UNIVERSITEIT·STELLENBOSCH·UNIVERSITY
jou kennisvennoot • your knowledge partner

Forest Engineering

Stellenbosch

27th October 2016

Reino Pulkki

Pierre Ackerman

Lise Gleasure

Chloe Williams

Jennifer Norihiro

Research Focus

your knowledge partner

Supply Chain Management

- Wood cost, product quality and resource utilisation
- Productivity development and systems optimisation
- Operations productivity research and analysis
- Time study standard and time concept development
- Machine and systems costing
- Emissions and costing parameter estimations
- Transport and logistics

Productivity Improvement Protocol

Time Study Standard for the South African Forest Industry

- Decision support in:
  - What time-study is and its correct application
  - The power of analysing comparable data
  - Time study selection and applications
  - Experimental design
  - Statistical methods
  - Statistical analysis and inferences methodology
- Documented work/time concepts - time ratios
- Costing protocols:
  - Machine and systems costing (including silviculture)
  - Business Model (International Cost Action)
- Development of productivity database
- Tool development for forestry industry
  - Time study App
  - Deci-minute timer App

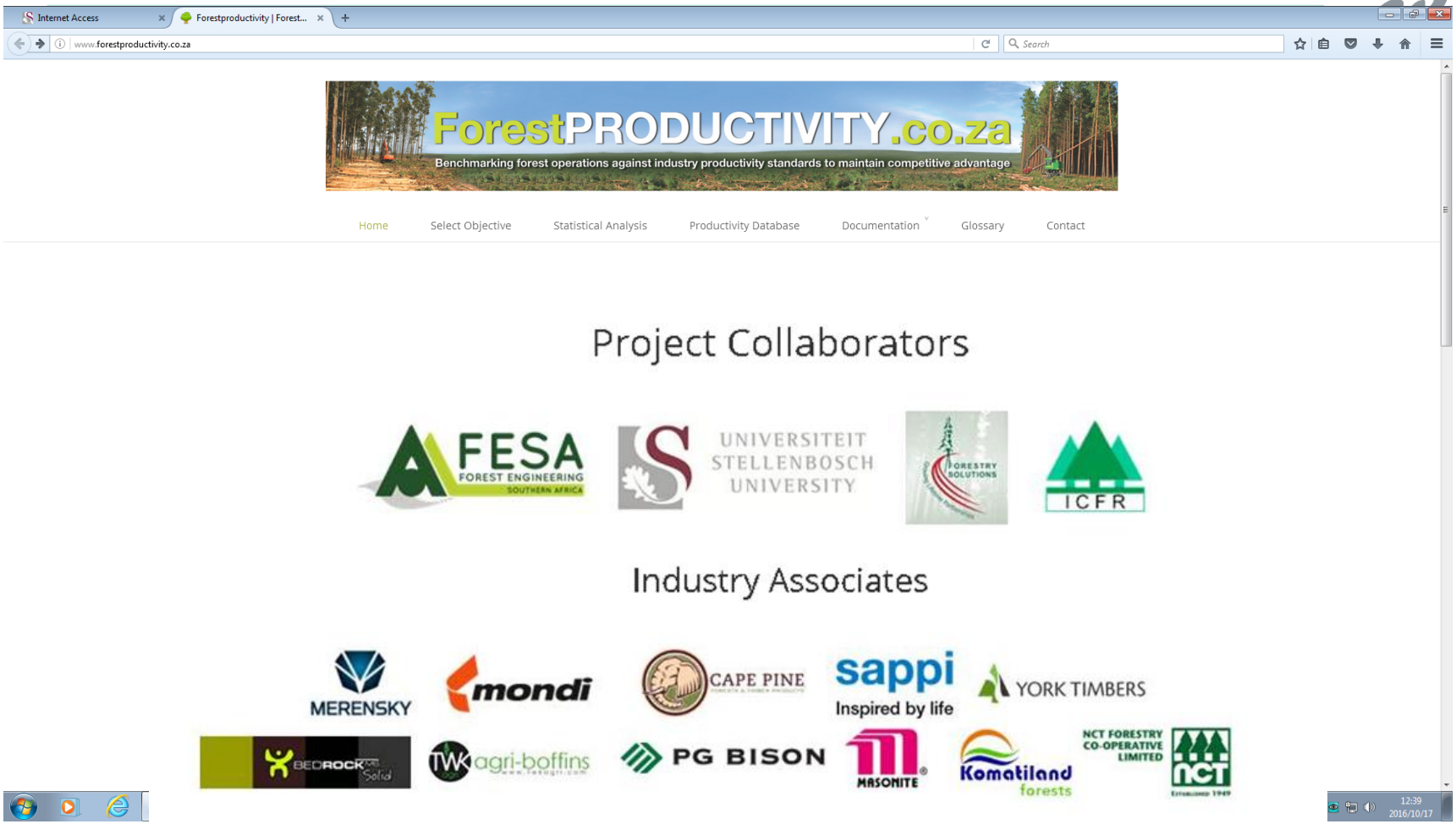






your knowledge partner

Time study standard for South Africa
(www.forestproductivity.co.za)



Supply Chain Management

South African softwood sawtimber supply chain analysis.

Modelling of potential monetary gains and improved resource utilisation from forest to mill.

- Fibre balance analysis
- Modelling primary transport
- Modelling secondary transport
- Supply chain simulation



  - Wood flow over repeatedly refined road network (upgrades, decommissioning)
  - Travel speed dynamics, payloads, primary transport efficiency, resource utilisation)
  - Applying DCF analysis – Project NPV R40m to R300m (R180m) in terms of annual revenue benefits

Simulation

