Forest Engineering Southern Africa

Research overview

Prepared by: Dirk Laengin and Benno Krieg
Presented by: Benno Krieg

November 2010 – Focus on Forest Engineering conference
SA harvesting operations
Harvesting workforce challenges

- High labour turnover (estimated 20-50%) and absenteeism (estimated 10-20%)
- Forestry work regarded as a “desperation employment”
- 90% of contractors’ workforce at minimum wage
- Nutritional deficits, rest break & hydration deficiencies of manual labour
- Problematic health conditions, impact of HIV/Aids (HIV infection >30%*)
- Working lifespan of debarkers, stackers & chainsaw operators at 9 years

Vision of future semi-automated logging systems

[Fryk & Kaarnametsa]
The role of FESA

- Identify Forest Engineering and Supply Chain industry needs
- Commission and manage industry research projects to address above needs
- Technology transfer
- Facilitate the implementation of R&D results
- Facilitate Forest Engineering stakeholder interaction
- Indirect involvement and support of training and education to support skills development in South Africa
FESA’s broad research themes

**Holistic integrated supply chain focus (silviculture interlink)**

- **Harvesting** (appropriate harvesting technologies, safety on harvest equipment & terrain, equip. for small gum harvesting, purpose built equip)
- **Roads** (economics, technologies, new materials, interface harvest & roads, terminology, road network design)
- **Transport** (cost reduction, technologies)
- **People** (labour transport, health, nutrition, ergonomic checklist, viability of contractors, absenteeism & turnover)
- **Bio energy** (cost effective, silviculture overlap, harvest systems, energy efficiency)
- **Precision Forestry** (functional terrain classification, ICT applications, operational control, benchmarking)
- **Logistics** (interface harvest & roads, economics, tracking of products)
- **“Future forestry”** in SA (“future” harvesting equipment)
- **Work study** (terminology, basic elements, work & method study, data pool, costing & productivity, training and education,)
FESA’s focus in 2009

- Back to basics ..
  - Restructure FESA with a new constitution
  - ICFR – the interaction and roles defined
  - Clarify FESA’s R&D focus
  - Guidelines and procedures for project funding
  - Secure basic project funding through FSA
FESA’s R&D focus in 2009

- **Funded research projects**
  - Harvesting and transport costing model
  - Shift scheduling in mechanised harvesting operations
  - Mechanised processing of Eucalyptus
  - Pine saw timber tree optimisation in South Africa
  - Mechanical Wattle debarking

- **Handbook**
  - Ground based harvesting handbook (finalize Q3 2010)
  - FIETA chainsaw training handbook (incorporating FESA chainsaw handbook)

- **ICFR field days**
Mechanised Processing of Eucalyptus

A. McEwan
<table>
<thead>
<tr>
<th>Processing Equipment &amp; Country</th>
<th>Company and Contractor</th>
<th>Compartment</th>
<th>Species</th>
<th>Age at felling (yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFDD - Chile</td>
<td>CMPC – Mecharv</td>
<td>Totoras 3</td>
<td><em>E. globulus</em></td>
<td>10</td>
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<td>CFDD&amp;C – W Aust</td>
<td>ITC – Edenborn</td>
<td>Millinup 13</td>
<td><em>E. globulus</em></td>
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<td>GSP – Edenborn</td>
<td>Snowball</td>
<td><em>E. globulus</em></td>
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<td>CFDDC – W Aust</td>
<td>GSP – Softwood Logging</td>
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<td><em>E. globulus</em></td>
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<td>CFDDC – W Aust</td>
<td>ITC – WAPRES</td>
<td>Willow Springs 13</td>
<td><em>E. globulus</em></td>
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<td>11</td>
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<tr>
<td>DHP - Zululand</td>
<td>Mondi – Iningi</td>
<td>Mill Site G04B</td>
<td><em>E. grandis</em></td>
<td>6</td>
</tr>
<tr>
<td>DHP - Zululand</td>
<td>Mondi – Iningi</td>
<td>Mill Site G01B</td>
<td><em>E. grandis x camaldulensis</em></td>
<td>7</td>
</tr>
<tr>
<td>Harvester - Zululand</td>
<td>Mondi - Iningi</td>
<td>Mill Site G01B</td>
<td><em>E. grandis x camaldulensis</em></td>
<td>7</td>
</tr>
</tbody>
</table>
CFDD&C – Western Australia Full tree
Tree size and productivity

Tree size and productivity

Tree Volume (m$^3$)

1. < 0.051
2. 0.051 – 0.099
3. 0.1 – 0.199
4. 0.2 – 0.299
5. 0.3 – 0.499
6. >0.5
Shift Scheduling for mechanized harvesting operations

Ria Steyn
Human factor

- Psychological effects
- Effects on family and social life (balance)
- Physical effects
  - Circadian rhythms – shift work demands worker to be active when the body wants to be inactive
- Performance
Recommendation

