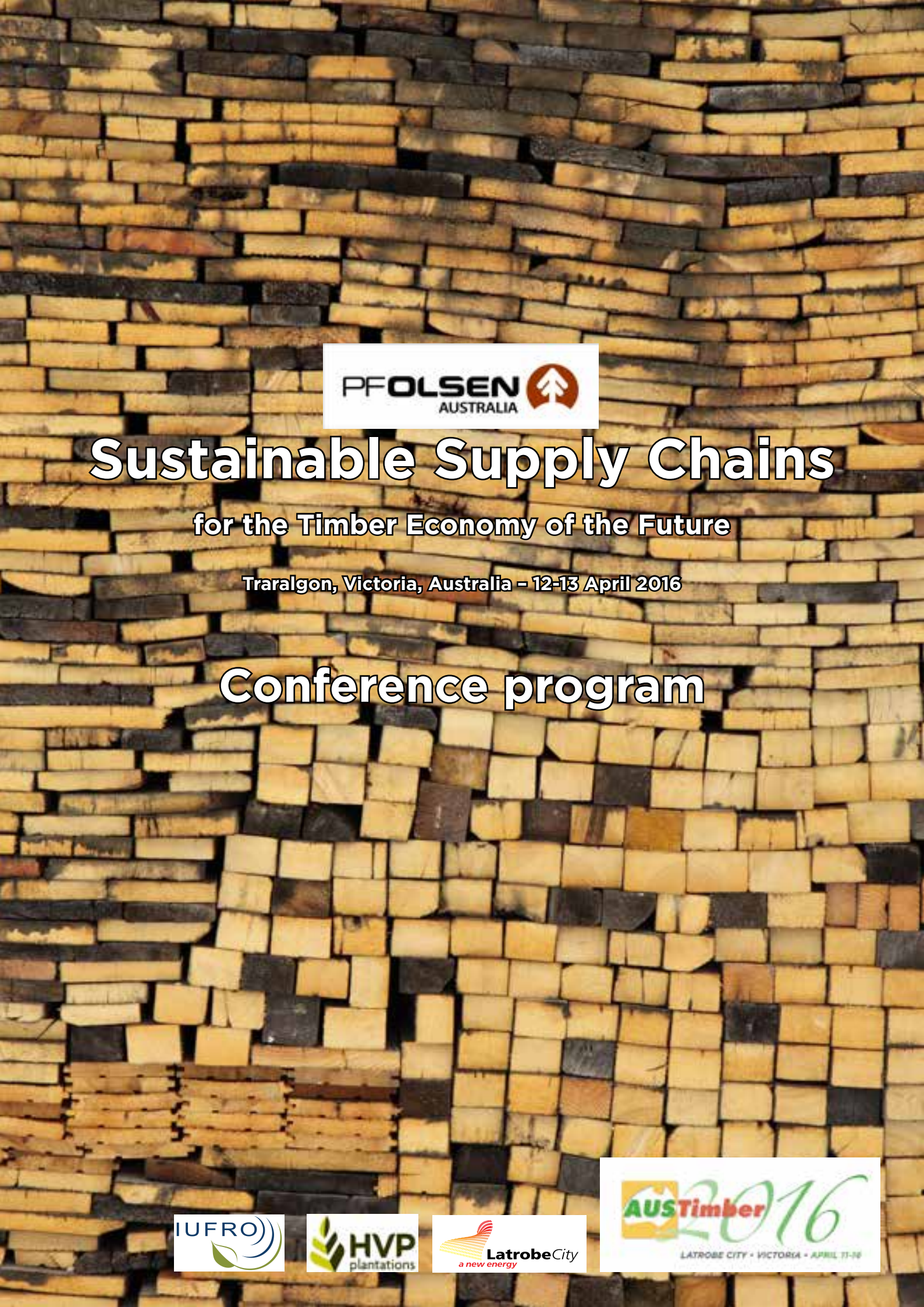

PFOLSEN AUSTRALIA

Sustainable Supply Chains

for the Timber Economy of the Future

Traralgon, Victoria, Australia – 12-13 April 2016

Conference program

IUFRO

HVP plantations

Latrobe City a new energy

AUSTimber 2016

LATROBE CITY • VICTORIA • APRIL 11-16

Mayoral Welcome

Latrobe City Council is pleased to host AUSTimber2016, the Australian timber industry's biggest event.

This prestigious event will create many economic and employment opportunities now and into the future for not only our local economy but for the wider Gippsland region and across Victoria. The event is perfectly suited to Latrobe City's unique and abundant natural resources which support a productive timber and forestry industry providing softwood, value-added hardwood, and paper products sold to domestic and export markets.

Whilst our region may be known for its brown coal deposits and power generation, AUSTimber2016 will demonstrate how major industries can work symbiotically. This is highlighted by the location of the in-forest event site near the Loy Yang brown coal-fired electricity generation plant. Latrobe City Council sees this as an opportunity to underscore the environmental benefits inherent in the timber industry. The focus on sustainability as a theme runs throughout the event.

There's more to Latrobe than you know. It is one of Victoria's regional cities. With our central location, range of accommodation and country feel you'll be a welcome visitor here. Our local community has embraced AUSTimber2016 with accommodation providers, hospitality venues, retail sector and local business sector looking to get involved and leverage off the event

I'm sure you will enjoy the hospitality and friendliness that we are known for here in Latrobe City.