Mechanised pine thinning harvesting simulation: Impact on cost and productivity with changes in planting geometry for mechanised operations. Published paper and MSc (Simon Ackerman)

- Change in planting geometry - from 2.7 x 2.7 to 2.5 x 2.9, 2.3 x 3.1, 2.4 x 3.0 (1st and 2nd thinning)
- Row removals moved from 7 to 9 rows (harvester reach)
- (<) trail length ha^{-1} by 16%
- (>) productive area and reduced stand impacts
- (>) proportion of selectively harvested trees ha^{-1}
- Maximise volume per harvester setting – improved utilisation ratio
- Maximise volume per unit length of trail - ditto
- Maintain stand integrity – gaps in canopy
- Productivity for harvester (>) 8%; forwarding (>) 21% and costs (<) 10%




Simulation
Productivity and Systems improvement

Mechanised CTL harvesting operation: discrete-event simulation (DES). John Rabie MSc

- Detailed and extensive time study data of the system
- DE simulation model to test possible improvements.
- Results included potential areas of improvement of productive time-use, corridor widths, stack volumes, grapple sizes, impact of extended primary transport, travel speeds.
- Strongly evaluated the use of R in DES.

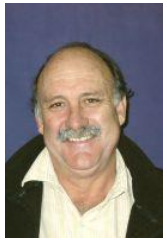




Wood Quality

- Impact of mechanical log surface damage on fibre loss and chip quality when processing *Eucalyptus* pulpwood. Jaco van der Merwe MSc

1. Fibre losses during debranching & debarking (R21 m and R34 m annually – 6.5 m t)
2. The impact on chip size uniformity during debranching and debarking (prime chips volume reduced with decreasing log size – manual operations)
3. The impact of log moisture content on chip size distribution (log drying period)
4. The impact on pulp value recovery (trends indicated increased value losses with increased passes)


Systems selection

Slope effect on costs and productivity of single-grip purpose-built and excavator based harvesters – what makes sense in hilly terrain? Chad Martin. MSc study

