A forecast of silviculture re-establishment technologies of the future in plantation forestry

Muedanyi Ramantswana,
Prof M Brink, Dr R Spinelli, Prof K Little & Prof Chirwa
FORMEC: “Forest mechanisation of the future”

Hungary, Sopron – 8th October 2019
Contents

- Introduction
- Research question and objectives
- Methods and materials
- Data collection
- Data analysis
- Results
- Summary
- Conclusion
- References
Introduction

- Re-establishment is core to silviculture
- Over the past decade – new emphasis on technology development
- Challenge with re-establishment technology is:
  - Globally fragmented
  - Variable sites and treatment requirements
  - No standardization of activities globally
  - Different landowner objectives
Main drivers

- Health and safety improvement
- Cost reduction and productivity improvement
- Quality and consistency improvement
- Social challenges e.g. labour availability
- Environment e.g. reduction of waste and certification bodies

(McEwan and Steenkamp 2014; da Costa, 2013)
Research question

- Which silviculture re-establishment technologies are likely to emerge and or adopted in future (5-20 years) in South Africa and other countries practicing plantation forestry?

Research objectives

- Identify existing re-establishment technologies
- Identify re-establishment technologies that are likely to emerge and adopted in medium to long term
Methods and Materials

- Information gathering
  - Literature review
  - Technology exhibitions: Expo Forest, NAMPO and industry visits
  - Interviews with Experts (semi structured)

- Delphi method

- Three rounds of forecasting reviews
Data Analysis

Each expert:

1. Confirms their expertise and describe re-establishment methods
2. Forecasts when each technology will be adopted on 50% of new machines/system
3. Summarizing results of specific round (Administrator)
4. Examines group results:
   1. If required, revises prediction
   2. If necessary comments
4. Step 3 repeated
5. Results analyzed
Countries of origin of the panel

24 Experts

- Australia
- Brazil
- Uruguay
- South Africa
- Canada
- China
- Finland
- Indonesia
- Japan
- Sweden
- USA
Results

Plantation forest experts only (24)
Forecasted Technologies

1. Machine specific innovations
   • Multifunctional machines
   • Machine terrain handling enhancements
   • Machine automation and robotics
   • Drones to monitor and conduct some re-establishment activities
   • Machine self-diagnosis and maintenance

2. Material inputs innovation
   • Paper based plant pots
   • Advance chemical application
   • Nano fertilizers and fertilizer tablets
   • Ultra low emission engines

3. Machine operator specific innovations
   • Ergonomically friendly cabs
   • Simulation training
   • Artificial intelligence
   • Advance human-machine interfaces

4. Computerized technology applications
   • Real time machine monitoring
   • Real time stand assessment
   • Operator behaviour and performance monitoring
   • Processing and application of big data
   • Remote control of operating machines
Machine specific technical innovations

- Multitask: +30%, -65%
- Terrain: +33%, +67%
- Automation: +74%, -48%
- Drones: +17%, +40%
- Self-diagnosis: +48%, -74%

Year categories: 2018, 2020, 2025, 2030, 2035, 2040, Future, No
Material input innovations

- Paper based pots: +33%
- Chemical reduction: +36%
- Nano fertilizers: +100%
- Low emission engine: +1%
- Other technologies: +9%
Machine operator innovations

<table>
<thead>
<tr>
<th>Technology</th>
<th>2018</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
<th>Future</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ergonomic cabs</td>
<td>-33%</td>
<td>+67%</td>
<td>-52%</td>
<td>+15%</td>
<td>-52%</td>
<td>+15%</td>
<td>-52%</td>
<td>-52%</td>
</tr>
<tr>
<td>Simulation training</td>
<td>+8%</td>
<td>+25%</td>
<td>+25%</td>
<td>+25%</td>
<td>+25%</td>
<td>+25%</td>
<td>+25%</td>
<td>+25%</td>
</tr>
<tr>
<td>Machine learning (AI)</td>
<td>-36%</td>
<td>+13%</td>
<td>-36%</td>
<td>+13%</td>
<td>-36%</td>
<td>+13%</td>
<td>-36%</td>
<td>-36%</td>
</tr>
<tr>
<td>Advance human interface</td>
<td>+59%</td>
<td>+59%</td>
<td>+59%</td>
<td>+59%</td>
<td>+59%</td>
<td>+59%</td>
<td>+59%</td>
<td>+59%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Computerized technology applications

Delphi 3 Expert Forecast (%)

- Real time operation monitoring
- Real time stand assessment
- Real time operator monitoring
- Big data processing
- Remote control of machines

- 2018  2020  2025  2030  2035  2040  Future  No

Percentages:
- +50%
- +70%
- +18%
- +100%
- -50%
- -67%
- -20%
- -40%
- -11%
- -0%
Summary of results

- **2018**
  - Ergonomic cabs
  - Drones

- **2020**
  - Multi-task
  - Simulation training
  - Nano fertilizers
  - Low emission engines
  - Chemical reduction
  - Paper-based pots

- **2025**
  - Self diagnosis
  - Terrain
  - Automation

- **2030**
  - Real time operation monitoring
  - Real time assessment
  - Real time operator monitoring
  - Real time assessment

- **2035**
  - Big data processing
  - Remote control

- **Future**
  - Advance human interface

- **No**
  - Machine learning
  - Change the World
Conclusion

- New and emerging technologies were identified and forecasted
- Most technologies show a high probability of adoption within the next 5 to 15 years
- Technology forecasting is important for planning purposes
- Future studies can monitor the adoption of technologies identified
Acknowledgements

- Nelson Mandela University and University of Pretoria
- All grower companies and contractors who participated
- All the experts who participated in the interviews and Delphi study
- Supervisors for support and guidance
Ndo livhuwa

Thank you

Muedanyi Ramantswana,
E-mail: Muedanyi.ramantswana@mandela.ac.za

Nelson Mandela University (South Africa, George)
Faculty of Science
School of Natural Resource Management
Forest Engineering
References


Change the World

mandela.ac.za