mills also use horizontal band saws to split peeled posts into halves or quarters for specialized products. These saws may be driven by tractor PTOs or powered by electric or hydraulic systems.
- Peeling / Shaving: The sapwood or outer layer is planed off to achieve a smooth, rounded profile. Stationary post peelers rotate the log against fixed knives, with operators adjusting the depth of cut to leave a clean, bark-free finish. Many peelers can also shape a pointed tip on the log during the same operation.
- Drying / Seasoning: Peeled posts and poles are dried to stabilize moisture content before final processing. Traditional air-drying involves stacking posts under cover with spacers for airflow, allowing natural drying over several weeks or months. Some plants accelerate drying through steam-heating in sealed cylinders, where wood is pressurized with steam and then rapidly depressurized. This process both dries the timber and conditions the wood grain for improved preservative penetration.
- Preservative Treatment: Posts are treated in a pressure-vacuum cylinder. A vacuum is first applied to remove air, after which a preservative - such as copper-chrome-arsenate (CCA) or copper azole - is injected under high pressure. The wood is held under pressure for a specified duration, and often a second vacuum is applied to remove excess preservative. In New Zealand, CCA is the standard treatment for ground contact and in-ground use, although some

facilities also offer copper azole (MCA) or oil-based treatments for applications like marine pilings.

- Quality Grading: Finished posts are graded according to size, straightness, and soundness, in accordance with New Zealand standards. Graders assess diameter, taper, sweep (bending), knot size, and surface defects. Tools such as the HITMAN sonic timber tester are used to measure acoustic velocity, estimating stiffness or density in utility poles. Larger mills may use in-line machine grading systems. Each post is marked with its grade, species, and treatment—often based on the smallest cross-sectional dimension in the case of split posts.
- Storage and Shipping: Graded posts are stacked, bundled, and stored until dispatch. Bundles are banded or strapped and placed on dunnage to keep them off the ground. Covered storage areas are used to protect treated timber from moisture and weathering. Forklifts or cranes move the bundles, typically using pallet forks or slings. Automated stacking conveyors and careful yard layout planning help optimize space and handling efficiency.

Veneer, plywood, and LVL

The following list provides an overview of the primary unit operations typically found in small and medium-sized wood veneer production facilities. A corresponding process flow diagram is included below to illustrate the sequence of material flow (the diagram is indicative only):



- Log Selection: Logs are sorted by quality, size, and grade before processing. In New Zealand, “Pruned Peeler” logs (large, straight, pruned) are used for clear face veneers, while “Industrial Peeler” logs (larger, unpruned, small knots) are used for knotty veneers or LVL cores. Logs are screened for straightness, diameter, and defect distribution; high-grade logs are reserved for decorative or structural face veneers. Log scanners or manual inspection help separate billets based on moisture content and visible defects. Acoustic testing could assist with identifying stiffer logs.
- Debarking: Logs are debarked to remove bark and dirt before peeling. Industrial veneer lines employ mechanical debarkers. In New Zealand, traditional plywood mills typically use ring debarkers, which scrape bark off.
- Soaking / Steaming (Log Conditioning): Bolts are conditioned with heat and moisture to soften the wood. This typically involves soaking in hot water or steaming: logs are placed in baths or chambers heated to 70 - 90 °C for several hours. This raises the core temperature and plasticizes the wood and knots, reducing lathe load and minimizing splitting during peeling.
- Peeling (Rotary Lathe): Conditioned bolts are mounted in a rotary lathe and peeled against a long knife to produce continuous veneer sheets. Bolts, centered by lasers or rollers, are spun at high torque while a fixed or rotating knife peels off layers 1 to 5 mm thick. New Zealand mills use robust lathes equipped with three-stage chucks and backup rolls. The peeling process produces a “loose” knife-side face with lathe checks (micro-cracks) and a “tight” back side.

- Slicing (Decorative Veneer): For appearance grade panels, logs are sliced rather than peeled. Selected (typically pruned) logs are sawn into short blocks or flitches using a bandsaw. Each flitch is then fed into a horizontal or vertical slicing machine where a knife shears off thin sheets as the wood is moved under the blade. This creates “flat-cut” decorative veneers. The slices are then clipped and arranged - either book-matched or slip-matched - to form the panel face.
- Clipping (Trimming): Freshly peeled veneer sheets are oversized with irregular edges. Clipping machines trim them to square, standard dimensions. While early mills used manual guillotines, modern plants employ powered trimmers or band saw clippers. Automated clippers can trim and sort in one step. The objective is to maximize yield - removing edges with checks or defects while achieving the desired sheet width.
- Grading and Sorting (green): Veneer sheets are sorted by moisture content before drying to ensure consistent and efficient kiln performance. Additionally, veneers are graded by stiffness, often using acoustic or mechanical methods, to classify them into strength categories. These categories are then used to create specific layup “recipes” for engineered wood products such as laminated veneer lumber (LVL).
- Drying: Green (wet) veneers are dried to a target moisture content - typically around 6 to 10% - using staged dryers. Large-scale operations use multi-deck veneer kilns or continuous dryers. Smaller facilities may use batch kilns with multiple venting stages, but this is not currently the case in New Zealand.
- Grading and Sorting (dry): Dried veneers are inspected and graded by quality, then sorted accordingly. Skilled graders assess each face and back based on knots, splits, and grain features. Many New Zealand mills use a combination of manual and automated grading - employing scanners, moisture meters, and imaging systems. Some systems measure moisture content online and sort sheets into categories; laser or camera-based scanners detect defects prior to clipping.
- Packaging: Finished veneers or panels are stacked, protected, and bundled for shipment. Sheets are separated by slip sheets or stickers and covered with plastic wrap or cardboard. Bundles are banded or shrink-wrapped to secure the stack. In practice, packaged veneers are stored under cover, often on pallets or in sheds, before shipping. Each package is labeled by grade and size before dispatch to customers or downstream processors.
- Further Processing (Gluing): Veneers are coated with adhesive and assembled into panels or billets. Common adhesives include phenol - formaldehyde (for exterior-grade products or LVL) and melamine-urea-formaldehyde (for interior plywood). Glue is applied using roller spreaders or curtain coaters to one or both veneer faces. In LVL and plywood lay-ups, veneers may be overlapped or scarfed to achieve required widths. The assembled lay-up is then hot-pressed. After curing, the panels or billets are demoulded, cooled, and undergo quality testing to confirm bond strength.

APPENDIX 4: Results of industry survey

A five-question online survey was distributed on two occasions: on 14 March 2025 via the WoodTech workshop in Rotorua, and on 7 April 2025 via the New Zealand Timber Industry Federation (NZTIF). The complete set of survey questions and responses is presented in Table Q1. It should be noted that the responses spanned a wide range of topics, and with only 18 responses, it is not possible to draw broad or statistically robust conclusions. However, this diversity of responses reinforces the observation that there is no single, universally applicable approach to improving efficiency across New Zealand's forest products sector.

In an effort to identify potential patterns within the 18 responses, selected excerpts (Highlighted in bold text in Table Q1) were grouped into thematic keywords, which are summarized in Tables Q2 to Q5. The numbers presented in Tables Q2 to Q5 indicate the frequency with which defined thematic words were mentioned in connection with specific industry sectors. A summary of the total number of mentions associated with each industry sector is provided below. The three industry sectors mentioned most frequently were appearance timber, structural timber, and chips and energy:

- Appearance timber (31%)
- Structural timber (29%)
- Chips and energy (10%)
- Remanufacturing (5%)
- Engineered wood (5%)
- Packaging material (5%)
- Equipment and maintenance (5%)
- Outdoor treated timber (3%)
- Forestry (3%)
- Shipping and logistics (3%)

The percentage of times each thematic word was mentioned within the same survey question, irrespective of industry sector, is summarised in the lists below. The most frequently mentioned thematic words were as follows. Areas with the greatest potential for growth: Products, processing, and residues. Technologies with potential to improve operational efficiency: Equipment upgrades, energy generation, artificial intelligence and thermal modification. Barriers to investment in new technologies: Costs, other priorities, and market conditions. Challenges limiting growth: Market access, business uncertainties, and lack of data.

Which areas have the most potential for growth:
- Products (34%)
- Processing (25%)
- Residues (19%)
- Exports (13%)
- Hardware (3%)
- Automation (3%)
- Energy (3%)

Which technologies have potential to improve operational efficiency:
- Equipment upgrades (40%)
- Energy generation (20%)

- Artificial intelligence (13%)
- Thermal modification (13%)
- Better hardware (7%)
- Better software (7%)

What prevents the company from investing in those technologies:
- Costs (41%)
- Priorities (22%)
- Markets (19%)
- Finance (11%)
- Understanding (7%)

What are the main challenges limiting growth:
- Markets (42%)
- Uncertainty (25%)
- Data (17%)
- Resources (8%)
- Regulations (8%)

In summary, there is clearly a need for more market research and knowledge. This is essential to determine priorities and support investment decisions. More data on internal operations is also required to support these decisions. There is substantial recognition that upgraded equipment has the potential to improve efficiency. There is also awareness of potential to improve energy recovery and to introduce new products (thermal modification).

