Refocusing the Future of Queensland's Forests

Executive Summary

The Forests and Timber Industry in Finland and Sweden is a source of inspiration for Queensland. The industry there is critically important economically as well as culturally to the region, and has been a key driver for technological development in the sector. Key areas where this region appeared to be global leaders were

- their use of data to develop decision making tools for operations use as well as tactical and strategic planning
- to increase efficiency continuing the development of mechanisation for all parts of the forest industry, but especially silviculture
- developing vision and robotic logic systems for machinery to progress towards semi-automation and full automation
- a timber processing sector which reinvents itself through difficult times, and is currently a leader in emerging technologies like engineered wood products and pre-fabricated construction techniques
- Encouragement from government to increase the use of timber in buildings, including approving buildings up to 18 storeys tall at the moment, and a public appreciation of biophyllic design

These approaches outlined could be applied to the Queensland Forests and Timber Industry. If successfully implemented they could raise Queensland's profile as a modern, efficient, dynamic, and effective forestry region. I'd like to imagine that at that point, the motto for forests and timber in Queensland could be:

Growing world class timbers for use in world class structures

Background

In Australia, timber products are tightly linked to global trade. Although Australia does supply a significant portion of domestically sourced timber for its own use, there is also a large and complex export and import trade system. Export of different grades of chip and log, both containerized and bulk, and import of lumber of various degrees of finished state, make up a significant portion of timber trade within and into Australia.

National and global events in the last few years have created some incredible and unanticipated shocks to our timber trade, chiefly the Black Summer Fires, the Covid-19 global pandemic and the Russian invasion of Ukraine. The effects of these are still reverberating and will for some time, particularly socially and diplomatically with some of our key trading partners.

The Forests and Timber industry is a fast moving and dynamic sector of the Queensland economy, if a somewhat small section of the economic output overall, about 1%. As both local and global forest and timber industries grapple with the effects the most recent shocks to trade, it was considered to timely to visit Scandinavia, and to get an idea of trends in their forests and timber industry.

Finland and Sweden

Scandinavia, specifically Finland and Sweden, was chosen as the destination for this study tour for a number of reasons. These two countries have been at the forefront of technological development and innovation in forestry for a long time. Modern log making equipment was first developed there, and many leading brands are still designed and manufactured there. Many timber processing developments originated there, and even software critical to forest management was first written there. These globally significant innovations came from Scandinavia in part because of the sheer economic and social importance of the forests and timber industry to the region.

These two countries combined make up about half the area of Queensland, and have a total population of around 15 million. The Forests and Timber industry makes up around 10% of Sweden's total economic output, and a touch more than this in Finland. There is a long history of forest use by the inhabitants of the area, relying on a healthy forest not only for building materials but also food, game, and recreation. The volume of their annual harvest is orders of magnitude larger than Queensland's, however their processing technology multiplies the value of their timber assets. Because forests and timber are so important to these countries, their research capacities are very significant. In summary, the Forests and Timber industry is critical to these countries economically but also culturally.

Figure 1 This is a thinning trial planted in 1875, and monitored from the 1920's in Tönnersjöheden. Every Forester trained in Sweden visits this site.

Study tour details

My study tour took place in the early northern summer of 2023. My aim was to visit as many different elements of the supply chain as I could. Our trees are grown for use in buildings, so it was important for me to make contact with milling and construction businesses where possible, as well

as emerging processing technology due to structural use of timber being a key component of the timber industry in Queensland.

The tables below detail the different entities I visited, and their segment of the industry.

Finland

OOPEAA, Järvenpää	Award winning architecture firm, focusing on timber buildings
Metsähallitus, Lieksa	Finnish state owned forest manager
Risutec, Nakkila	Manufacturer of mechanized silviculture equipment
Raute, Nastola	Manufacturer of leading veneer, LVL, and plywood processing equipment
Metsäteho, Vaanta	Finnish forest industry research company

Sweden

Skogforsk, Uppsala	Swedish forest industry research company
Bracke Forest, Bracke	Manufacturer of mechanised silviculture equipment
Tönnersjöheden	Research forest for long term trials
Linnaeus University, Växjö	Timber Engineering research
Vida Building, Växjö	Modular timber construction factory
Södra nursery, Flåboda	Mechanised, high tech forest nursery

Our forests in Australia are very different to those found in Scandinavia, and are managed very differently accordingly. My study tour was not intended to bring specific timber management techniques back to Queensland but rather to **consider their approach to dealing with key challenges, and identify what might be applied here.**

Themes and approaches observed in Scandinavian forests and timber industry

Preparing for the future

Climate change is something which is being looked at very pragmatically in Scandinavia. The land of the region is still rising with the end of the last ice age, so the Baltic sea is actually retreating on some areas. Shifting to a warmer climate will have some more mixed results. A warmer climate might mean adjustment in agricultural possibilities as growing seasons change. This would also impact forest productivity, and their long (typically 60-120 yrs) rotation times. Changes in risks to forests would also appear however, with drought, fire and pests all anticipated to have larger impacts as time goes on.