- The study tested an excavator based and purpose built harvester over a range of slopes from level to 50%. (+/-)
  - Intensive time studies
  - Purpose built harvester >m^3 pmh^{-1}
  - Purpose built harvester not affected by slope
  - Excavator based harvester lower cost

Productivity and emissions modelling

Mechanised cut-to-length (CTL) pine sawtimber productivity studies. Chloe Williams and Pierre Ackerman

- Three separate studies were undertaken and included intensive time-studies for modelling purposes:
  - Cost-productivity analysis of pine sawtimber mechanised CTL harvesting – productivity models
  - An analysis of fibre loss and productivity – productivity and fibre loss modelled
  - Diesel consumption and the carbon balance in pine sawtimber clear-felling CTL operations – emission models

Operator productivity development

Analysis of mechanised CTL operator development: A life assessment! Roland Wenhold MSc

- How does operator selection, training, retraining and simulator exposure impact an operator's learning/development curve?
- Is there a ceiling to productivity development?
- If so what are the drivers?
- Why are learning curves not uniform?
- What factors determine the success of operators in practice?
- Can an operator's learning curve be modeled successfully?
- How does training affect fuel consumption and emissions?
- What is the relationship over time?

Costing inputs

Cost inputs and time ratios for mechanised CTL harvesting in pine in South Africa – Custon Rugare MSc

- Case study to model operating/input costs for pine CTL mechanised systems
- Individual facets of cost input analysis over a range of site, species, product and machine characteristics etc:
  - Fuel and lubricant use and expected emissions per PMH and m^3
  - Repair and maintenance factors
  - Machine utilisation benchmarks
  - What models gives the best prediction of actual operating costs?



Other relevant past research

- Irregular stand structure and tree growth, wood quality and its mitigation in harvest planning – Simon Ackerman
- Multi-stem mechanised harvesting: Discrete Event Simulation – Glynn Hogg
- Skidding systems comparison – Benedict Ohdiambo
- Harvesting impacts on forest soils – Daud Kachamba
- Pulpwood transport in South Africa – Pierre Ackerman
- Forest products transport in South Africa – Stephen Nicholls
- Harvesting woody biomass – Emile Kitenga
- Road network interventions in a forested landscape – Vincent Young

Productivity Improvement Protocol

Time Study Standard for the South African Forest Industry

- Decision support in:
  - What time-study is and its correct application
  - The power of study comparable data
  - Time study selection and applications
  - Experimental design decision tree
  - Statistical decision tree
  - Statistical analysis and inferences
- Documented work/time concepts - time ratios
- Costing protocols:
  - Machine and systems costing (including silviculture)
  - Business Model (International Cost Action)
- Development of productivity database
- Tool development for forestry industry
  - Time study App
  - Deci-minute App







Productivity modelling and cost input data

your knowledge partner

Current status:

- Contribution to overall supply/value chain modelling/optimisation recognised
- Necessary alignment with current and future initiatives realized (Forest Enterprise Simulator)
- "Protocols" have been established, tested and disseminated
- Productivity modelling and cost inputs benchmarks taking shape
- Database developed, but needs data to reach full potential and value
- Database housed at "unaligned" venue and "available"
- Ongoing and protocol driven management is vital
- Data analysed and made available by "specialists" to ensure uniformity

The Road Ahead
"To realise full potential"

Envisaged process

- Come to an agreement to data acquisition with industry for industry
- Develop "matrix" to ID gaps in data taking stand, product and machine variables into account
- Allocate responsibility among SU/ICFR and industry partners
- Train (SU/ICFR) and put specific data collectors into the field (industry/SU/ICFR)
- Collect data according to tight control & under auspices of steering group
- Model data but continually add to database
- Large data analysis – refining productivity models over time and scope
- Set reasonable time-lines

Capacity

- SU/ICFR develop matrix in conjunction with partners
- SU/ICFR to training, control of data collection and data analysis
- Immediate action required
- Ben Spong – affiliated with SU – July 2017