Complete results of the industry survey

Table Q1: Complete set of questions and answers obtained through on-line survey

	Q1 **Which sector of the wood processing and manufacturing industry does your company primarily operate in?**	Q2 **Which product or market segment do you see as having the most potential for growth for your company?**	Q3 **Are you aware of any new technologies that could potentially enhance your business growth or improve operational efficiency?**	Q4 **What factors are preventing your company from investing in these new technologies?**	Q5 **If you are not aware of any new technologies, what do you consider to be the main technological challenge limiting your business growth?**
1	Manufacturing - **Structural**	**Waste fibres**			
2	Manufacturing - **Structural**	**Export** structural	**Torification and steam exploded** wood pellets	**Technology commercialisation**	
3	Manufacturing - **Structural**	**Lumber breakdown**	Not at this point	**Market conditions**	Yes
4	Manufacturing - **Appearance** grades, Manufacturing - **Structural**, Wood **chips / Energy**, **Engineered wood** products, Secondary **remanufacturing** (molding, millwork, woodturning)	**Residues**	Yes	**Time and opportunity**	
5	**Equipment** maintenance and development	**Hydraulic reliability** improvements, **sensor and AI technology** developments.	**AI**	**Not enough understanding** of where this can be implemented in reality to add value to our business to clients. Following that, how we convey that value and convert that to company growth	
6	Manufacturing - **Appearance** grades	**Value add**, **secondary processing**	**TMT**	**Previous failure** in equipment selection	**Data mining**
7	Manufacturing - **Appearance** grades	**Custom dimensions**	**Better sawmill hardware** that enables more variable production. **Smarter software** to optimise and automate decision making.	Very **large capital investments** that require a lot of planning to enable. **Uncertainty of future** costs in increasing the R&D team.	
8	Advisory to the **forestry** and forest industry sector	Developments in **processing technology** and economies	Yes	We advise - but key hurdle for our client is **returns**	**Data**
9	Manufacturing - **Appearance** grades, Manufacturing - **Structural**, Wood **chips / Energy**	**Structural**	**Cogen plants**	**Location and finance**	
10	Manufacturing - **Appearance** grades	**TMT and C1 grade** growth	**Grade scanning and AI investment**	**Cashflow timing**	

11	Manufacturing - **Appearance** grades, Manufacturing - **Structural**, Wood **chips / Energy**, **Engineered wood** products, Secondary **remanufacturing** (molding, millwork, woodturning)	**Secondary Remanufacturing**	Yes, lots.	Just **can't spare the capital to invest** with the ownership structure and lack of investors in NZ. Government loans are not the answer, that's just disguised bank debt and the banks adjust their credit to compensate.	
12	**Shipping & Logistics** - primarily sawn timber	**Sawn timber exports** - **value add**	n/a	n/a	**Current global environment** & slow NZ economy
13	Manufacturing - **Appearance** grades, Manufacturing - **Structural**	**Structural appearance** grades	***Constantly changing****	N/A	N/A
14	Manufacturing Some **structura**l, mainly **pallets, bins, gluts** etc	As above. Industrial users, **Export packaging** customers. Meat plants, Dairy Factories, Export Food	**Upgrade timber optimizer saws**	**Capital cost**	**Market demand**
15	Wood **chips / Energy**, Energy Retailer	**Energy sector**	***Regulations**** and the current electricity market structure		
16	Manufacturing - **Structural**	**Structural**		Fast follower strategy - **too expensive to develop**.	**GF priorities for volume and harvest age for logs declining** = lower density, elasticity and strength properties
17	Manufacturing - **Structural**				
18	Manufacturing - **Appearance** grades, Manufacturing - **Structural**, **Outdoor treated** wet	**Appearance** Grades	We are installing an **edger** over the next few months. Also a new **planer**.	**Markets**	**Sales and Marketing**

**** Note: Words in italic are associated to Q5***

Survey results grouped by thematic keywords

Table Q2: Which areas have the most potential for growth

Sector	Products	Processing	Hardware	Automation	Exports	Energy	Residues
Structural	3	2			2		2
Appearance	6	2					1
Remanufactured		1					1
Engineered		1					1
Outdoor							
Packaging					1		
Chips/Energy	1	1				1	1
Equipment			1	1			
Forestry		1					
Shipping	1				1		

Table Q3: Which technologies have potential to improve operational efficiency

Sector	Thermal modification	Better hardware	Better software	Equipment upgrade	Artificial intelligence	Energy generation
Structural	1			2		1
Appearance	1	1	1	2	1	1
Remanufactured						
Engineered						
Outdoor				1		
Packaging				1		
Chips/Energy						1
Equipment					1	
Forestry						
Shipping						

Table Q4: What prevents the company from investing in those technologies

Sector	Costs	Finance	Markets	Priorities	Understanding
Structural	3	1	2	2	
Appearance	3	1	2	1	1
Remanufactured	1			1	
Engineered	1			1	
Outdoor			1		
Packaging	1				
Chips/Energy	1	1		1	
Equipment					1
Forestry	1				
Shipping					

Table Q5: What are the main challenges limiting growth

Sector	Data	Uncertainty	Markets	Resources	Regulations
Structural		1	2	1	
Appearance	1	1	1		
Remanufactured					
Engineered					
Outdoor			1		
Packaging			1		
Chips/Energy					1
Equipment					
Forestry	1				
Shipping		1			

APPENDIX 5: Equipment suppliers

Table 2 outlines the primary unit operations within New Zealand's forest product industry, encompassing the Sawmill (primary manufacturing), Reman. (secondary manufacturing), Pole production (posts and poles), and Veneer processing sectors.

Table 2: Primary unit operations within New Zealand's forest product industry

Unit operation	Sawmill	Reman	Poles	Veneer
Log reception and sorting	X		X	X
Log debarking	X		X	X
Log trimming cut to length	X		X	X
Log primary and secondary breakdown	X			
Log soaking and steaming				X
Log peeling or slicing				X
Green timber edging and trimming	X			
Green veneer clipping				X
Green grading and sorting	X	X	X	X
Drying	X	X	X	X
Planing	X	X		
Dry grading and sorting	X	X	X	X
Preservative treatment	X	X	X	X
Shaping and routing		X		
Moulding		X		
Sanding		X		
Gluing, laminating, finger-jointing		X		X
Finishing		X		
Packaging	X	X	X	X

Log reception and sorting



In small to medium-sized forest product companies in New Zealand, efficient log reception and sorting are critical for optimizing sawmill operations. The equipment used in these processes is designed to accommodate varying log sizes and species, ensuring a smooth workflow and maximizing yield. Below are examples of equipment suppliers that may be suitable for SMEs:

- Nicholson and Millright: Commonly paired in New Zealand timber processing, they provide log reception and sorting systems including conveyors, log decks, and front-end loaders. Nicholson manufactures advanced ring debarkers for various log types and speeds, while Millright distributes and services Nicholson equipment locally, offering design, fabrication, installation, and support.
- Southern Cross Engineering (SCE): SCE specializes in the design and manufacture of customized log handling systems tailored to the specific needs of timber processing facilities. Their solutions typically include heavy-duty log decks and conveyors, often incorporating automated systems that classify logs into designated bins or areas.
- Sawmill Equipment (NZ): This company supplies robust log decks and conveyor systems suitable for small to medium-scale operations. Their equipment is engineered to handle various log sizes and weights, ensuring consistent feed rates into the sawmill.
- Mebor: Mebor offers a range of log decks, including motorized and heavy-duty models, as well as step feeders designed for high-speed sawing lines. Their systems are adaptable to different log dimensions and are recognized for their durability.
- MHM Automation: Through the SCE brand, MHM Automation provides timber storage and stacking solutions, including sling sorters and bin sorters capable of handling a variety of board sizes and throughput requirements.
- Hekotek: Hekotek specializes in log sorting lines that can be customized to meet the specific requirements of sawmills, offering solutions that enhance sorting efficiency and accuracy.
- Mellott Manufacturing: Mellott produces a variety of log handling equipment, including live decks, log troughs, and transfer decks, all designed to support smooth and efficient log movement within the mill.
- Bezner-Oswald: This company offers conveying systems capable of transporting logs of various lengths and diameters, providing flexibility and adaptability in log handling operations.
- Powerhand: Offers a log sorting grapple attachment designed for precise log handling, enabling operators to accurately sort and position logs during reception and sorting processes.

Log debarking



Small to medium-sized forest product companies commonly employ specialized log debarking equipment to efficiently prepare logs for further processing. The choice of debarking machinery typically depends on factors such as production scale, log size, and desired throughput. Below are examples of equipment suppliers that may be suitable for SMEs:

- MHM Automation: MHM Automation provides a comprehensive range of debarking systems tailored to various operational needs. For smaller-scale operations, they offer a proprietary Rosser Head-style debarker designed for low production volumes and large-diameter logs. They also distribute Nicholson Ring Debarkers, which are suited to medium- to high-capacity requirements.
- Fulghum Industries: Fulghum specializes in Rosser Head debarkers, offering models that accommodate different production scales. Their equipment includes a 25 hp head motor for logs between 6 and 36 inches in diameter, a 30 hp head motor for logs from 8 to 42 inches, and a 40 hp head motor for logs between 10 and 42 inches in diameter.
- Valon Kone: Valon Kone offers a broad selection of debarker models suitable for both small plants and large, high-speed production lines, enabling SMEs to select equipment that aligns with their specific capacity and performance needs. Their range includes rotor debarkers with 48 cm diameters and hydraulically pressed debarking tools along with fixed ring and sliding ring debarkers.
- SCE Debarking Systems: SCE offers a range of debarking machines, including Rosser Head, ring, and drum debarkers, suitable for various log sizes and production capacities.

Log trimming and cut to length



Small and medium-sized forest product companies use a variety of equipment for log trimming and cutting to length, tailored to their specific operational needs. The selection of

machinery depends on factors such as production scale, log size, and desired throughput. Below are examples of equipment suppliers that may be suitable for SMEs:

- Springer Maschinenfabrik GmbH: Offers fully integrated compact sawmill solutions. Also supplies standalone trimmers, log-sorting and merchandizer lines including multiple cross-cut saw stations and end-to-end log handling systems.
- Salem Equipment, Inc.: Offers integrated log debarking and log bucking systems, as well as high-speed cut-off saws in full mill lines, including stationary or mobile cut-to-length units.
- Baxley Equipment: Features cross-cut saws (cut-off systems) that use laser-scanners to optimize yield and integrate with trimming lines.
- L-M Equipment Co. Ltd: Offers hydraulically guided package saws and cut-off systems, often used for trim-to-length after debarking.
- Pacific Trail Manufacturing: Supplies deck-mounted systems built for high-accuracy log cross-cutting integrated into milling lines.
- Bezner-Oswald: Specializes in cross-cutting saw machines. Their systems process round or square logs with precise trimming post-debark.
- Peterson Portable Sawmills: Based in Rotorua, Peterson offers portable swing blade sawmills. These mills are designed to handle a wide range of log sizes and are suitable for processing both hardwood and softwood.
- Mahoe Sawmills: Mahoe's sawmills feature hydraulic rise-and-fall mechanisms and a “Cut to Taper” function, enabling precise alignment with the log's natural shape and grain for optimized recovery and accuracy.
- MHM Automation: Through its SCE brand, MHM offers systems that include an AC vector winch drive and curtain scanner, enabling accurate log positioning and cutting. These systems are designed for easy integration into existing sawmill operations and offer scalability for expanding businesses.
- Shandong Gaotong Machinery: Specializes in veneer production equipment, ensuring logs are properly prepared for veneer slicing and lamination processes.