Welcome.

Cr Michael Rossiter
Mayor, Latrobe City Council

Foreword from AFORA

On behalf of the Australian Forest Operations Research Alliance (AFORA), we would like to cordially invite you to attend the 2016 Sustainable Supply Chains for the Timber Economy of the Future Conference.

Attending our conference presents a great value and an excellent opportunity to meet industry experts from all around the world and learn about the latest technologies in forest operations. Besides our normal technical conference, attendees will have access to a variety of activities covering a large range of interests, including field tours, seminars, and an exhibition of harvesting and transportation equipment to see how the modern timber industry works using the latest in technology.

You will also have the opportunity to meet with AFORA's scientific staff and discuss potential collaborative projects. AFORA is an alliance established by the University of the Sunshine Coast with Australian forest industry stakeholders to continue the collaborative forest supply chain research established by the CRC for Forestry. The objectives of AFORA are to deliver a collaborative applied research development implementation program to improve the understanding, management and control of forest operational costs for existing, evolving and new harvest systems, the planning and management of value recovery within harvest operations, and the application of optimisation to supply chain efficiency planning and management.

We look forward to seeing you in Traralgon!

Kind regards,

Professor Mark Brown and Dr. Mauricio Acuna
AFORA

Tuesday, 12 April Conference day 1

8:30 – 9:30 Welcome participants and registration

9:30 – 10:30 Plenary session

Distinguished Professor John Sessions - Oregon State University

Rob de Fégely - Institute of Foresters of Australia

10:30 – 11:00 Coffee break

11:00 – 12:30 Session 1: Right tool for the job

Moderator: tba

1. Maximising the potential of Australia's forests – the importance of a sector wide innovation culture (L. Bull, E. Hansen)

In April 2015, Dr Lyndall Bull and Professor Eric Hansen conducted an industry survey and workshop to identify innovative actions that would help realise the potential of the Australian forest sector. This presentation will outline the main outcomes of both the survey and workshop.

The workshop identified as its highest priority the need to manage culture based issues – both within and between organisations along the supply chain. With this in mind, this presentation will highlight the importance of culture in fostering innovation.

Development of a sector-wide innovation culture is critical for the long-term development of the industry. Such a culture allows companies along the value chain to effectively create and adopt a spectrum of innovations, such as product, process and business systems. The industry has demonstrated its capacity to embrace and incorporate significant cultural change in the past and so with this in mind the presentation will conclude with suggestions for a range of activities that the industry could support to facilitate the formation of a more innovative-centric culture.

2. World overview of log truck scheduling and opportunities for the Pacific NorthWest (J. Sessions., M. Acuna)

Transportation from the forest to the mill accounts for 25-50% of the cost of delivered logs. Log truck scheduling and central dispatching has potential benefits for the logging contractor, the trucking contractor and the forest landowner. Potential benefits for the logging contractor include more time to focus on the primary business of logging, elimination of contract negotiation and scheduling of log truck drivers and assures delivery requirements will be met when trucks break down and during peak haul periods. Potential benefits for the trucking contractor include increasing loads per day in the same work hours, fewer empty miles, reduced waiting time at the landing/log yard, greater opportunity to change plans during loader breakdowns, and more transparent business relationships. Potential benefits for the landowner (log owner) are reduction in total transportation costs, improved control over log deliveries, the ability to change in real time to market changes and purchaser needs, and security and traceability of log loads.

World interest in log truck scheduling has been increasing led by applications in South America where central dispatching was successfully implemented more than 25 years ago. Centralized dispatching has become common in New Zealand and is increasing in Europe. A number of successful business models exist including central dispatching by mill owners, landowners, individual trucking contractors, third parties, logger-truck owners, and trucking associations. Within the United States major landowners implementing central dispatching include Weyerhaeuser, Sierra Pacific Industries, and Hancock.

Log truck scheduling becomes most effective when land owners and truck owners collaborate to provide increased opportunities for backhaul. Increases in average loaded mile fleet efficiency of 10 percent or more are not uncommon with increases in truck loads per day and reductions in total transportation costs including fuel consumption. A number of computer assisted programs have been developed to aid in log truck scheduling. Availability of low cost real time truck tracking services are now offered by more than 40 companies. These real time tracking services not only permit real time dispatching to accommodate changing conditions during the day, but also can provide other services including truck maintenance scheduling, driver behavior records, monitoring of hours of service, and paperwork reduction for invoicing of road user fees.

Conditions in the Pacific Northwest supporting change to centralized log truck scheduling and dispatching include a general shortage of drivers and trucks, increased cost of trucking to meet environmental regulations, the prospect of increasing fuel prices, a changing work force, the increasing availability of fleet management services, and examples of successful early adopters.

A number of challenges to implementation include hesitancy to change from existing successful practices, logging contractors wary of losing control of log shipments, loader/driver relationships, apprehensive attitudes toward the new technology-based culture, drivers wary of being monitored, and the need for a flexible model to accommodate the different conditions around the Northwest.

Log truck scheduling and central dispatching can a provide benefits to the logging contractor, the trucking contractor and the forest landowner. However, during the transition expect frustration and anxiety - EVERYONE must be committed to making it work!