A lot of research, modelling, and thought was being applied to how to prepare for the future. It was considered that in 50 years time parts of Southern Sweden will have a climate similar to Southern Germany today. Therefore discussion was beginning on emulating that area; for instance changing planted species to the likes of Douglas-fir because the Norway Spruce and Scots Pine forests of today will not be as competitive under this altered climate regime.

Continuous Research Efforts

The long and continuing culture of research throughout the entire supply chain of the Forests and Timber industry was striking and impressive. I was shown through a research forest in Sweden, which they say every forester trained in Sweden will visit. The earliest thinning trials were planted here in the 1870s, and this stand is still yielding results as the remaining trees survive various events that measurably impact growth.

Operations research is critical to both of these countries. There are complicated funding arrangements, but everyone agrees that research is crucial. **The research investment is vital to ensuring that forest practices in these countries are as efficient and effective as possible**. Industry leads the research, asking the research groups for help with particular problems. These research efforts were almost always collaborative, to ensure teams were combining the best possible minds in their efforts. Industry owned companies like Skogforsk and Metsäteho ensure that their research results and novel solutions are available for all of their owners.

A key research project which a lot of people were very proud of was the Autoplant. This was a very large research effort proving that an autonomous machine could be built to successfully traverse an area and plant trees. The ability of the machine to navigate the area, pick a planting site, the sequence of events to plant a tree, and the logic within the robotic control program to make all of this happen was incredible to learn about.

Figure 2 Forest Science being done in the field. How many Foresters does it take to hang a thermometer?

Productivity and Mechanisation

A key theme seen right through the supply chain was mechanisation. This is a trend seen globally, with a few key drivers. Chief among them is sheer labour shortage, from which Queensland is not immune. Alongside this **is a need to increase labour productivity to remain competitive on the global stage**. Mechanised timber harvesting is well and truly entrenched in Queensland, however other silvicultural operations are not. I visited 2 manufacturers of machinery to carry out spot site cultivation and tree planting in one pass. These manufacturers were increasing their deliveries globally, with South America being a key market for both of them. Units were also being delivered to Africa and South East Asia as well. We would typically consider these countries to have low labour costs, yet mechanised silviculture is still attractive. These machines are demonstrated to work in a variety of conditions, with a variety of species, proving their usefulness.

Figure 3 A Risutec SKB planter head, being prepared for delivery to Indonesia.

The mechanised nursery was also fascinating to see. This is nursery that is growing seedlings in trays, and at the moment grows two species but there are plans to increase this further as desired species shift. The interesting point about the equipment in the nursery was that it generally came from the cut flower industry, or other horticultural sectors, it wasn't tree nursery specific equipment. Almost the entire operation was automated in the nursery shed, from sowing, to transplanting (where late sown seedlings go from a small to large plug), to final grading, treating for pine weevil (spraying a sand and glue mixture) and packing. Staff on site ensured that equipment

was working properly, moved trays around mechanically and ensured the greenhouses and field systems were all working.

Figure 4 One of a number of greenhouses, with control, climate control and automated fertigiation

Figure 5 The remotely operable forwarder, put together by Skogforsk .

Automation

Skogforsk demonstrated their research forwarder that they use to develop and demonstrate operations applications of technology. This machine had been set up with stereo-cameras with the ultimate goal of developing automation for this machine. The hardware and equipment have also been set up to enable remote operation with a VR vision system - a convenient and useful step along the way to automation. Indeed, this machine had been driven remotely utilising the mobile phone network. The focus now is on training the robotic system. It has already been trained to do tasks like determining the orientation of a log, then identify the best location to place the grapple, and then pick up the log.

Increasing use of big data

As harvesting machinery has become more and more computerised, the possibilities to collect data from them have also increased. **Machinery can now collect more detail than ever**; not only a GPS record where antenna sits in the cab, but the precise location of the implement can be calculated and related spatially along with every command given to the machine. The move towards mechanised silviculture means that this data collection opportunity can be extended to site preparation and planting machinery as well increasing the detailed data available form of harvesting machinery already.

The benefits of this are hard to say yet, just that the opportunity is there. For instance it is only now that the harvesting head data for thinnings machinery is being interrogated in new detail to inform thinning quality in near real time for the operator, and to accurately describe the residual stand for inventory purposes. The limitation is our imagination on linking different sets of information together.