Log primary and secondary breakdown



Efficient primary and secondary log breakdown is crucial for maximizing yield and product quality. Below are examples of equipment suppliers that may be suitable for SMEs:

- Cleereman Industries: It offers a range of sawmill carriages featuring simple yet effective designs that minimize moving parts while maximizing performance. Their modular track frames provide a precision-built foundation for carriage systems. Cleereman also supplies cant processing systems that convert squared logs into boards, as well as edger systems for trimming board edges to achieve desired widths.
- SERRA Sawmills: Specializes in both mobile and stationary sawmills equipped with wide-band sawing technology. These sawmills are engineered for durability and precision, making them suitable for a variety of operational scales and requirements.
- Primultini: It provides vertical log band saws designed for primary breakdown. Their machines are known for robust construction and can be integrated into complete sawmill lines. The company also offers resaws for processing slabs and semi-finished products, as well as multiple rip saws for efficient secondary breakdown.

Log soaking and steaming

Veneer-producing companies in New Zealand use a combination of soaking pools, steam conditioning chambers, energy-efficient steam boilers, and integrated control systems to effectively soak and steam logs. Below are examples of equipment suppliers that may be suitable for SMEs:

- Thermodyne Boilers: Thermodyne offers energy-efficient steam boilers designed for the plywood and veneer industries. Their systems provide a reliable steam supply for log soaking and steaming.
- Windsor Engineering: Windsor has developed patented technology that generates and uses clean, atmospheric-pressure steam within steam conditioning chambers. In addition to the chambers themselves, Windsor provides integrated steam generation systems tailored to their log conditioning solutions.
- Automation & Electronics: This New Zealand-based company supplies customized automation systems for the wood processing industry. Their offerings include control systems for veneer dryers and log steaming chambers.
- Shandong Gaotong Machinery: While not directly involved in log soaking, this company provides comprehensive veneer production lines, including veneer peeling machines and auxiliary equipment.



Log peeling or slicing



Log peeling and slicing are essential processes in veneer and plywood manufacturing. These operations require specialized equipment to efficiently convert logs into high-quality veneer sheets. Below are examples of equipment suppliers that may be suitable for SMEs:

- Shandong Gaotong Machinery: It specializes in veneer production equipment, including veneer peeling machines. It offers spindleless veneer peeling machines designed for processing small-diameter logs that are particularly suitable for small to medium-sized operations due to their compact design and lower operational costs. It also offers lengthwise veneer slicing machines that slice veneers along the length of the log providing different grain patterns.
- Shuliy Machinery: offers a range of veneer peeling equipment, including small wood veneer peeling machines and rotary cutting machines, designed for the efficient and precise processing of logs into veneer sheets.
- Fuzhou Mutian Import & Export: provides a comprehensive range of veneer peeling machines tailored for various applications, including spindleless veneer peeling machines, core veneer peeling machines, and face veneer peeling machines for producing thin decorative face veneers.

- HOLZH Woodworking Machinery: supplies vertical veneer slicers designed for precision slicing of various wood species. These machines slice veneers vertically and are suitable for producing high-quality face veneers.

Green timber edging and trimming



Efficient edging and trimming of wet timber are crucial for removing irregular edges and end defects in rough-sawn boards, and for producing lumber with straight sides and uniform dimensions. Below are examples of equipment suppliers that may be suitable for small and medium-sized enterprises (SMEs):

- McDonough Manufacturing: It offers manual 2-saw and 3-saw edgers, as well as combination board/gang edgers designed for durability and precision. It also provides optimized edger systems that maximize yield without requiring mill expansion, capable of handling various inputs from carriages and resaws.
- Esterer WD GmbH: It supplies manually fed edging and resaw units suitable for small sawmills. These units are ideal as a supplementary solution to main breakdown machines such as sash gangs or log bandmills.
- TS Manufacturing: It provides manual board edger systems with configurations ranging from 2 to 5+ saws. These systems are fully stress-relieved and line-bored for precision, with options including driven or idler top press rolls, spiral roll outfeeds, and automatic infeed systems for hands-free operation. TS Manufacturing also offers trimmer systems with multiple sawbox configurations for accurate end trimming. Their modular designs provide flexibility to meet demanding length specifications.
- Baxley Equipment: It offers a variety of edger systems designed to optimize lumber recovery and operational efficiency, including transverse edgers, lineal edgers, and the patented crosscut edger. The company also provides comprehensive trimmer systems suited for both sawmill and planer mill operations.

Green veneer clipping



After peeling or slicing, veneers often require trimming to achieve uniform sizes. Veneer clipping machines, also known as veneer guillotines, are used for this purpose. Below are examples of equipment suppliers that may be suitable for SMEs:

- Qingdao Xinlihui Machinery: offers pneumatic veneer clipper machines designed for woodworking applications. These machines use pneumatic pressure to operate the cutting blade efficiently.
- Kingmarks Machinery: manufactures hydraulic wood veneer guillotine machines that meet various industrial requirements. By utilizing hydraulic systems, these machines provide powerful and consistent cutting force, making them ideal for thicker veneers or high-volume production.
- Shandong Minghung Wood Machinery: provides complete veneer processing lines, including veneer peeling machines, clippers, and stackers, tailored to the needs of small and medium-sized enterprises.

Green grading and sorting

Grading green timber is a critical process in New Zealand's forest products industry, particularly for SMEs. This process ensures that timber meets structural and aesthetic standards before further processing or sale. The equipment used combines traditional mechanical systems with advanced technologies to enhance efficiency, accuracy, and safety. Below are examples of equipment suitable for grading wet timber in New Zealand:

- EBI Electric - EBI Inspector: An AI-powered vision grading system that detects wood characteristics such as knots, wane, and grain deviations. It is designed for easy integration into existing operations, making it suitable for SMEs aiming to improve grading precision without significant capital investment.
- Comact - GradExpert: An AI-driven board optimizer that eliminates the need for manual grading. It assesses both softwood and green hardwood, optimizing board value and throughput - ideal for SMEs seeking to modernize their grading processes.

- MiCROTEC - Goldeneye 900: A comprehensive scanner that evaluates green, dry, or planed lumber from all four sides. It provides detailed assessments of defects and dimensions, enabling precise sorting and grading.
- Metriguard Mechanical Stress Grader: This system measures the stiffness of each board by applying a known deflection and recording the force required. It ensures that timber meets specific structural grades, such as SG8, which can be verified in green timber conditions.
- Tui Technology – Acoustic Grader: This system evaluates timber stiffness by tapping the board and measuring its resonant frequency. It is a non-destructive method suitable for high-speed grading lines and provides accurate assessments of timber properties.
- Calibre - Timber Vision System: Calibre Engineering offers custom-built optical grading systems tailored for the Australasian timber industry. Their solutions often integrate high-resolution imaging and software-based defect detection, designed with the operational scale and needs of local SMEs in mind.
- Lucidyne - GradeScan: A high-performance transverse scanner used globally in both green and dry mills. It uses vision and laser technologies to detect defects in real time and optimize grading decisions automatically.
- Sterling Solutions - Stress Wave Timer: This portable, non-destructive testing tool evaluates stiffness in logs or sawn timber using ultrasonic stress wave propagation. It's a low-cost option suitable for smaller operations needing stiffness classification in green timber.
- USNR - Lineal High Grader (LHG): Though traditionally used in larger operations, scaled-down versions of USNR's grading systems are available for SMEs. These systems use multiple sensors to detect defects and optimize lumber based on predefined grading rules.



Grading and sorting wet timber in New Zealand's SMEs may also involve manual inspection stations and it requires conveying systems. The integration of these components ensures that timber products meet both structural and visual quality standards. Below are examples of equipment suppliers that may be suitable for SMEs:

- Supply Services Ltd: Exclusive New Zealand distributor of the Shark Fin™ Board Turning System, designed to assist manual graders by automatically turning boards for inspection.

- MHM Automation (formerly Southern Cross Engineering): Designs and manufactures timber storage and stacking solutions, including sling sorters, bin sorters, and stacker lines suitable for various board sizes and throughput levels.
- Skookum Technology: Offers a range of timber sorting equipment and systems for sawmills and planer mills, including bin sorters, sling sorters, and tray sorters.
- Supply Services Ltd: Also supplies various chains used in timber processing, such as bin sorter chains with polyurethane J-hooks, welded steel mill chains, and rooftop series chains.
- Dyno Conveyors: Customizes chain conveyor systems to meet specific needs, offering products such as chain roller conveyors and plastic Dyno chains.
- Conveyor Industries Ltd: Designs, manufactures, and installs conveying systems, including chain transfer systems and rollcases, for various industries across New Zealand and Australia.
- Grain Tech Ltd: Provides tube and chain conveying systems suitable for continuous conveying of bulk materials, with applications in wood processing and other industries.

Drying



Drying timber in small and medium-sized enterprises (SMEs) in New Zealand relies on a combination of cost-effective, scalable, and energy-efficient kiln technologies. Below are examples of equipment suppliers that may be suitable for SMEs:

- Nyle Systems: Offers a range of lumber drying kilns suitable for various scales of operation, including SMEs. Their systems are known for energy efficiency and ease of integration.
- American Wood Dryers: Provides high-performance kiln designs featuring additional coils and large fans to enhance heat capacity and air velocity.
- KDS Windsor: Supplies advanced kiln drying systems tailored for both hardwood and softwood markets. Their kilns are recognized for exceptional performance, reliability, and energy efficiency.