3. Effective allocation of mobile chippers in a region for the establishment of a stable wood chip supply chain (M. Yoshida)

To promote the energy use of logging residues in addition to the timbers, one of the inevitable issues to be clarified was the cost-efficiency of chip from logging residues produced at a landing in forest by using mobile chippers. Indeed mobile chippers with high productivity would be the most economical solution, but it was often difficult to introduce because of the limited budget and its required business scale to depreciate. The chip supply cost of the mobile chipping system using both several small chippers and one large chipper in a region, Iwate prefecture in Japan, was analyzed as a case study by using geographic information system for its network analysis and by linear optimization for the most economical material distribution. The chip supply costs were the same between in the conventional system using a fixed chipper and in the mobile chipping system using smaller ones at the landings close to the power plant. Moreover, when introducing several large chippers instead of small ones, the total supply cost was superior to that of conventional system. The results encourage the stakeholders to start to use logging residues even though they cannot introduce a large chipper, and benefit the society by the wise use of woody materials.

4. Performing an automatic timber assessment during cable yarding operations: results from an experimental cable yarding system (R. Gallo, F. Mazetto)

This paper describes the approach that was followed, the development and the application of a new ICT solution for the operational monitoring in forestry activities. The goal of this new idea was to assess the weight of the biomass transported during the inhaul in cable logging operations. The present approach can be considered as a Precision Forestry application and once embedded with other ICT equipment can performs assessments about the productivity of logging operations.

A simplified experimental in-scale cable logging system has been designed and installed in order to test the approach. An "S" load cell and an inclinometer have been used as main sensors and they have been installed between the carriage and the hook and on the choker, respectively. The two sensors have measured the variations in terms of load's weight and choker's angles during the inhaul due to the soil profile the friction the point of hook from the top.

Indeed the choker has been hooked, from the top end, at 2%, 5%, 10% and 20% of the total length of the log, in order to study how the part above the tying influences the weight assessment. The synchronization between the two sensors permitted to detect, time by time, which was the component of the timber's weight discharged to the ground and the component held by the carriage during the travels. Adding those components the assessment of the entire transported load was performed.

The preliminary overview of the study has permitted to obtain good correlation values (R2 > 0,9) when the comparison between the estimated weight with the real one has been done. Averaging, the difference between those weights, considering the different distances of hooking, has ranged between 0 and 5% (in absolute terms) of the total weight of the sample. In conclusion, the use of these ITC devices can be considered as valid tools for the operative monitoring for the cable yarding activities.

12:30 – 13:30 Lunch break

13:30 – 15:00 Session 2: Measure, manage, repeat

Moderator: tba

1. Improving the Thinning Decision in Production Forests (J. Sessions, B. Strimbu)

A fundamental issue in forest management is the management of growing stock to reach a land manager/owner's objective. For even-aged management, the decisions are rotation age and management intensity. Management intensity decisions include thinning decisions, if any, to provide intermediate income and redistribute growth to remaining trees. For uneven-aged management the decisions include cutting cycle, what trees to remove of each species and diameter class, and what should be the level of reserve growing stock.

Typically, in the uneven terrain in Pacific Northwest forests, seedlings are planted by hand to a desired number of trees per acre, more or less systematically, depending on availability of planting spots. Periodically, thinning decisions are revisited depending upon current and projected prices and actual stand development. The goal is to determine which trees are to be removed that yield the best combination of immediate income plus their removal effect on the adjacent trees. Field and/or remote sensing data can be used to identify current stand condition. Typically, instructions or criteria are developed for a marking crew or the operator as to which trees are to be removed. These instructions specify criteria such as number of trees to be removed, diameter of trees, position in the canopy, tree form, vigor, and number of trees or basal area to be retained.

We propose to investigate the feasibility of combining remote sensing technologies and growth and yield models at the operational level to improve the thinning decision. Method 1 would use above canopy LiDAR to identify tree locations, do a value analysis on the target trees and adjacent trees, and record their spatial coordinates to control field operations. Method 2 would use below canopy camera images to supply the spatial information for cutting criteria in real time considering the target tree and adjacent tree effects.

2. Applying a Reference Model Approach for Timber Traceability (M. Amuno, L. Mirowski, P. Turner)

Interests in systems for timber traceability have in recent years been stimulated by increased requirements for ensuring sustainable forest management practices. As the quest for sustainable timber value chains has increased, traceability systems and technologies have been seen as one important element of the data and information infrastructure necessary to support new value generation, new business models, and new opportunities in these chains.

Existing focus for timber traceability has been on traceability technologies, specifically targeting traceability internal to a firm for inventory management, or constrained to one-up or one-down traceability between immediate firm's supply chain partners. In some limited examples, some work on timber traceability has focused on meeting compliance obligations for certification, source verification, or chain of custody requirements.

In order to explore the broader range of traceability opportunities for timber value chains, in this paper, we apply a reference model based approach. This adapted reference model considers the role of technologies across both layers and partitions of timber value chains. By applying this reference model based approach, a range of available timber traceability systems and technologies is considered and mapped into the model.

The outcome is that the adapted model illustrates how value chain integration can be achieved by extending supply chain reasoning from "product based" traceability to more broadly "value-based" traceability through the incorporation of actors, processes and technologies.

