



# Improving forest operations through applied research

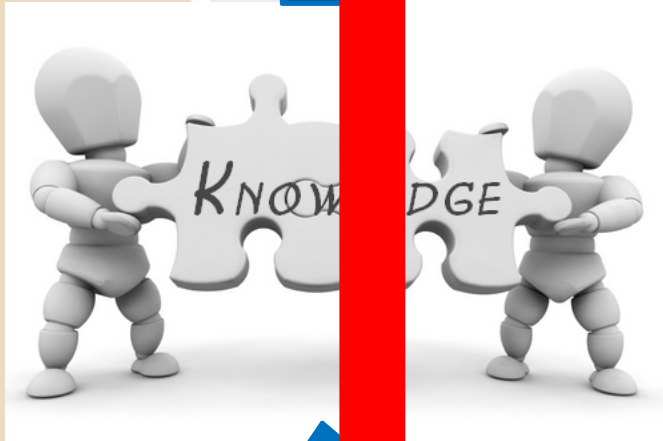
**Mark Brown**

Harvesting Program manager & manager industry engagement,  
CRC for Forestry – University of Melbourne  
Adjunct Research Fellow, University of the Sunshine Coast



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Innovation



Research

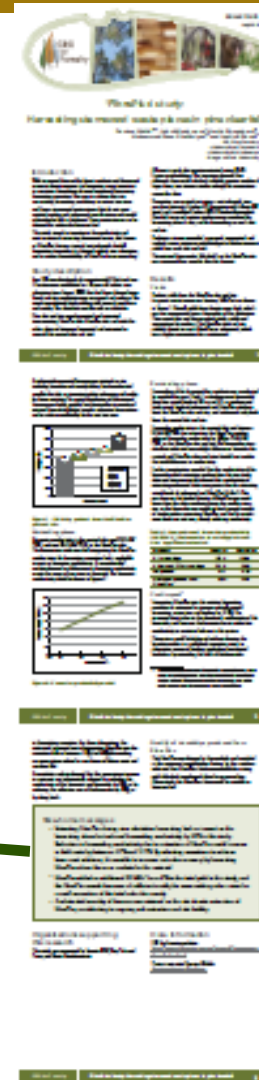
- Collaboration of industry & researchers
- Collaborative R&D for utilitarian outcomes
  - positive economic, environmental & social impacts
  - Improve industry's social licence
  - Increase yields and value while reducing costs
  - Increase capacity for innovation

# Overall strategies

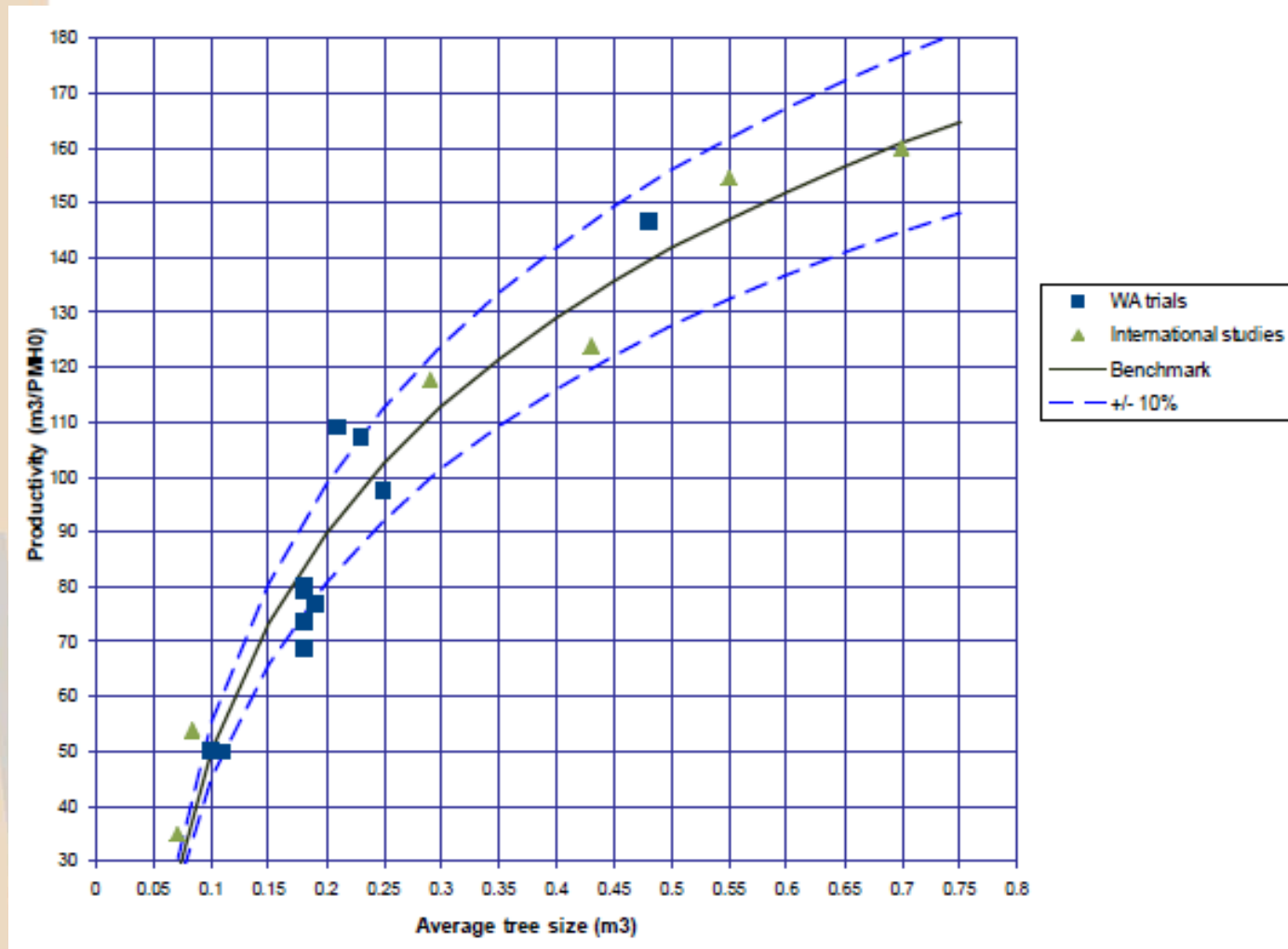
- Bulletins
- Workshops
- One-on-one
- Tools