- Fujian Zhangping Chiqin Technology: Offers track-type veneer drying kilns designed for small to medium-sized wood processing operations. These kilns feature corrosion-resistant aluminum alloy shells and intelligent control systems for optimized drying.
- Wood-Mizer: Provides dehumidification kilns equipped with corrosion-resistant aluminum cabinets and specially coated dehumidification coils to ensure durability and long service life.
- Shuowei HF: Offers a range of high-frequency vacuum wood drying kilns engineered for efficient, uniform, and rapid lumber drying with minimal defects.
- MAHILD Drying Technologies: Renowned for high-performance lumber drying kilns, including high-temperature (UHT) and continuous drying systems. MAHILD kilns are utilized by major New Zealand timber processors like Red Stag Timber.
- Termolegno: Specializes in sustainable wood drying and steaming machines. While primarily based in Europe, Termolegno's equipment is available internationally, including in New Zealand.

Planing



Planing dry timber is a critical operation that requires reliable, efficient, and precise machinery. The equipment typically includes four-sided planers, combined planer-thicknessers, and specialty planers, tailored to the scale and specific needs of the operation. Below are examples of equipment suppliers that may be suitable for SMEs:

- REX Maschinenfabrik: Offers compact four-sided planers designed for small to mid-sized operations. These machines accommodate a variety of applications, including planing of solid timbers, boards, tongue-and-groove profiles, profiled logs, and glued laminated timber (glulam), whether wet or dry.
- SCM Group: Provides combined planer-thicknessers that are ideal for small workshops, offering versatility and space efficiency in one compact unit.
- WEINIG: Supplies planing machines that cater to a wide range of applications, from small-scale workshops to full-scale industrial production lines.
- Newman Machine Company: Offers a variety of planers suitable for SMEs, focusing on high-quality finishing of boards and dimensional lumber. Their machines include features specifically designed to meet the needs of smaller operations.

- Yates-American Machine: Provides versatile planers capable of delivering high-quality finishes on boards and patterned panel stock. Their machines are adaptable to a wide range of operations, making them well-suited for SMEs.
- Ledinek: Specializes in high-performance four-sided planers and profiling lines. Their compact models are suitable for SME operations that require precision and high surface quality in solid wood processing.
- Boarke Group: Offers cost-effective planers and moulder solutions for small to mid-sized woodworking businesses. Known for compact design and ease of use, particularly in Southeast Asian markets.
- Griggio: Manufactures reliable planer-thicknessers and four-sided planers with a focus on affordability and durability-ideal for workshops looking to upgrade without heavy capital expenditure.
- Houfek: A Czech manufacturer providing industrial woodworking machinery, including four-side planers and surface planers, with robust construction tailored for small-scale continuous use.
- Cantek: Supplies a wide range of woodworking machines, including planers and jointers with strong after-sales support. Their models are well-regarded by SMEs for their simplicity and reliability.

Dry grading and sorting

Dry timber grading and sorting processes are increasingly automated, leveraging advanced scanning technologies to enhance efficiency and accuracy. Below is an overview of typical equipment used in these operations, with a focus on solutions suitable for SMEs:

- MiCROTEC: Offers comprehensive scanning and optimization solutions for the wood processing industry, including grading and sorting of dry timber. Their systems provide high-precision, multi-sensor grading capabilities tailored for SMEs.
- EBI Electric: Specializes in AI-powered wood scanners that deliver dimensional precision, appearance control, defect detection, and production yield optimization. Their systems are designed specifically to meet the needs of SMEs seeking reliable and advanced wood scanning solutions.
- Comact: Provides a grader-free board optimizer powered by artificial intelligence, suitable for both softwood and dry or green hardwood products. The system supports grading to industry standards or custom grade specifications.
- Argos Solutions: Focuses on the engineering, design, and manufacture of surface grading systems and panel repair systems for the wood panel and building materials industry.



Automated veneer analysers are widely used to evaluate veneers based on visual appearance, moisture content, and mechanical strength in large operations. These systems utilize technologies such as machine vision, ultrasonic testing, and radio-frequency sensors to detect defects and measure properties like density and modulus of elasticity. Below are a couple of examples. However, manual grading remains an essential practice for small operations in New Zealand, where operators assess veneers for defects such as knots, splits, and discoloration to ensure compliance with product specifications.

- Metriguard: It specializes in non-destructive testing equipment for the wood products industry, including models designed to measure veneer properties such as density, moisture content, and modulus of elasticity.
- Raute: Provides comprehensive veneer grading solutions, including analysers for various stages of veneer processing, such as peeling, drying, and patching.

Pole producers are required to implement rigorous quality assurance procedures that include the documentation, maintenance, and calibration of measuring and monitoring equipment such as testing devices, load cells, and pressure gauges. Commonly used equipment includes purpose-built proof testing machines capable of handling poles up to 20 meters in length. These machines typically use hydraulic rams to apply and measure loads, ensuring compliance with strength and density specifications.



Preservative treatment



In New Zealand, companies utilize a range of specialized equipment for wood preservative treatment, tailored to meet local standards and environmental considerations. Below are examples of equipment suppliers that may be suitable for SMEs:

- Kop-Coat Protection Products: Specializes in innovative protective solutions for timber and manufactured wood products, including specialty chemical programs and application equipment. It offers chemical handling and mixing units, as well as automation and control systems for wood preservation processes.
- Incon Automation: Specializes in designing and building remote electrical cabinets for the control of automated processes and robotic systems in timber processing operations. It provides custom-built solutions that integrate advanced electrical controls, ensuring seamless automation and system integration for timber treatment plants.
- Koppers Performance Chemicals: A leading supplier of timber preservatives in New Zealand, offering products like MicroPro® (Micronised Copper Azole), Lifewood® CCA, NatureWood® ACQ®, and Protim® LOSP systems. They also provide anti-sapstain treatments such as Blue Control® and Hylite®.
- Arxada NZ: Formerly known as Lonza, Arxada NZ develops and manufactures timber treatment chemicals, including fungicides and insecticides. Their products are tested and produced in New Zealand, ensuring suitability for local conditions.

- Alchemy Agencies: Supplies a wide range of technical actives and formulation raw materials to the wood treatment industry. Their offerings include preservatives and fungicides from Lanxess, surfactants and emulsifiers from Stepan, and other specialty chemicals.

Shaping and routing



Shaping and routing tasks are facilitated by specialized equipment designed for efficiency, precision, and adaptability to various production scales. Below are examples of equipment suppliers that may be suitable for SMEs:

- Avid: It offers customizable CNC routers suitable for workshops of various sizes. These machines provide expansive work areas to accommodate large material sheets and feature high-performance components, including precision ball screws and rigid all-metal designs.
- SCM Group: It provides a range of CNC machining centres designed for routing and drilling applications. These machines deliver advanced technological solutions for producing a wide array of wood components, including furniture parts and architectural elements. Features include high-speed processing, modular configurations, and user-friendly interfaces.
- HOMAG: It offers CNC machining centres tailored for furniture manufacturing, architectural millwork, and panel processing. These machines support efficient nesting capabilities, enabling the sizing, shaping, grooving, engraving, and drilling of multiple parts on a single panel.
- Hoffmann: It supplies bench-top machines designed for the precise end trimming of applied window and door mullions. Features include two counter-rotating router motors with adjustable speed controls, pneumatic hold-down clamps, and fine adjustment settings for accurate cuts.

Moulding

Moulding operations are essential for producing components such as skirting boards, architraves, window frames, and decorative trims. These tasks require specialized

machinery that offers a balance of precision, efficiency, and adaptability. Below are examples of equipment suppliers that may be suitable for SMEs:

- SCM Group: Offers a range of through-feed moulders designed to machine solid wood, MDF panels, and similar materials along their length. Their models cater to both artisan and industrial woodworking, delivering consistently high-quality results.
- WEINIG: Provides planing machines and moulders for the longitudinal processing of solid wood and panels. These machines offer precision and reliability in creating profiled mouldings from square timber. Their modular design allows customization based on individual requirements for quality, flexibility, and performance.
- HOMAG: Supplies a variety of moulder machines available with manual or CNC setup, independently driven spindles, and configurations ranging from 4 to 8 spindles. Key features include profile memory, CNC controls for fast setup, and heavy-duty feed systems.
- Woodmaster: Offers planer/moulder machines that combine both planing and moulding functions. Designed for custom builders and small-scale manufacturers, these machines enable the production of a wide variety of moulding profiles.



Sanding

Sanding is a critical process for achieving smooth, high-quality wood surfaces. Small and medium-sized enterprises (SMEs) typically employ a range of sanding equipment tailored to their production needs. Below are examples of equipment suppliers that may be suitable for SMEs:

- Costa Levigatrici: It specializes in wide belt sanding machines designed for calibrating and sanding wood surfaces. Their equipment is suitable for small to medium-sized woodworking operations and includes technologies for both sanding and brushing applications.
- SCM Group: It offers a range of sanding machines for woodworking and custom craftsmanship. Their sanders are ideal for calibrating solid wood, sanding, and veneered panel finishing, making them well-suited for craftsmen and small woodworking companies.
- HOMAG: It provides wide belt and brush sanding machines designed for high-quality surface finishing of wood and panel materials. Suitable for small to large-scale

operations, their solutions support fine sanding, brush sanding, and lacquer sanding, with efficient handling of small workpieces and complex profiles.

- Timesavers: It offers versatile sanding and finishing machines tailored for small to medium-sized woodworking operations. Their equipment ensures efficient, high-quality surface preparation with minimal setup time, making it ideal for cabinetmakers and furniture manufacturers.