3. Sustainable Supply Chains for Bioenergy – Results of Sustainability Assessments of Multiple Different Wood-Energy Supply Chains (M. Brunsmeier, G. Becker, D. Jaeger)

Split logs, wood chips and pellets represent the most commonly used wood products to generate energy. In this study supply chains of these three products have been compared based on a sustainability assessment. The standards ISO 14040 and ISO 14044 provide the framework for the assessment and make this study comparable as well as repeatable on a scientific level.

The wood-energy supply chains set the system boundaries for the investigation. This includes the harvesting process as well as the processing (split logs, wood chips and pellets), the conversion to energy and the disposal management. The transportation and logistics are also taken into account. The data collection is conducted in case studies in Europe with actual data from companies which are all part of the supply chain system. The results are compared based on selected criteria, which include energy efficiency, production costs and effects on employment as well as ecological effects like greenhouse gas emissions, acidification and eutrophication. Sensitivity analyses reveal differences in the impacts on the environment and production costs as a consequence of alternative technical and organizational solutions.

The results of this study allow for a holistic comparison of the sustainability of different wood-energy products. The calculations reveal hotspots within the supply chains which are responsible for a low energy efficiency, high costs or low social benefit. The study serves as a basis for the overall evaluation of sustainability by using wood for thermal energy purposes. Furthermore, it can be used as a benchmark for companies within the supply chains and provides facts for political processes within the climate change debate. The study answers the question, how wood can help to solve ecological, social and economic problems and challenges. It outlines how wood can be used for energy purposes in a highly efficient and sustainable way.

4. Evaluating the efficiency of log procurement operation: A case study in Peninsular Malaysia (Norizah K., Ismail Adnan, A.M., Lokman A., Rhyman P.P., Mohd Hasmadi I., Muhammad Farid, A.R.)

In Peninsular Malaysia, the most common log procurement technique is directional felling. Directional felling is a felling method practiced along with Selective Management System (SMS) introduced in 1978. Selective management system require pre-inventory of 1 to 2 years preceding the timber harvesting operation to be conducted for directional felling determination.

The main purposes of directional felling are to ensure the quality of log with less injuries, to reduce impacts on residual stands and to ease the extraction of log from felling site to the temporary log pond. Usually, the direction of felling are not always precise as predetermined. The changes of weather and/or wind direction during felling work is possible to change the direction of tree felling resulted to log injuries.

The priority of feller's safety is the other factor of the changes of felling direction following the log injuries. The degree of injuries are varies with log size and may reduce the prices. We compared the direction of tree felling with predetermined direction and classify the level of log injuries to three classes of (1) No injury, (2) Minor injury, and (3) Severe injury.

A 1.5 hectares (ha) plot was observed for this study. Result shows that 33.3% of fallen trees observed complied with predetermined direction, while 66.7% were not. Meanwhile, injuries recorded for three classes of (1), (2) and (3) were 79.0%, 9.3% and 11.7% respectively. With dynamic changes of the direction of tree felling, causes and solutions method should be examined to ensure the quality of log produced that promotes the efficiency of log supply in terms of good log with high prices.

15:00 – 15:30 Coffee break

15:30 – 17:00 Session 3: Profit in the wood

Moderator: tba

1. Appropriate timber transportation route using google maps API (L. Rianthakool)

The objective of this study was to estimate transportation cost based on short-distance transportation by applying Google Maps API. The study was applied in rubber wood transportation from plantations to sawmill using small trucks in Thailand. The advantages of Google Maps API were free for non-commercial user, updated data frequently, and easy to obtain the information of road networks covering local and highway roads. The interface of cost estimation required the location of plantation and sawmill, and quantity of rubber wood in that plantation. The shortest distance was retrieved by the working of direction service function from Google Maps. The transportation cost was estimated based on machine rate method according to the travelling distance and loaded volume. This system will be useful for plantation owners, wood harvesting contractors, and sawmill owners to manage and design the rubber wood supply chain.

2. Payload management of timber trucks in Australia (M. Ghaffariyan, M. Brown)

A project was carried out to investigate the impact of four different weighing systems on over/under load of forestry trucks operating in Australia for 7-axle and 6-axle trucks under two types of roads; gazetted (approved for higher legal gross vehicle weight limits) and non-gazetted (standard public road gross vehicle weight limits). For all the technologies tested for 7-axle trucks there was found to be a substantial under-loading issue ranging from 5.3 to 6.4 tonnes per load on gazetted roads while the same technology achieved a much better outcome on non-gazetted with a range of 1.4 tonnes under-loaded to 0.1 tonnes over-loaded on average. In the case of 6-axle trucks, under-loading varied from 1.1 to 1.3 tonnes while overloading ranged from 0.2 to 0.3 tonnes. The results point to a more significant role for policy and methods than the technology used for in-forest weighing in achieving effective payload management in forestry haulage.

3. Impact of reduced log and chip moisture content on the forest supply chain (M. Strandgard, M. Acuna, R. Mitchell)

The Australian forest industry has been experiencing increased competition from imported wood and wood products and non-timber substitutes. Transport costs make up a substantial proportion of delivered wood costs in Australia. As green logs and chips contain approximately 50% water, 25% of the cost of transport is to transport water, much of which is then removed during later processing. As such, transport costs could potentially be significantly reduced through infield drying prior to transport.