Different approaches were being taken to achieve the goal of assessing a thinning job using this data. One approach was to use algorithms to characterise the different stems removed, and create a model of the forest pre- and post thinning. This can be calculated over hours or one to two days of work, to provide a feedback for operators on their work quality. Further developments were being made in this space to use Lidar and other sensors to provide real time feedback and to assist with decision making before a tree is harvested. This would help operators in achieving a very high quality result, but also reduce fatigue, as this system is intended to aid decision making.

The tree breeding program in Sweden is considered a critical component of the forests and timber industry adapting to climate change. Some impressive tools have been developed to optimise species and stocking based on information from a range of sources, including harvester head data. Site condition information is combined with information on the available seedling material, and then the available material is ranked according to predicted growth at that site over a rotation. This tool was evaluated against the 2015 planting season for one particular company. The evaluation measured the total genetic gain for this planting program. This tool suggested a combination of genetic material for each site, and if it had been achieved, was a gain of 18.9% over the previous rotation. The result achieved from this planting program was in fact 8.5% due to sub-optimal genetic deployment. This is an impressive demonstration of the potential a clever decision support tool can help to achieve.

Increasing use of timber in buildings

It was fascinating to see the relatively high use of timber in new buildings, at least in some parts of these countries. One timber building in Norway is over 80m in height, and one in Sweden is 75m. Generally the technical challenges to building at these heights can be considered to have been met. The common denominator between all major timber buildings is the use of engineered wood:

products like glu-lam beams, cross-laminated timber panels (CLT), and laminated veneer lumber (LVL).

My conversations with those people in the wood processing side of the industry reinforced the observation that world wide (and Queensland is no different) average log diameters are reducing. This ongoing trend makes it more difficult for sawing to remain efficient when compared to peeling, shredding and slicing logs. Alongside this was **an observed increase in demand for engineered timber products worldwide**. Engineered wood meets a critical need for beams, as trees large enough for this purpose are very rare or protected. They are also homogenous products with predictable performance. This means engineers are comfortable predicting their performance in a building. Through the use of veneers and other panel products, timber can be used in ways never before imagined in buildings.

Thermal comfort, and acoustic isolation are key criteria for making a large building pleasant to live in. The use of CLT panels could very efficiently address thermal comfort, however this product on its