No single, universal shift-scheduling process available

- Is it necessary to implement a shift system (cost, production, efficiency)?
- Are the necessary means and resources available to boost levels of production?
- Apply continuous job-rotation schedule
- Incorporate daily machine maintenance into shift system (machines are important to the process) and completed by the team
- Integrated rest breaks in groups, leave, and improve travel conditions
- Try to eliminate solitary work, but adequately compensate
- Break up day with team activities (machine maintenance - core activity)
- Consider split-shift scheduling, reduce shift lengths and early morning starts
Split shifting example

<table>
<thead>
<tr>
<th>Time</th>
<th>Operator 1</th>
<th>Operator 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>6:00am</td>
<td>Harvest 4 hr</td>
<td>Harvest 3 hr</td>
</tr>
<tr>
<td></td>
<td>Lunch 1 hr</td>
<td></td>
</tr>
<tr>
<td>10:00am</td>
<td>Maintain 2 hr</td>
<td>Lunch 1 hr</td>
</tr>
<tr>
<td>7:00pm</td>
<td>Harvest 3 hr</td>
<td>Maintain 2 hr</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Harvest 2 hr</td>
</tr>
</tbody>
</table>

Split shifting
WATTLE DEBARKING STUDIES

J Eggers & A McEwan
Demuth, Hyena & Hypro
Effect of tree size on productivity

Productivity (m³/PHM)

Volume class

Demuth
Hypro
Hyena
Effect of strip-ability on productivity

Productivity (m³/PMH)

Strip-ability class

Demuth  Hypro  Hyena

m³/PMH

0  5  10  15  20  25

1  2  3  4  5

Version 1.1

Available online at: http://www.sun.ac.za/forestry
Please select a method for balancing: Balance by highest priced equipment

Time frame of this project in years: 6.66

Multiplication factor for the balancing unit: 1.70

<table>
<thead>
<tr>
<th>Activity</th>
<th>Equipment</th>
<th>Price (R)</th>
<th>m³/PMH</th>
<th>m³/annum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fell</td>
<td>Harvester (wheeled)</td>
<td>4500000.00</td>
<td>27.00</td>
<td>74903.40</td>
</tr>
<tr>
<td>Extract</td>
<td>Forwarder</td>
<td>2000000.00</td>
<td>25.00</td>
<td>88400.00</td>
</tr>
</tbody>
</table>

By adjusting this factor, the number of equipment can be increased.

Quantity of timber that the system can produce per annum: 74903.40

Balanced replacement value for all equipment (R): 86500000.00

<table>
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<tr>
<th>Activity</th>
<th>Equipment</th>
<th>Working days/annum</th>
<th>Shifts/day</th>
<th>Scheduled hours/shift</th>
<th>Machine utilisation</th>
<th>Estimated productivity utilisation</th>
<th>% Use of Effective equipment utilisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fell</td>
<td>Harvester (wheeled)</td>
<td>260.00</td>
<td>1.00</td>
<td>11.00</td>
<td>97.00</td>
<td>27.00</td>
<td>100.00</td>
</tr>
<tr>
<td>Extract</td>
<td>Forwarder</td>
<td>260.00</td>
<td>2.00</td>
<td>8.00</td>
<td>85.00</td>
<td>25.00</td>
<td>100.00</td>
</tr>
</tbody>
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FESA Roads Working Group:

The focus on the following issues:

- Effective inter-company cooperation
- Improve road construction and maintenance knowledge
- Custodian of the Forest Road Standards and Handbook
- Road network optimization
- Development of generic guidelines for the maintenance and construction of forest roads
- Development of broad budget guidelines for forest road maintenance
The following meetings were held:

- 17 March 2010 ~ Pretoria
- 12-13 May 2010 ~ White River
- 29-30 September ~ Pietermaritzburg

(4th meeting of 2010 scheduled for mid Nov 2010)

- Good response from land owners
- Good cooperation
FESA R&D projects 2010

- Research projects
  - Decision support model for the use of forest residue for bio energy in SA
  - Work study protocol and manual for the South African Forest Industry
  - Guidelines for steep slope semi- and mechanized harvesting operations in Southern Africa
- ICFR field days
- Co-operation with CRC for Forestry (Australia)
- Dissemination of R&D results (webpage, publications)
- Roads working group
- Mechanised harvesting working group
Fasa Publications

Fasa has produced a number of publications under the broad focus areas of Forest Engineering (general), Roads & Transport, Ergonomics and Harvesting.

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Forest Engineering
- Forest Standards Generating Body. (2001)

Roads & Transport
- National Forest Road Classification System, Standards and Specifications. (1994) [.5 MB]
- Central Tyre Inflation (CTI). A literature review. (2002) [5.2 MB]
- A new tool to improve vehicle scheduling for the timber transport industry. ICFR Technical Note 01-2006. (2006) [261 KB]
FESA contacts

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  - Andie Immelman (Sappi)  
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- **Roads working group**
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- **Mechanised harvesting working group**
  - Johannes van Rooyen (PG)  
    - jhvanrooyen@pgbison.co.za
South African Ground Based Harvesting Handbook

2010

Afesa Forest Engineering Southern Africa

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ICFR