Preliminary studies in Australia have shown that reductions of log moisture content (MC) of up to 30% are achievable after two to three months of infield drying. However, consideration needs to be given to the potential deterioration of stored material during drying. Stored sawlogs can be rapidly colonised by sap-staining fungi and can also undergo checking and splitting, potentially reducing their value, while chips can lose significant amounts of their mass when stored in piles and can also undergo changes that reduce their suitability for chemical pulping. In addition, dry pulp logs can require more energy to chip and can produce a higher proportion of pin chips and fines, though the drier chips may require less chemical treatment to convert to pulp. Although forest biomass can also deteriorate when drying, it also gains in value from increased energy content, which can double when biomass is dried from green to 30% MC.

In order to balance the potential gains from reduced MC against potential deterioration or contamination, and increased storage costs and demand considerations, forest owners need an understanding of the implications of different MC levels on logs, chips and biomass along the supply chain and to be able to predict the MC of these materials along the supply chain.

4. Managing Deforestation Risks in Timber Supply Chains (L. Bull, K. O'Grady)

Increasing numbers of companies are making commitments to avoid trade involving deforestation. Similarly, investors are seeking assurances that companies they invest in are not contributing to deforestation either directly or indirectly through their supply chain. Despite the considerable momentum around corporate commitments on deforestation there is still a significant lack of understanding of the issues and risks.

This presentation will discuss:

- Why companies need to analyse their supply chains for exposure to deforestation risks
- Outline the different types of deforestation & related risks that exist, including the legal risks of not understanding your supply chain
- The importance of conducting or improving your risk assessments for deforestation risks
- The merits of taking part in the Carbon Disclosure Program (CDP) Forest Program
- The role of system analysis for improved approaches, including the pros and cons of requiring 3rd party certification

17:00 End of Day 1

Wednesday, 13 April Conference day 2

8:30 – 10:00 Session 4: One man's residue is another's feedstock

Moderator: tba

1. Mobilisation of forest biomass supply chains in the boreal and temperate biomes (E. Thiffault)

Countries from the temperate and boreal biomes will likely play an important role in the global deployment of forest bioenergy. However, wide differences exist between them in level of forest biomass mobilisation. Specific solutions have to be tailored to meet challenges in different contexts.

An initiative funded by the International Energy Agency-Bioenergy aims to analyse roadblocks and opportunities to mobilisation of sustainable forest bioenergy supply chains in those biomes. Results show that the integration of wood-based products and energy carriers within a common industrial and land management framework is the cornerstone of a market-driven and ecologically sustainable replacement of fossil fuels.

Market-driven replacement of oil and gas has become more promising by producing liquid biofuels, even with modest financial incentives. However, management of biomass feedstock quality is currently a weak aspect of most supply chains. Technological learning, leveraged with knowledge from experience of well-established supply chains from other countries, represent an opportunity to set strong foundations in countries with currently limited biomass mobilisation.

2. Potential of Bamboo resprouting for bioenergy: a case study in Brazil (S. Guerra, H. Eufrade Junior, R. de Melo, G. Oguri, M. Brown)

Bamboo is traditionally used in Asian countries, especially China, India and Japan for several purposes such as buildings, pulp and paper, food industry and due to it fast growth has become an alternative renewable fuel source. However, the potential of this specie is not well known in Brazil.

The objective of the research was to analyze the potential of bamboo crops for bioenergy. To accomplish this objective, the resprouting of 3.5 years old of Bambusa tuldoides plantation was evaluated. Small plots of 25 m^2 were installed with completely randomized to collect the diameter at breast height (DBH) and height. After, ten mean bamboo culms were selected randomly to determine some physical and chemical properties. Dry matter and energy yield per culms and hectare were measured combining the productivity and bamboo technology properties. Additionally, it was monitored the drying period of bamboo until to reach <30% w.b. (minimum value for burning in ovens).

The results showed that bamboo had a basic density greater than 0.700 g cm-3 and higher heating value from 17-18 MJ kg-1. Although, dry matter yield was lower than eucalypt forests, bamboo provide a low moisture content biomass in a short time (one month after harvest).

3. Development of bioactive extracts from Black Spruce bark residues (N. Francezon, T. Stevanovic)

Wood industries are generating huge amounts of residues, among which bark is an important resource for further processing and valorization of bioactive molecule through simple extraction. The residual bark of the Black Spruce, Picea mariana, the most abundant softwood species of Canadian boreal forest, is known for its richness in polyphenols. These molecules, which have been associated with health benefits, are powerful antioxydants.

The aim of the project we work on is to develop new products from the bark of the black spruce using only water for extraction green processes. Proven non-toxic on cell lines and active as antioxidant, the hot water extract is a promising product for food industries, nutraceuticals or even cosmetics as a natural alternative to artificial ones.

Three different lines of research are investigated. First, the chemical composition of the crude water extract from bark will be fully elucidated using isolation, fractionation and characterization analytical techniques such as HPLC, LC-MS, GC-MS, NMR. The studied aqueous extracts will be tested for their bioactivity on cell lines (antioxidant, anti-inflammatory). Finally, the methods optimized in laboratories will be scaled-up in order to validate the lab-scale developed operations (extraction, drying…) for the industrial requirements related to the quality and stability of the final products.