Gluing, laminating, finger-jointing



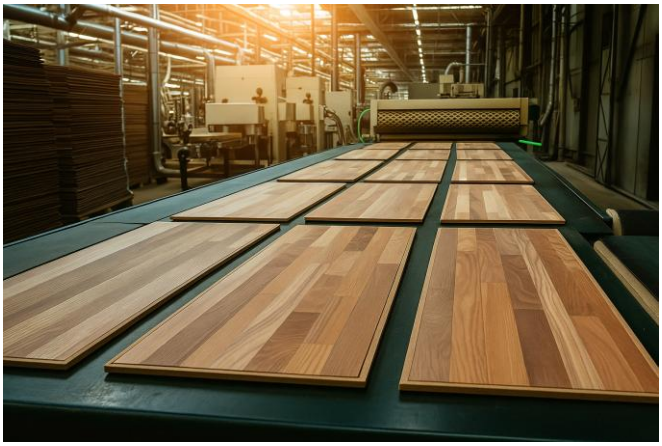
Processes such as gluing, laminating, and finger-jointing rely on specialized equipment that balances precision, efficiency, and adaptability. Below are examples of equipment suppliers that may be suitable for SMEs:

- Oliver Machinery: It offers a range of jointers designed for preparing wood edges for gluing. Their models feature robust construction and precision engineering, ensuring smooth and accurate edge preparation. These jointers are equipped with helical cutterheads, providing a superior finish and reduced noise levels.
- HOMAG: It provides a comprehensive range of edge banding machines tailored to various production needs. For entry-level applications, it offers precise gluing units

capable of processing PUR glue. For more advanced requirements, it offers multi-level technology for the automated processing of different profiles.

- WEINIG: It offers compact finger-jointing lines designed for efficient gluing applications. These systems feature contact-free glue application and top-to-bottom shaping, ensuring high-quality finger joints. The equipment is optimized for transporting freshly pressed finger joints in the production direction.

Finishing



Surface coating systems are essential for enhancing the durability and aesthetic appeal of wood products. Below are examples of equipment suppliers that may be suitable for SMEs:

- SCM Group: It provides comprehensive finishing solutions suitable for SMEs. Their offerings include automatic and robotic spraying lines equipped with vertical, linear, or UV dryers; roller and curtain coating lines ideal for flat panels; specialized equipment for coating three-dimensional items such as window and door frames; and advanced UV and UV-LED curing technologies.
- HOMAG: It offers compact spray machines designed for small to medium production volumes. These machines feature a pressurized spray cabin, automated part recognition for efficient coating application, dual-stage exhaust filtration, and a user-friendly touchscreen interface.
- Biesse: Supplies a range of finishing equipment designed for flexibility and scalability, including edge coating machines, roller coating lines for flat surfaces, and automated finishing lines that integrate multiple processes.

Packaging

Timber packaging is crucial for product protection, compliance with export standards, and streamlined logistics. Several local suppliers offer specialized equipment and solutions tailored to the unique needs of these operations.

- Smipack: It offers a range of semi-automatic and automatic shrink wrappers and L-sealers which are characterized by a great quality/price ratio and modularity. These machines are suitable for various products and can be supplied with or without a shrink tunnel, making them adaptable for SMEs.

- Viking Masek: It manufactures packaging machines, including vertical form fill seal machines, stick pack, sachet, and premade pouch fillers. Their equipment is designed to be flexible and can handle a variety of products, making them suitable for SMEs in the forest products sector.
- TransPak: It provides comprehensive packaging solutions, including custom wood crates, skids/pallets, and protective packaging materials. Their services are tailored to meet the needs of various industries, including the forest products sector, and are suitable for SMEs.
- Wexler Packaging Products: It offers alternative packaging and bundling solutions, including banding machines, which are compact and can be easily integrated into existing production lines. Their equipment is designed to be efficient and is suitable for SMEs looking for cost-effective packaging solutions.



Boiler suppliers in NZ

Boilers are primarily used to generate steam and heat. Boilers in the New Zealand forest product sector typically burn wood residues such as bark, sawdust, and wood chips - turning waste into energy. Below are examples of boilers suppliers that may be suitable for SMEs:



- Taylor's Manufacturing: A leading New Zealand manufacturer with over 50 years of experience, specializing in industrial and commercial boilers and stokers for the New Zealand and Australian markets. They offer solutions for solid fuel, electric, diesel, and gas low-pressure hot water systems.

- Lyttelton Engineering: Supplies Maxitherm boilers—robust, fuel-flexible, and ISO 9001 certified—with 24/7 support and portable backup units.
- Tubman Heating: Supplies, installs, and services a full range of heating systems, including high-efficiency boilers, burners, heaters, and sustainable biomass heating solutions. With over 35 years of experience, they provide 24/7 support.
- Windsor Energy: Specializes in sustainable thermal energy solutions, offering industrial biomass boilers, electric and electrode boilers, fuel conversions, and consulting and engineering services.
- Advance Boiler Services (NZ): Focuses on energy-saving innovations, including Organic Rankine Cycle (ORC) technology, to help businesses reduce energy costs and carbon emissions.
- Nu-Way Energy: Provides a comprehensive range of burners, boilers, heating equipment, and spare parts across New Zealand.
- McKenzie & Ridley Kawerau Ltd: An ISO 9001:2015 certified company offering boiler engineering and boilermaker services across New Zealand, Australia, and the South Pacific.
- Cooke Industries: Supplies a complete range of high-efficiency steam boilers and indirect steam generators, utilizing the latest European designs for optimal performance and low emissions.
- ComMec – Combustion/Mechanical Ltd: Represents Hurst Boiler in New Zealand, providing sales and support for a full line of industrial boilers, biomass boilers, and boiler room equipment.
- Polytechnik: An Austrian-based company specializing in climate-neutral technologies for heat and power generation from biomass. With over 50 years of experience and more than 3,000 systems installed worldwide, they offer solutions including combustion, gasification, and carbonization systems.
- C H Faul & Company: The New Zealand agent for Froling Wood Boilers, supplying and installing log, wood chip, and pellet boilers. Froling systems are known for their automation and efficiency, suitable for residential, commercial, and industrial applications.
- Heatwise Solutions: Supplies HERZ biomass boilers, offering a range from 7 kW to 1,500 kW. These boilers are compatible with various biomass fuels and are known for their high efficiency and adaptability.
- KWB – via KE KELIT NZ: Provides the KWB Easyfire pellet boiler, a durable and efficient heating system ideal for both renovations and new constructions, with extensive installations worldwide.

APPENDIX 6: Examples of Innovation Presented at LIGNA 2025

At LIGNA 2025 in Hannover, Germany, a wide array of innovations highlighted the rapidly advancing digitisation, automation, and smart integration across the wood processing and timber value chain. The exhibition showcased transformative technologies spanning production automation, AI-powered optimisation, process monitoring, and advanced materials handling.

Automation and Robotics were central themes, with numerous solutions enabling fully automated handling, machining, coating, sanding, and assembly across timber construction, furniture manufacturing, and engineered wood production. Robotic systems were demonstrated for subassembly of wall panels, door and frame production, panel sawing, and stacking. Vision-based quality inspection and AI-guided sanding and coating robots were also prominent, promising improved precision, repeatability, and labour efficiency.

Cloud-based platforms and AI solutions are reshaping digital planning and predictive manufacturing. Integrated software suites now span Enterprise Resource Planning (ERP), Computer-Aided Design/Manufacturing (CAD/CAM), Manufacturing Execution System (MES), and maintenance monitoring, enabling end-to-end data flow and optimisation across operations. AI-driven tools for press control, resin dosing, sawmilling optimisation, and maintenance decision-making were presented, promising significant gains in yield, quality, and cost efficiency.

Process monitoring innovations included advanced wireless sensors for dryer optimisation, AI-powered lumber inspection combining vision and X-ray sensing, and smart fastening platforms that enable real-time tool and quality tracking. These solutions contribute to improved control, reduced downtime, and enhanced product consistency.

Technology improvements in core woodworking equipment were also evident. High-speed nailing systems, precision CNC machines, advanced vacuum handling devices, and innovative sanding and coating technologies all aim to increase throughput while improving product quality. Developments in diamond tooling, laser engraving, and high-performance abrasives further support enhanced machining performance.

Overall, LIGNA 2025 underscored the sector's shift toward connected, intelligent, and autonomous production systems, addressing labour shortages, improving flexibility, and supporting sustainable manufacturing practices across wood industries worldwide. The following are examples of innovative solutions presented at LIGNA 2025

Automation and Robotics

- Fully Automated Edge-Banding: IMA Schelling Group showcased the Novimat Contour R3 edgebander as a "good friend" to operators. This compact machine features intelligent aimi.DO control, fully automated setup for up to four edge profiles, IR-curing glue fusing with minimal joint gap, and modular finishing units (milling, scrapers, buffing). The touchscreen interface, hand-scanner integration, and built-in production

data acquisition simplify operation, increase flexibility, and elevate edge-banding quality and efficiency.

- Flexible Sanding Robot for Surface Finishing: PolishStyl debuted a collaborative sanding robot ("cobot") equipped with a PolishStyl head that accepts interchangeable sanding brushes. Designed to handle profiles, grooves, and curved parts, its dual-joint kinematics offer enhanced flexibility. Users can swap in other heads depending on the task. This cobot delivers consistent, precise sanding with reduced manual labor while integrating seamlessly into woodworking environments.
- Automatic stick applicator for forklifts: Latvian firm ErgoTak introduced the ErgoSticks automatic stick applicator for forklifts. This fully automated system lifts, spaces, and places stacking sticks precisely - no manual loading needed. Adjustable spacing and retrofittable design enable quick setup, reduce labor costs, and boost throughput in timber stack operations.
- Unified Production Suite for solid wood: HOMAG brought its complete ecosystem - SYSTEM TM, Kallesoe, WEINMANN and others - together for the first time. The integrated suite spans solid wood processing to timber construction and furniture, unified under digital interfaces for ERP/CAD/CAM. Enhanced planning capabilities streamline workflows, boost precision, and simplify customer discussions.
- Robotic Subassembly for Wall Panels: Sweden's Randek introduced the ZeroLabor robotic subassembly cell. Designed for wall-panel construction, the system automates framing components like openings and studs with precision and speed. It integrates into larger panel production lines or works standalone, reducing manual labor, improving efficiency, and addressing skilled-worker shortages.
- Robotic Subassembly for Timber Construction: Randek also showcased its ZeroLabor robotic subassembly for timber construction. It automates framing elements such as studs and rough openings, improving throughput, standardizing quality, and supporting LEAN off-site production - all while mitigating manual labor constraints.
- 3D Vision for Inline Quality Control: Apixa showcased its 3D edge, tongue-&-groove, log, flake-mat, and flake-distribution scanners - powered by AI. These industrial-grade systems provide sub-millimeter inspection on production lines, enabling real-time defect detection, improved process optimization, and support for Industry 4.0 standards in wood panel and board production.
- Fully Automated Material Handling Systems: AMS introduced its FA and MA series handling systems, along with the COMBI line and SEALSYSTEM, designed to automate end-to-end material handling. These systems pick up stacked boards, load/unload CNC lines, apply gaskets, and feed components into assembly - offering integrated, flexible automation for doors, windows, and panel lines. Customizable and modular, these solutions streamline logistics and eliminate repetitive manual tasks.
- Robotic Sanding & Polishing System: Developed by Industrial Robotics Company (IRC), RoboSand is a versatile robotic system designed for sanding, polishing, and grinding on wood, metal, plastic, and composites. Using no-code "Easy to Teach" programming, operators can demonstrate finishing paths without scripting. It handles complex shapes, contours, and edges with consistent precision, reducing manual labor while providing uniform surface quality.
- Mirka Robotic Sanding & Polishing Cell: Mirka demonstrated a robotic cell built around their DEROS rotary sander for sanding and polishing wood and epoxy surfaces. The system delivers consistent, predictable results on irregular or curved pieces, while