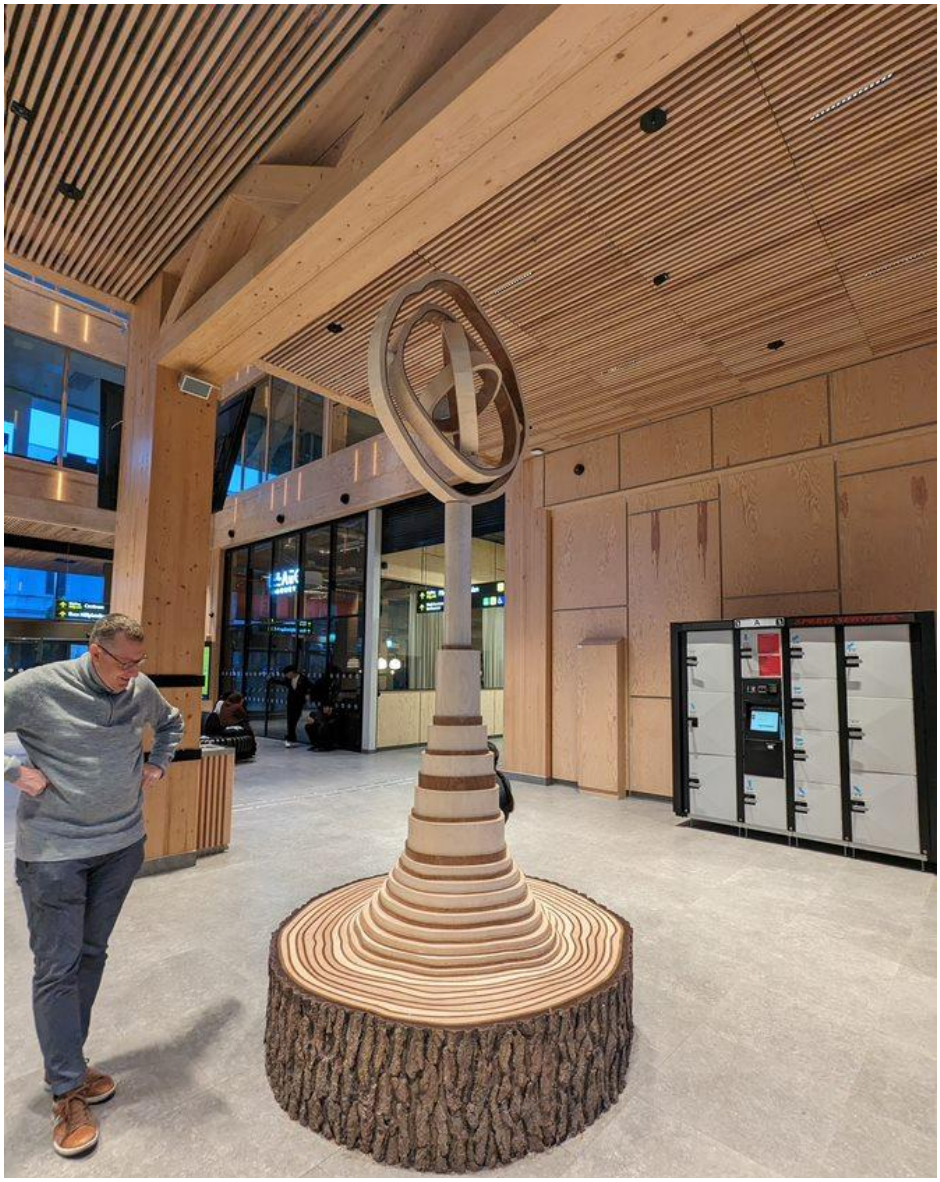

Figure 6 Johan contemplating growth rings. Note the expressive use of timber throughout this train station, with various timber products, mostly engineered.

own is less useful for acoustic isolation. Noise and wall solutions in certain areas therefore required composite construction methods, to ensure performance was satisfactory.

The timber buildings I saw were, in my opinion, quite pleasant to be within. Visually they had a lot of features generating interest, as each piece of wood is unique. They also tended to be spaces which were open and flowed gently through various areas for different purposes. I would not be the first person to suggest that a building showcasing the use of timber has a 'warmer' feel to it and makes for a very beautiful and comfortable space to walk through.

Prefabricated and Modular building construction

I was given the opportunity to go through the Vida Building facility, which constructs pre-fabricated timber houses, and modular apartments. The challenges to the building industry in Scandinavia are similar to here, with rising costs of labour and materials, and a shortage of good quality tradespeople.

In a country with a climate that makes building challenging for half of the year, **this pre-fabricated system allowed for year round work in a warm factory, and greatly reduced time on site**, typically less than 12 months from turning a sod, to residents moving into a large apartment

Figure 7 External wall for a module, ready for assembly. Note the thick insulation and double glazing on the windows.

complex. It also dealt with labour issues, as factory staff were trained and highly skilled, but were not traditional builders.

There could also be efficiencies gained through this style of building around materials inventory. These modules were built at a steady rate, but can be stored safely for over 2 years at an outdoor depot prior to installing on site.

How might any of this apply to Queensland?

As Queensland comes through the most recent global financial shocks, there are some opportunities due to unique circumstances. Like much of Australia, Queensland is reducing native timber harvesting in state forests, making **our plantation resource all the more critical to the state and the nation**. The 2032 Olympic games will be held in Brisbane in 9 years time, requiring a lot of investment and renewal in sporting and other public facilities. Additionally, as a result of the pandemic-associated lock downs and restrictions on trade and movement, there is still a desire from much of society to see some increased self-sufficiency in terms of materials produced in Australia.

Our plantation resource in Queensland is in fact unique for Australia, growing 2 species that are not grown elsewhere in any real volume - our Southern pine hybrid and our native hoop pine. Considering the volume of timber potentially required for upcoming works on major public buildings, housing shortage notwithstanding, there is an opportunity to showcase our unique resource in efficient and innovative engineered wood products to rapidly build high quality houses and other infrastructure. Indeed, an article published recently in 'The Conversation' by Matthew Aitchison about the housing crisis in Australia, advocated for setting up this 'pre-fabricated' style building to augment, rather than replace, the more common building methods in Australia.

Another aspect of the Scandinavian forests and timber industry relevant to Queensland was the nature of their value adding and their export products. Whereas Queensland and Australia generally might export logs, or woodchips, the Scandinavians export complete prefabricated house packages. Changing demand has also forced the once huge paper and pulp industry to change what products they can produce and export. Alongside paper and card stock exports, specialty papers like filter papers, and even chemicals such as combustion fuel replacements, are derived from pulp logs. This demonstrates a tenacity for **reinvention in difficult times, rather than closing down** because the original product was no longer in demand.

It is has to be recognised that we don't have anywhere near the research capacity as they do in Scandinavia, and there could be the opportunity instead to really build relationships in some key areas. This would enable the local industry to keep more up to date with developments in this area, and adapt them to our conditions quickly as part of a joint effort, rather than carrying out all of the development work ourselves. The use of **captured data, especially from machinery but from a vast range of sources, to not only monitor performance but also to optimise decision making** where possible is impressive. In Queensland there is definitely the opportunity to invest some more capital and time to improve our capabilities in this space. With some strategic positive relationships, Queensland's advancement in this space could be accelerated.

Thank you

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Figure 8 This was the Vida Building guard dog. A very important staff member