The development of this new non-wood forest product (standardized black spruce bark water extract) could help the Canadian forest industry embrace the concept of sustainable development through a new eco-responsible solution which adds value to black spruce transformation by giving new life to its residue.

4. Economic implications of green vs dry forest harvest residue feedstock for the aviation fuel supply chain (R. Zamora, J. Sessions)

Forest harvest residues are produced as a byproduct of commercial timber harvest and represent a source of readily available material for aviation fuel production. However, these forest harvest residues, when green, contain high moisture content that can increase the costs of processing and transportation and may reduce the yield of potential extractable polysaccharides for biofuel production.

Different moisture management strategies can be implemented to reduce the moisture content prior to processing but the most important question is what are the economic and environmental trade-offs between collecting processing and transporting green versus dry residue, moreover what is the opportunity cost of letting the material sit while drying. Our main objective was to estimate the implications in processing, transport and pretreatment of using Douglas-fir green versus dry forest harvest residues.

Our analysis was focused on harvest residues ground at the landing and loaded and transported in chip vans. Specifically, we discuss differences in bulk density, bark and needles content, and polysaccharides yield. We processed 150 tons of green and 150 tons of dry forest harvest residues from two similar 45 year-old Douglas-fir stands. Dry residue moisture content when ground was estimated at 15% (wet basis). Green residue was collected immediately after harvest and immediately ground. The green residue had an average moisture content of 60%.

Results indicate that the proportion of bark, needles and other substances in green residue is higher than in dry material (14% versus 8%). Chemical analysis from the pretreatment process revealed that polysaccharides content in dry residue are 26% higher than in green residue. Lignin content in dry residue is 17% higher compared to green residue. Implications in processing, and transportation economics are discussed in the paper.

10:00 – 10:30 Coffee break

10:30 – 12:00 Session 5: One plus one equals three

Moderator: tba

(4 x 20 min) **1. Integrated transport framework to optimise timber and biomass supply logistics (M. Acuna, S. Sánchez-García, E. Canga)**

Transportation from forestry harvest areas to mills accounts for up to 50% of the operational costs in forestry supply chains and costs the forestry industry millions of dollars annually. Given the level of spending on transportation costs, even small increases in efficiency can reduce costs substantially. Decisions on timber transport planning must be made at different levels

and planning horizons: strategical/ tactical, operational, and real time. The integration and interrelation of the decisions made at all these levels must connect to each other, inform and support one another for the effective management of transport operations.

In this paper, we propose an optimised integrated transport framework that includes a tactical wood and biomass flow model (MCPLAN), and an operational truck scheduling programming model (FastTRUCK). The tactical model optimally determines wood flows (transport tasks) from harvesting units to customers while minimizing supply chain costs and meeting customers' demand. The outputs of the tactical model are inputs for the operational truck scheduling model which optimally allocates transport tasks to trucks with the goal of minimizing daily trucking costs. A case study in Northern Spain is used to test our integrated approach and confirm the potential savings (2%-20%) obtained with the implementation of these decision support systems.

2. Investigating the integration between harvesting and silviculture for the South African pulpwood supply chain (S. Ackerman, D. Rietz, L. Titshall)

Plantation management involves a cycle of operations that are often viewed and managed as separate events. This can lead to miscommunications, inefficiency of spending and the focus of resources that do not benefit the overall supply/value chain. By investigating the interaction of parts of the South African supply chain, in particular the interaction of harvesting and silviculture it is evident that cost-effective operations are a priority.

These operations in general do not involve large scale mechanisation (in harvesting or silviculture) but a re-engineering of what is done and how work it allocated and managed. This work has led to further analysis of the pulpwood value chain and identified the connections between particular parts (or operations) and areas where further efficiencies can be achieved. This identification and analysis of the pulpwood supply chain was achieved through inter-company collaboration and is a first for the South African forestry industry.

3. Integrated timber harvesting: We sustainably recover more woods from our plantations! (M. Ghaffariyan, R. Spinelli, N. Magagnotti, M. Brown)

Integrated biomass harvesting system is one of the conventional biomass utilisation methods applied in Australian pine plantations. This project studied the productivity-cost and yield of this harvesting system in 32 years old Pinus radiata plantations located in South West Western Australia. The harvesting systems consisted of a harvester and a forwarder.

There were two study treatments; control plot (extracting saw log and chip wood) and fibre-plus plot (integrated sawlog, chip wood and fibre-plus (residue logs as source of biomass)). In the integrated biomass harvesting plot, 36.6 GMt/ha of Fibre-plus materials were utilised in addition to the normal sawlog and chip wood volumes. Extracting additional biomass materials reduce the productivity of the forwarder and increased the cost of extraction (2.7 AU$/GMt) compared to the control plot (2.2 AU$/GMt) but the harvester's productivity and cost did not change highly in both plots.

DBH was significant factor influencing the working time of harvester while load volume, extraction distance and extraction type (sawlog, chip wood, chip wood and Fibre-plus) significantly impacted forwarding time. Additional biomass recovery in the Fibre-plus plot resulted in less residues left on the site (103.2 GMt/ha) than control plot (144.2 GMt/ha).