enabling operators to monitor processes without direct manual intervention - boosting productivity and repeatability.

- Compact Woodworking Robot: Zimmer Group's "Raptor" is a space efficient industrial robot tailored for woodworking tasks including cutting, shaping, grinding, and painting. With a compact footprint and quick-change tool interfaces, Raptor enables multitasking in tight cells, seamlessly integrating with AMRs ("Miles") for material transport and robotic conveyors for fabrication workflows.
- Robotic Automation Across the Production Line: IRC showcased RoboSpray (for coating and glueing), RoboMill (for component machining), RoboFrame (for frame assembly), RoboPack (for packaging), and RoboCut (for cardboard cutting). All use the same no-code Easy-to-Teach interface, enabling adaptable, cross-process robotic automation across the production line.
- Robotic Inspection & Vision Systems: Baumer introduced the ColourBrain RawBoard 4.0, using line-scan cameras and advanced lighting to inspect both sides of chipboard and MDF/HDF. Equipped with industrial-grade imaging, it flags grinding faults, surface damage, and contamination at production line speeds. Its compact form factor and interoperability with control systems facilitate real-time quality control without disrupting throughput
- Robot-Assisted Assembly & Handling for Door and Frame: G. Kraft Maschinenbau showcased bespoke robotic solutions for door and frame assembly, levering automation for tasks like component loading, fastening, and sealing. Their systems - customized and robot-assisted - improve consistency, reduce manual labor, and speed up production, integrating steps from machining through packaging.
- Robot-Assisted Assembly & Handling Stacking and Packaging: Kraft also presented robotic handling cells linked with conveyor and portal transport systems. These robotic arms automate stacking, packaging, palletizing, and line feeding - ensuring cohesive material flow and reliable operation from CNC output to shipping.
- Automated Panel Sawing & Packaging: Bala Makina's DPM AV is a fully automatic vertical panel saw incorporating CNC controls, powered saw blades, and robotic clamping. It handles full panel cutting with minimal manual interaction, optimizing accuracy and throughput for cabinetry and panel shops.
- Robot-Equipped Presses & Planer Oversight: The Powermat 3000 from WEINIG includes optional robotic feeders for moulders and planers. These robots handle board input/output, minimizing manual material handling, increasing safety, and enabling continuous operation in high-volume planing and profiling.
- Robotic Coating & Spraying Systems: Range + Heine demonstrated a fully integrated coating robot featuring six-axis movement and 3D vision. The system scans objects, generates spray paths, and applies custom finishes (e.g., doors, windows) directly - combining speed, accuracy, and repeatable quality with minimal manual involvement.

Cloud and AI

- Cloud enabled catalog database: DIGI-SOFTWARE (now part of OneQrew) introduced the OneQrew HUB integrated into its ANNEXUS office software. This cloud-enabled catalog database connects carpentry firms to manufacturer-wide product information - videos, CAD/BIM files, datasheets, instructions - easily accessed via ERP for quotes or on-the-go via mobile apps. It accelerates specification, reduces errors, and enhances productivity for trade businesses.

- Real-time Data Monitoring for the Modern Maintenance Workshop: Altendorf Group revealed its NEXUS IIoT platform alongside the new F 35 sliding-table saw and Hebrock K-series edge-bander. NEXUS enables real-time data monitoring, remote diagnostics, software updates, and operator guidance - supporting digital integration, predictive service, and safety enriched woodcutting processes.
- AI-Driven Quality Control with 3D Scanners: Belgian firm Apixa debuted its latest 3D scanning systems, featuring edge scanners for real-time inspection of board edges, tongue-and-groove profiles, incoming logs, flake mats, and flakes. Utilizing industrial grade 3D vision, the solution enhances inline quality assurance, detects defects early, and supports Industry 4.0 integration in wood-based panel production.
- AI-powered design planning: Imos AG showcased the iX 2025 suite with integrated AI tools. The updated CAD, CAM, and NET modules now offer cloud or on-premise licensing, advanced visualization, and AI-powered design planning - particularly for kitchens. Users can transform customer ideas into detailed plans and quotes faster, leveraging photorealistic renderings and intelligent assistance.
- AI-driven optimization, digital planning, and predictive maintenance: HOMAG centralized its suite - SYSTEM TM, Kallesoe, Weinmann, SAWTEQ, DRILLTEQ and software like production-Manager and wood-Commander. The unified presentation emphasizes compatibility across sawmilling, CNC, panel cutting, and edgebanding. AI-driven optimization, digital planning, and predictive maintenance showcase full production efficiency.
- Integrated Software Suite: Cyncly demonstrated its integrated software suite, combining 3CAD visual CPQ tools, Insight ERP/MES/WMS, and Mozaik CNC software. The platform delivers end-to-end visibility - from sales and real time shop floor dashboards to CNC output - empowering furniture producers with higher flexibility, profitability, and production speed.
- A New Era of Sawmill Control: SERRA Maschinenbau introduced the CX control system, marking a breakthrough in sawmill automation. Featuring a large 21" TFT touchscreen, new joystick controls, smart software, and remote diagnostics, the CX system enables automatic adjustments, intelligent tool/time management, and improved usability - ushering in a new age of precision and efficiency in sawmill operations.
- Cloud-Enabled Platform across the Timber Value Chain: Swedish company ForestX unveiled Optinex integration with SAP S/4HANA. The cloud-enabled Optinex platform delivers real time planning, simulation, and optimization across the timber value chain - from log intake to finished products. By syncing log data, machine capacity, and pricing structures with existing SAP landscapes, it empowers sawmill and wood-processing operators to maximize yield, refine production sequences, and boost profitability through data-driven decision making.
- Smart Tool Tracking Solution for Fasteners and Parts: German firm iBlade unveiled its RFID-enabled iBlade Classic reader paired with Multitag 7.0/10.0. Designed for fasteners and parts tracking, this system ensures reliable, contactless scanning of components directly on the production line. By automating inventory and assembly verification, it supports traceability, reduces errors, and strengthens quality control processes.
- CAD-driven expert for managing blade profiles and tools: The WEINIG Group introduced "Moulder Master," a fully integrated digital system that bridges design to production in profiling. Featuring a CAD-driven expert system for managing blade profiles and tools, it automates job recognition, tool deployment, process data setup, and communication

with grinding rooms. Moulder Master minimizes manual steps, speeds order handling, avoids errors, and supports consistent high-quality output.

- AI-driven Solution for Multi-Daylight Panel Presses: SMARTECH (now part of Hexion) unveiled SmartPress, a breakthrough AI-driven solution tailored for multi-daylight panel presses. It autonomously adjusts press parameters in real time to minimize cycle times and optimize raw material usage, boosting throughput and consistency. A joint venture with Siempelkamp - market leader in heavy multi-daylight presses - Prod-IQ SmartPress delivers predictive press control that maximizes efficiency and product uniformity.
- Self-Learning AI Control System for PLC-Connected Production Lines: Alongside SmartPress, SMARTECH introduced its Autonomous Manufacturing platform - a self-learning AI-based solution that monitors PLC-connected production lines, learns from operator behavior, and actively implements optimal settings. Its "Ultimate Operator" capability enables fully autonomous decision-making, increasing production capacity, reducing bottlenecks, and retaining product quality - all while shifting expertise from personnel into the digital layer.
- AI-Driven Resin Reduction for Panel Production: Also from SMARTECH, SMARTMDI is an AI-enhanced resin dosing system designed to reduce MDI resin consumption by at least 15% during panel manufacturing. It integrates with existing presses and production workflows, intelligently adjusting resin flow based on real-time data, offering significant cost savings, emission reductions, and precise control in wood-based panel lines.
- Smart Sawmilling – AI, Robotics & IoT Integration: Canadian-based Comact showcased its AI-infused smart sawmilling systems, combining robotic automation and IoT connectivity. Their solutions enable real-time process adjustments, predictive maintenance, and enhanced machine utilization. Whether part of new greenfield setups or retrofit projects, Comact's digital sawmill line translates data into operational improvements, throughput gains, and maintained ROI.
- AI Planning for Timber Mills: Swedish software provider ForestX demonstrated Optinex, now integrated with SAP S/4HANA. This AI-based tool delivers real-time production planning, log optimization, and process simulation via SAP environments. It helps mills simulate cutting patterns, predict best log usage, and refine schedules for maximum yield and profitability.