4. Economics in fuel woodchip transportation: Brazilian case (S. Guerra, G. Oguri, P. Brito, M. Ghaffariyan, M. Brown)

Improvement scheduling of the woodchip transport decreases unnecessary wasting of time (i.e. waiting time, blocking, among others), thus reducing the operational costs. Operational cycle and costs involved on the woodchips removal from in-field to farm facility was analyzed. In order to transport the fuel woodchips was used a 24 m^3 silage trailer pulled by tractor during cut-and-chip Eucalyptus harvesting. Plantation was implanted two years before harvesting aiming energy production.

Machine cost were calculated with the method developed by European COST Action FP0902 and a typical time-and-motion study was designed to identify those variables that are most affected it. The transport toward the facility is the most time consuming task being highly affected by system productivity. Fuel price in Brazil is more expensive than some European countries that use cut-and-chip system. Therefore, the fuel consumption has high influence (~30%) on total cost.

12:00 – 13:00 Lunch break

13:00 – 14:15 Session 6: We are only as good as our people

Moderator: tba

(3 x 20 min) **1. Developing and demonstrating a MS Excel-VBA tool for work posture analysis and assessment in forest operations based on the OWAS concepts (S. Borz)**

In forest operations that are characterized by a low mechanization level, forest workers are frequently required to carry on their tasks in uncomfortable work postures. Depending on several factors, such postures may or may not be avoided. In time, this leads to muscoloscheletal injuries and/or disorders that may affect their work capacity. In order to make the work more comfortable as well as to eliminate hazardous work habits, it is frequently required to assess the usual way of doing work so that work posture improvements to be formulated. However, posture analysis is rather time consuming due to the necessity to process large amounts of data that is usually collected using frequency studies.

Collecting the data on-site in a traditional fashion has the advantage of a rapid assessment but, in case of error, a given posture cannot be reconstructed for reanalyzing purposes and further data processing would be required anyway. This study explores the possibility to partially automate postural data analysis by developing and demonstrating a MS Excel VBA tool whose implement is based on the OWAS (Ovako Working posture Assessment System) concept for processing image frames obtained from video recordings. Several case studies corresponding to different levels of mechanization were assessed. The possibility to extract the real time spent by workers in given postures including here the possibility to avoid some of them, as well as the possibility to differentiate between static and dynamic work were explored as well.

2. Sustainability of the workers in the Chilean forestry sector (F. Meyer)

Problem statement and aim: Sustainability principles have been acquiring greater significance in the business world and in the forestry sector. In that sense this study deals with the contribution of the human-at-work systems for business sustainability, since it is widely conceived that human performance is becoming a critical factor, in improving the sustainability of the organization.

In this context, this research aims to contribute to achieving the balance between people capacity and system demand, and expects to provide an understanding of these complex interactions and the benefits that this view could bring for the organisations.

In the specific case of the forestry sector, this sector is facing a number of challenges that having direct or indirect in impact the sustainability of the workforce and it's necessary know it to understand the situation under a holistic point of view. In that sense, the purpose of this research is explain, what is happened with the sustainability of the workforce of the forestry sector.

Approach/method(s) used: To achieve the aim of this research, the author used an ergonomics approach, specifically an ergonomics questionnaire that has the purpose to identify the elements in the work environment that are affecting that the sustainability of the workforce in the Chilean forestry sector

Results and conclusion(s)/implication(s): The sustainability of the workforce in the Chilean forestry sector is under threaten, since exist element in the sector that potentially could affecting it. The initial results show that the working conditions are a crucial element to improve the sustainability of the workforce.

3. Transforming forest safety attitudes and outcomes (J. Stulen)

Background The forest industries of New Zealand and Australia have continually improved their safety record over the past 30 years through combined engineering, systems and behaviour modifications. These techniques have been successful as they have been applied using the hierarchy of hazard control measures - take all practicable steps to eliminate, isolate or minimise exposure to workplace hazards.

Issues In 2013 the wider New Zealand public became highly attuned to failures in workplace safety after so many lives were lost in the Pike River mine explosion and the earthquake collapse of the Canterbury TV building in particular. The mainstream media, focused its attention on forestry. Booming log export markets and soaring forest harvest levels ultimately resulted in 10 forest industry workplace deaths in a single year. Forestry people felt the heat of an unrelenting union and merciless media. Forestry leaders were singled out as poor stewards of workers' safety.

Outcomes Meanwhile, away from the limelight, contracting industry leaders were well-advanced in applied research and industry development to make a paradigm shift in workplace safety. No less than 3 leading contenders for safer tree felling on steep slopes emerged commercially during 2014 and 2015. Now, New Zealand producers are leadning the forest machinery in harvesting developments. This paper sets out to explain the sequence of events that led an industry of hard-working 'can-do' confident people through a crisis that has ultimately seen radical behaviour changes towards workplace safety. The same conditions that wreaked havoc in forestry's safety sensitive workplaces also spurred the development of these cutting edge tools and techniques for ensuring step-change in forestry workplace.

14:15 – 14:30 Coffee break

14:30 – 15:45 Session 7: Chain of Responsibility – making uniform self-regulation a reality

Moderator: tba

1. Review of actual case law and a summary of prosecutions throughout the supply chain (Carlie Holt)

Carlie will provide a general overview about the current obligations in respect of chain of responsibility; including clarifying who is in the chain and what practical steps can and should be taken to comply with the law. She will talk about real prosecutions and use case examples of where organisations and individuals have breached their chain of responsibility requirements.

2**. Load Restraint of Logs: Providing compliant flexible solutions across industry (S. Carlson, D. Black)**

In 2013, key forestry industry organisations (Hancock Victorian Plantations, Midway Limited and PF Olsen Australia) identified that the frequency of load shift and associated incidents reflected concerns with the performance of existing load restraint systems. A process of investigation was commenced to improve load restraint performance in the forestry industry.

Engistics was engaged to develop and execute a testing method to confirm the appropriate method of load restraint. The process of investigation has, and continues to be, a collaborative process that combines load restraint engineering expertise with the extensive practical knowledge of transport operators and various forestry organisations.

This paper explores the critical assumptions applied to previous load restraint systems and details the methods used to test and develop improved systems.

The improved systems seek to provide a range of compliant options, for different restraint equipment and log types. A key outcome of the improved restraint solutions is improved transport safety of log types and to facilitate Chain of Responsibility compliance for the key duty holders.

3. Compliance Checkpoint – technology that underpins the due diligence elements of the ALC's code of practice (P. Molenaar)

Paul will provide a general overview of a guide to implementing an industry Code of Practice for Co-Regulation. He will describe and explain why organisations and governments need to Co-Regulate and why Co-Regulation is so difficult, as well as the critical success factors and rewards for Co-Regulation.

15:45 – 16:00 Coffee break

16:00 – 16:30 Session 8: Government influence on Supply Chain Sustainability

Moderator: tba

A panel of invited Federal politicians will discuss the role government plays or might play to ensure security of supply of wood fibre and the development of innovation through R&D

16:30 End conference

Our Plenary Speakers

Professor John Sessions

John Sessions is University Distinguished Professor of Forestry and Strachan Chair of Forest Operations Management at Oregon State University.

Before coming to OSU he served in various positions in the USDA Forest Service in engineering and timber management and was harvesting manager of JARI Florestal in northern Brazil.

He has consulted in 16 countries for NGO's, companies, and agencies on five continents.

He teaches courses in Forest Planning, Forest Operations, Transportation Planning, Logging Mechanics, Combinatorial Optimization, and International Forestry.

His research focuses on searching for efficient solutions to forest planning problems and all aspects of the forestry supply chain. He currently leads the Logistics Team for the multi-university 5-year effort to develop a supply chain for the conversion of forest harvest residues to aviation fuel. His research is documented in more than 300 publications.

For 15 years his software supported strategic planning by the Oregon Department of Forestry.

He has a BS in civil engineering, MS in civil engineering, MS in forest engineering, PhD in forest management and is a licensed professional engineer.

In 2013 he was recognized by the Society of American Foresters with the National Award in Forest Science.

In 2015 received the Forester of the Year award by the Intertribal Timber Council and the 2015 International Forest Engineering Achievement Award from the Council on Forest Engineering.

Rob de Fégely

Mr de Fégely is a committed natural resources professional with scientific qualifications and practical consulting experience in Australia and Asia in forestry, forest products, agriculture and land use management. He has proven business management skills that enable the integration of conservation and community expectations with strong commercial outcomes.

Mr de Fégely is highly respected in the Australian forest industry. He is Co-Chair with Senator the Hon. Anne Ruston, Assistant Minister for Agriculture and Water Resources of the Forest Industry Advisory Council as well as the forest industry representative on Agricultural Industry Advisory Council. He was previously a non-executive Director of VicForests, is Chairman of Cape York Timber and the National President of the Institute of Foresters of Australia.

He is Director of Margules Groome Consulting and since 2006 he has been Director of Myoora Investments which provides forest industry consulting services and manages investments in Agriculture and Forestry. Prior to that between 1996 and 2006 he was Managing Director of Poyry Management Consulting Pty Ltd (then Jaakko Pöyry Consulting Pty Ltd.).

He holds a Bachelor of Science (Forestry) from ANU 1978, a Master of Science in Forest Business Management, Aberdeen University, Scotland, UK 1989 (International Rotary Foundation Scholar) and a Financial Analysis Certificate from the University of Technology Sydney 2011.

Registration

Conference including Morning and Afternoon teas and lunch	$600
Early Bird (book by 29 Feb)	$540
Package	
Conference, dinner and field trip	$850
Early Bird (book by 29 Feb)	$750

To register, go to www.austimber.org.au/get-tickets/

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(www.visitlatrobevalley.com/accommodation.asp),

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For a more personal service, email (visitorcentre@latrobe.vic.gov.au) or phone 1800 621 409 and staff will manage your accommodation requirements.

FREE BUS SHUTTLE TO THE CONFERENCE

A free shuttle service to and from the conference venue is available from nominated motels.

To confirm accommodation and register for the free shuttle, bookings are to be made directly with the visitor information centre by email or phone.

Note: accommodation and shuttle service are subject to availability.

Conference Venue

The conference is being held in

the Little Theatre
at the Latrobe Performing Arts Centre
Corner of Grey and Breed Streets
Traralgon
Victoria 3844