Process Monitoring

- New Wireless Sensors for Optimum Dryer Performance: Norway’s El-Watch introduced the Neuron wireless sensor platform for sawmill dryers. The rugged, battery-powered sensors track vibration and temperature - over a wide °C range and harsh environments. Data is sent to a cloud gateway and app in real time, enabling operators to optimize dryer runs, detect faults early, meet moisture standards, reduce downtime, and enhance overall sawmill efficiency and timber quality.
- Camera based face veneer line: KUPER showcased an AI-driven, camera-based face veneer line. The automated system detects and removes defects in veneer sheets, robotically assembles them, and integrates predictive maintenance and remote diagnostics. This hybrid of traditional veneer processing and cutting-edge machine vision & AI addresses labor shortages, improves yield, and future-proofs veneer production.
- Smart Fastening Platforms: Germany’s BeA Group showcased several Industry 4.0-ready innovations under their autotec brand. The highlight was the Connector Box, which links stapling and nailing tools to the cloud, enabling real-time monitoring of metrics such as

system pressure and fastener count. Complemented by a height-adjustable Skater Vario chassis and the servo-controlled SD evo screwdriver, these solutions offer ergonomic handling, preventive maintenance, and data-backed quality control - supporting digital transformation in fastening workflows.

- AI-Powered Lumber Surface & Structural Inspection: SMARTI impressed with advanced scanning systems for lumber and logs, integrating AI-based machine vision with optional X-ray sensing. Their scanners detect internal defects, measure structural attributes, and enable precise sorting and grading, dramatically increasing yield and confidence in automated wood processing lines.
- AI Optical & 3D Board Inspection: Spain's LynxScan Technology presented its LS-501-PRO and PRO Series 2D/3D optical scanners for engineered wood products like CLT and LVL. These systems detect geometric anomalies and surface defects in real time, leveraging AI vision to enhance quality control, reduce waste, and support traceable production workflows.

Technology Improvement

- High-Speed Portal Nailing Machine: Stoiber debuted the StoNail 4000, a portal-style nailing system optimized for pallet manufacturing. The fully automated machine delivers precise nail placement, improved alignment consistency, and significantly boosted throughput - ideal for large-scale, high-volume pallet production operations.
- Inclined Bandsaw for Gentle Curve Cutting: Italian manufacturer Primultini showcased its new 18° inclined bandsaw at LIGNA. The inclined blade reduces stress on materials, improves finishing quality, and minimizes fiber damage. Specialized for fine woodworking, this bandsaw enables precise curved cuts with reduced waste - ideal for delicate applications.
- State-of-the-Art Coating Technologies: Austrian company Adler showcased its new surface technologies, including Adler NXT lacquer for deep-matte, scratch- and fingerprint-resistant finishes and Legno Smart oil for durable single-coat protection. These innovations offer easier, high-performance coatings without requiring complex systems, while also including metallic and façade options.
- New Milling Chain and Blower Nozzle Units: Benz Tooling showcased new milling chains and blower nozzle attachments to optimize woodworking production at LIGNA 2025. These accessories are designed to improve chip removal, reduce conveyor blockage, and streamline dust and debris extraction - leading to cleaner operations, lower maintenance, and better surface quality.
- Efficient Processing and Machining of Wooden Flanges: Brazilian company Naliteck presented its NL PR-2100 flange nailing machine. The hydraulic, screen-controlled system handles automatic rotation and bending nail points, ensuring consistent, secure flange assembly. It's a turnkey solution aimed at boosting production speed, quality, and user control in wood-flange manufacturing.
- Dual-Head CNC: Biesse introduced the Rover A Plus at LIGNA 2025: a compact CNC machining center with dual heads and an 83-tool magazine. Featuring Toologic tool pre-positioning and multifunction units (drill, blade, horizontal mill), the machine cuts tool-change time by up to 24%, boosting productivity while maintaining a small footprint.
- State-of-the-Art Coating Technologies: Austrian company Adler unveiled surface innovations at "Adler Square" - Adler NXT deep-matt lacquers offering scratch and fingerprint resistance without excimer technology, and Legno Smart oil for single-coat,

durable floor and stair finishes. The suite includes metallic and façade coatings, enabling efficient, high-performance wood finishing.

- CNC Machine for Small Workshops: Italian firm Masterwood showcased the MVD 900, a compact vertical 3-axis CNC machine ideal for small workshops. With a footprint of just 2.2 × 1.6 m and a 6-position tool changer, it handles full-sized doors and large panels. Despite its size, it houses a heavy-duty spindle module and energy-efficient design - maximizing utility in limited spaces.
- Automatic Thickness Measuring Planer: Hokubema (Panhans) launched a new thickness planer featuring automatic thickness measurement. It's capable of instant, continuous thickness adjustment during planing, ensuring high accuracy without manual rework. User-friendly interfaces and energy-efficient performance make it ideal for precision-focused workshops and industrial production alike.
- Ergonomic Vacuum Handling Systems: Schmalz introduced a suite of vacuum and robotic handling systems, including AI-guided 3D vision gripping for inconsistent workpieces. Tools range from lift systems (VacuMaster, JumboErgo) to flat-surface suction units and smart clamping devices. These improve ergonomics, speed, and efficiency while reducing physical strain and setup time in wood processing.
- Vacuum Clamping & AI Gripping: Also from Schmalz, the "No Room for Improvement" concept highlights their vacuum automation solutions - spanning suction cups, flat-surface units, and AI-equipped handling robots. These secure wood-based materials precisely, aid five-axis CNC machining, and automate feeding/destacking tasks. The systems optimize workspace ergonomics, and suction strength, all while minimizing compressed-air usage.
- "Air Knife" for Efficient Dust Removal: Swiss specialist Kündig introduced the Eco Cleaning System (ECS), a continuous motor-driven "air knife" that efficiently removes dust from sanding belts and workpieces. Unlike traditional compressed air, this system delivers even, full-width cleaning using a fan-driven air blade, cutting energy costs and extending belt life. Its maintenance-free, enclosed design channels dust straight into extraction systems—doubling cleaning efficiency without additional moving parts.
- Vacuum Lifting Device for Panels and Components: Slovenian manufacturer Most showcased a vacuum lifting device aimed at safe, ergonomic handling of panels and components in manufacturing and warehousing. This mobile system creates secure suction for manual lifting and precise placement. Its adjustable vacuum head and compact design help reduce worker fatigue and boost safety in panel handling applications.
- Mobile Assembly & Processing Unit for Large Wood Panels: German-Hungarian supplier HoKuTech introduced the "Vak Up Mobil," a mobile assembly system combining vacuum lifting and component processing. Mounted on a movable platform and featuring integrated vacuum lifting, the unit allows efficient, on-site positioning and handling of large wood panels - ideal for assembly lines and flexible workshop setups.

Tools Improvement

- High-Precision Diamond Tool: Swiss company DLTsaw unveiled the KunLun Tooth, a high-precision diamond-tipped saw blade. With unique tooth geometry and durable diamond tips, it's designed for extremely hard or coated materials, delivering top-tier cut quality, longevity, and efficiency in heavy-duty industrial machining processes.

- State-of-the-Art Laser Engraving and Cutting System: Austrian start-up JustLaser introduced the JustLaser Large, a state-of-the-art laser engraving and cutting system tailored for intarsia and detailed surface work. Designed for contactless processing on wood and composites, it enables intricate engravings, precision cuts, and the creation of textures and contrasts -without pressure marks or chemical treatments. This offers artisans and cabinetmakers high flexibility, quality, and creative freedom.
- Integrated Machine & Abrasive Portfolio: Swiss specialist Steinemann showcased its comprehensive sanding ecosystem, combining advanced sanding machinery with premium abrasives and rapid spare parts access. This integrated approach ensures high surface quality and uptime. By offering end-to-end solutions - from machine to consumable - Steinemann empowers users to optimize sanding operations, simplify maintenance, and maintain production continuity.
- High-Performance Abrasive for Woodworking: Mirka's new Ultimax Ligno abrasive features an hourglass-patterned, segmented surface and premium ceramic grains, offering fast cutting, excellent clog-resistance, and long service life. Integrated dust channels and Multifit holes keep the cutting surface clear and reduce heat buildup during sanding. Enhanced resin bonding and latex-impregnated paper improve flexibility and edge durability, promoting sustainable, dust-free sanding ideal for industrial woodworking applications.
- Advanced Machining Tools: Italian tool specialist Wirutex showcased a range of next-generation router cutters, boring bits, saw blades, and tool chucks built for both custom craftsmanship and high-volume production. Their exhibition emphasized versatile toolkits optimized for machining wood, panels, plastics, and composites - highlighting modularity, precision, and adaptability for automated manufacturing environments.
- Industrial Motors for Woodworking Machinery: Chinese manufacturer Haiyang Changchuan launched their CC Motor line - 10 premium motor series tailored for woodworking machinery. Engineered for high efficiency, torque and reliability, these motors are suitable for demanding industrial applications such as saws, routers, and planers. The offering emphasises robustness and longevity to ensure uninterrupted production performance.
- Wax-in-Water Suspension System: SMARTECH's SMARTWAX platform introduces a wax-in-water suspension system to replace traditional wax emulsions in panel production. It offers up to 40% cost savings and environmentally improved handling while maintaining consistent wax performance - thanks to AI-optimized suspension control within the plant.

APPENDIX 7: From industry 2.0 to industry 4.0 and beyond

The Industry X.0 terms represent different industrial revolutions, each marking a major leap in manufacturing and business processes driven by technology. Below is a breakdown of Industry 2.0 through to 5.0, focusing on their defining concepts, technologies, features, and impacts:

Industry 2.0 – The Second Industrial Revolution (late 1800s – early 1900s)

- Key Concept: Mass production through electricity and assembly lines
- Drivers: Electricity, steel, and oil
- Technology: Assembly lines, mechanization, internal combustion engines
- Output: Mass production of goods
- Impact: Huge productivity gains, rise of factory work, urbanization

Industry 3.0 – The Third Industrial Revolution (1960s – 2000s)

- Key Concept: Automation through electronics and IT
- Drivers: Computers, PLCs (Programmable Logic Controllers), semiconductors
- Technology: Automation, robotics, control systems, early digital systems
- Output: Flexible production lines, reduced human labour in routine tasks
- Impact: Increase in efficiency and quality, offshoring, beginning of globalization

Industry 4.0 – The Fourth Industrial Revolution (2010s – present (2025))

- Key Concept: Smart manufacturing using connectivity and data
- Drivers: Internet of Things (IoT), big data, AI, cloud computing, cyber-physical systems
- Technology: Sensors, real-time data analysis, predictive maintenance, smart factories
- Output: Highly adaptive, automated, and optimized production
- Impact: Blurring of physical and digital worlds, decentralization, data-driven decisions

Industry 5.0 – The Fifth Industrial Revolution (emerging at present (2025))

- Key Concept: Human-centric and sustainable industry
- Drivers: Collaboration between humans and machines, ethical AI, sustainability
- Technology: Collaborative robots (cobots), AI + human creativity, green tech
- Output: Personalized production, better working conditions, circular economy
- Impact: Rebalancing efficiency with purpose - social value, resilience, sustainability

Summary Table

	Industry 2.0	**Industry 3.0**	**Industry 4.0**	**Industry 5.0**
Era	1870 – 1914	1960 – 2000	2010 – present	Emerging
Power Source	Electricity	Electronics	IoT, AI, Cloud	AI-human collaboration
Production Type	Mass production	Automation	Smart factories	Personalized and sustainable
Tech Example	Assembly lines	PLCs, Robots	AI, Big Data, Digital Twins	Ethical AI, Circular Design
Human Role	Manual labour	Operators	Supervisors, Data analysts	Creative decision-makers
Philosophy	Efficiency	Productivity	Integration, Optimization	Human-centric & Sustainable

Industrial revolutions in the forest products industry

Industry 2.0 – Mass Production Foundations

- Current relevance: Still visible in some older mills.

- Assembly lines: Many NZ sawmills still run linear, batch-oriented production lines based on early 20th-century principles.
- Electrification: Fully adopted; electricity powers virtually all fixed equipment.
- Manual labour: Still used extensively in sorting, grading, wrapping, especially in smaller or legacy mills.
- Example: Small to medium mills using conventional breakdown saws and manual stackers.

Industry 3.0 – Automation & Control

- Current relevance: Common in most commercial sawmills.
- PLC-controlled systems: Automated log breakdown, can't handling, and board sizing.
- Mechanical optimizers: Laser-guided saws and edgers adjusting cuts to maximise recovery.
- Automated grading: Machine stress grading (e.g., Metriguard, Lucidyne) is common in structural timber lines.
- SCADA systems: Widely used to monitor plant performance and equipment status. Supervisory Control and Data Acquisition (SCADA) systems allows to monitor and control industrial processes from a central interface.

Industry 4.0 – Connected, Data-Driven Sawmilling (Emerging)

- Current relevance: Adoption is growing but patchy.
- IoT sensors: Some plants are beginning to use sensor arrays for real-time tracking of moisture, temperature, throughput, and energy use.
- Predictive maintenance: Early stage use via machine learning tools to forecast equipment failures.
- Digital twins: Mostly not yet implemented, but there's interest in modelling mill throughput digitally for optimisation.
- Data analytics: A few large operators collect big data for yield improvement or downtime reduction, but data silos and lack of integration persist.
- Example: Pan Pac and Red Stag are integrating digital optimisation tools and automated quality assurance.

Industry 5.0 – Human-Centric, Sustainable, Collaborative (Very Early Stage)

- Current relevance: Just starting.
- Cobots & collaboration: No real evidence yet of cobots (collaborative robots), but AI-driven systems that *support* human decisions (e.g., visual grading support) are emerging.
- Sustainability focus: Stronger alignment with Industry 5.0 ideals — NZ mills are improving waste recovery, biomass use, and carbon accounting.
- Customisation: Some re-manufacturers (e.g. for cladding, engineered products, or bespoke furniture components) are moving toward flexible, short-run production lines.
- Worker wellbeing: Growing concern with safe automation, especially in log handling, chemical treatment, and kiln operations.
- Example: Wood Engineering Technology (WET) in Gisborne using AI-enhanced optimisation for LVL manufacture - blending human judgement with machine power.

Challenges for NZ adoption of 4.0 & 5.0

Many sawmills in New Zealand operate on a small scale, which makes it difficult for them to invest in full digital integration. Much of the equipment in use is aging and was never designed to be compatible with modern Internet of Things (IoT) systems. At the same time, the industry is grappling with a shortage of skilled professionals in areas like information technology, data science, and robotics - fields that are essential for driving digital transformation. Even when the technology is available, the high upfront cost and long return-on-investment periods often deter investment unless co-funding or government subsidies are in place to offset the risk.

Despite these challenges, New Zealand's timber industry is making steady progress through the stages of Industry 3.0, with growing interest in the tools and opportunities offered by Industry 4.0. Looking ahead, it is likely that the first signs of Industry 5.0 will appear in larger, export-oriented operations or engineered wood product (EWP) facilities. These sites are better positioned to adopt cutting-edge technologies such as digital twins, advanced robotics, and artificial intelligence. In particular, regions with a high concentration of wood processing - such as Rotorua and Northland - present strong potential for leading this next wave of innovation.

Industry 4.0 roadmap for small NZ mills

Stage 1: Visibility & Data Collection (Low cost, big value)
Focus on improving visibility and data collection across key areas of the processing line to enable data-driven decision-making at low cost but with high impact. For kilns, this involves installing temperature and humidity sensors that log data to a central PC using platforms such as Arduino, Raspberry Pi with Modbus sensors, or commercial kiln monitors. At the saw line, simple optical sensors can be integrated with PLCs and SCADA-lite systems to track log counts and downtime. For other machinery, IoT power monitors (e.g. EpiSensor or Schneider devices) can be used to monitor motor loads, vibration, and energy usage. Collectively, these upgrades provide real-time and historical insights into plant operations, laying the foundation for continuous improvement.

Stage 2: Basic Integration & Automation
Target basic integration and automation to reduce manual intervention and streamline routine operations. Automated reporting can be implemented by linking SCADA systems with Excel and simple scripts to generate daily production, yield, and downtime summaries. Real-time fault detection is enhanced through alarm systems that send SMS notifications or on-screen alerts using SCADA platforms, Node-RED, or cloud-based tools. For timber sorting, off-the-shelf vision systems such as Keyence or Cognex can assist with basic board classification using cameras or laser sensors. These upgrades enhance responsiveness, improve operational consistency, and further embed data-driven decision-making into daily processes.

Stage 3: Analytics & Decision Support
Introduce analytics and decision support systems to enable predictive, adaptive, and continuous improvement across operations. Predictive maintenance can be applied to motors, fans, and kilns using vibration and current sensors combined with analytics tools

to detect early signs of equipment failure. Yield optimisation is achieved by analysing performance data by log species, grade, shift, and operator using databases and basic business intelligence dashboards such as Power BI or Grafana. For production planning, kiln loads, sorting runs, and staffing schedules can be optimised using data-driven tools ranging from enhanced Excel models to custom applications integrated with the production database. These initiatives significantly reduce unplanned downtime, improve material recovery, and enhance workforce efficiency.

Stage 4: Integration with Customers & Suppliers
Focus on integrating operations with customers and suppliers to create a more connected and responsive supply chain. Online order management and digital inventory tracking can be achieved through cloud-based ERP systems such as Unleashed or DEAR Systems, improving order accuracy and visibility. Dispatch operations can be enhanced by linking load-out processes to customer delivery systems using barcode scanners and transport software, enabling real-time tracking and coordination. Additionally, integrating customer feedback - such as complaints or returns - into quality control systems via CRM platforms or dedicated quality apps allows for continuous product improvement. These upgrades collectively enable faster fulfilment, improved product targeting, and reduced operational errors.

Checklist: Assessing a Small Sawmill's Readiness for Industry 4.0

- Infrastructure: Is the mill connected to reliable broadband internet? Are PLCs already in place for key machines (e.g. edgers, kilns)?
- Data Collection: Do you collect data from machines (e.g. throughput, downtime)? Are temperature, moisture, or energy use monitored and recorded?
- Monitoring & SCADA: Do operators have central dashboards to monitor equipment in real time? Are fault alerts automated (email/SMS/visual)?
- Automation: Are there automated grading, sorting, or scanning systems in use? Are there any robotics (even simple stackers or infeed units)?
- Analytics: Is production yield tracked by product, grade, or log type? Do you track and review downtime causes?
- Integration: Is the mill software linked with inventory, orders, or dispatch? Can customers see their order status or ETA digitally?
- Sustainability: Is energy or waste recovery monitored and optimised?
- People & Skills: Does the team include someone familiar with SCADA, sensors, or automation?

NZ Suppliers & Integrators for Industry 4.0 Solutions

SCADA & Automation Integrators

Company	Location	Focus	Website
TIS (Total Industrial Solutions)	Rotorua	SCADA, PLCs, sawmill controls	tisnz.co.nz
Vortex Integration	Nelson	Ignition SCADA, data logging, automation	vortexintegration.co.nz
Automation & Electronics (A&E)	Christchurch	SCADA, control systems, telemetry	automation-electronics.co.nz
Beca	Nationwide	Advanced automation & control systems (larger projects)	beca.com

IoT Sensors & Edge Devices

Company	Location	Focus	Website
Advantech NZ (via ICP Electronics)	Auckland	Industrial IoT, sensors, gateways	icp.net.nz
Control Devices NZ	Nationwide	Sensors, pressure, temperature, flow	controldevices.net
Mico Automations	Hamilton	Sensing, small-scale automation	micoautomations.co.nz

Data Analytics & Dashboards

Company	Focus	Tool Example	Website
BNZ Digital Solutions (freelance)	Power BI dashboards for manufacturing	Freelance via Upwork or local firms	
KPMG NZ (SME Digital)	Digital maturity assessments, data integration		kpmg.com/nz

Testing & Calibration for Sensors

Provider	Use	Region
Kilworth Engineering	Kiln controls and retrofits	Rotorua
Scion	Forestry tech R&D, may advise on tech validation	Rotorua
Onfarm Data	Ag sensor networks (adaptable to wood drying)	Canterbury

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