## Take-home messages

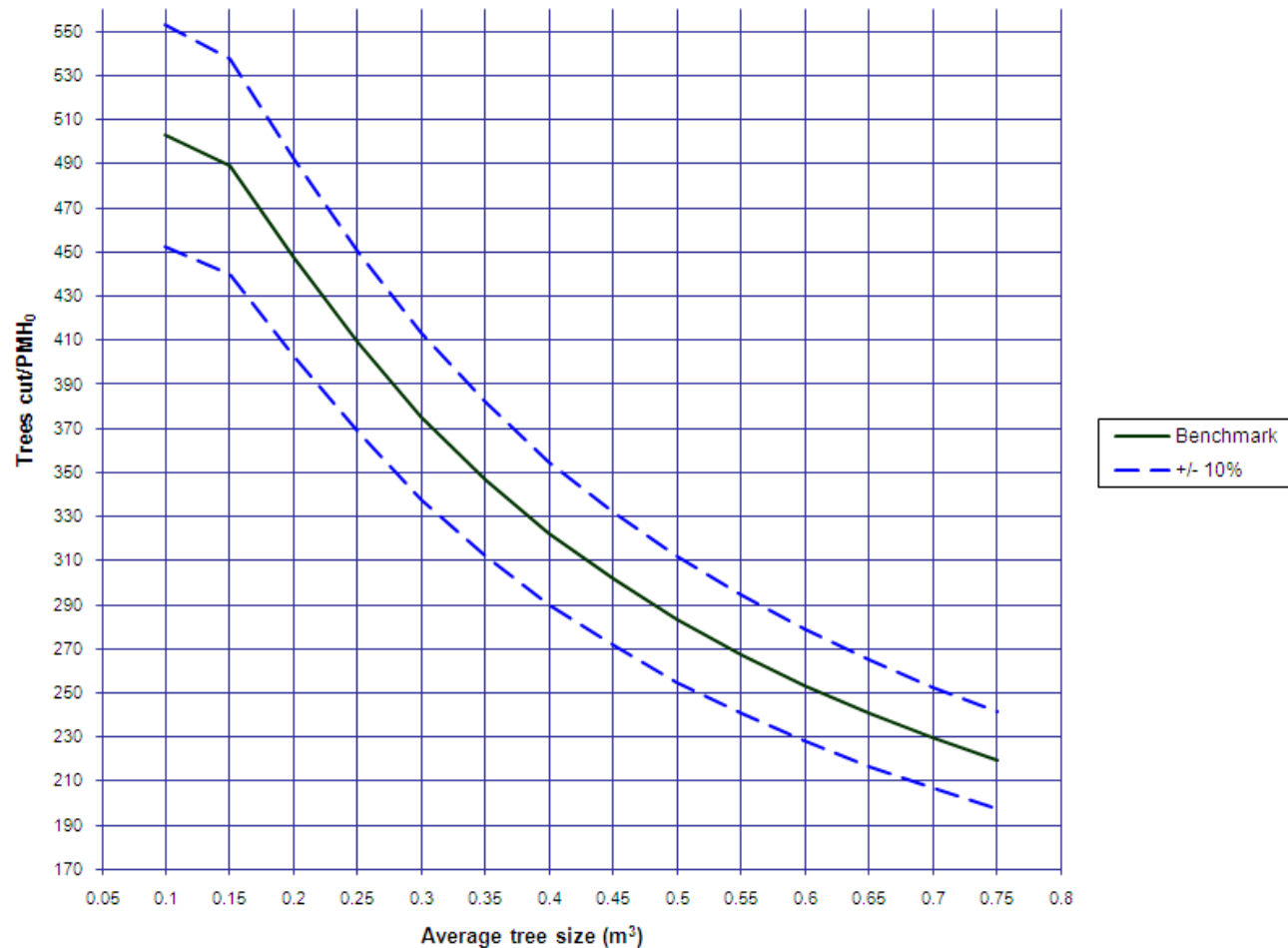
- Extracting FibrePlus during pine plantation harvesting had no impact on the harvesting phase but reduced forwarding productivity by 14% in this study. Reduction in forwarding productivity due to extraction of FibrePlus could increase in-field costs by between 2.7% and 12.1%. By adjusting operations to achieve lower-cost solutions, it's possible to improve net value recovery by harvesting FibrePlus where there are markets for the material.
- FibrePlus added an additional 23 GMt / ha or 4% to the total yield in this study, and the FibrePlus woodchips were of sufficient quality for papermaking when mixed as a small proportion of the total pulp chip supply.
- A substantial quantity of biomass was retained on the site despite extraction of FibrePlus, contributing to ongoing soil protection and site fertility.



# Feller buncher productivity curve



# Feller buncher field use curve



# Machine evaluation

Draft Technical Report

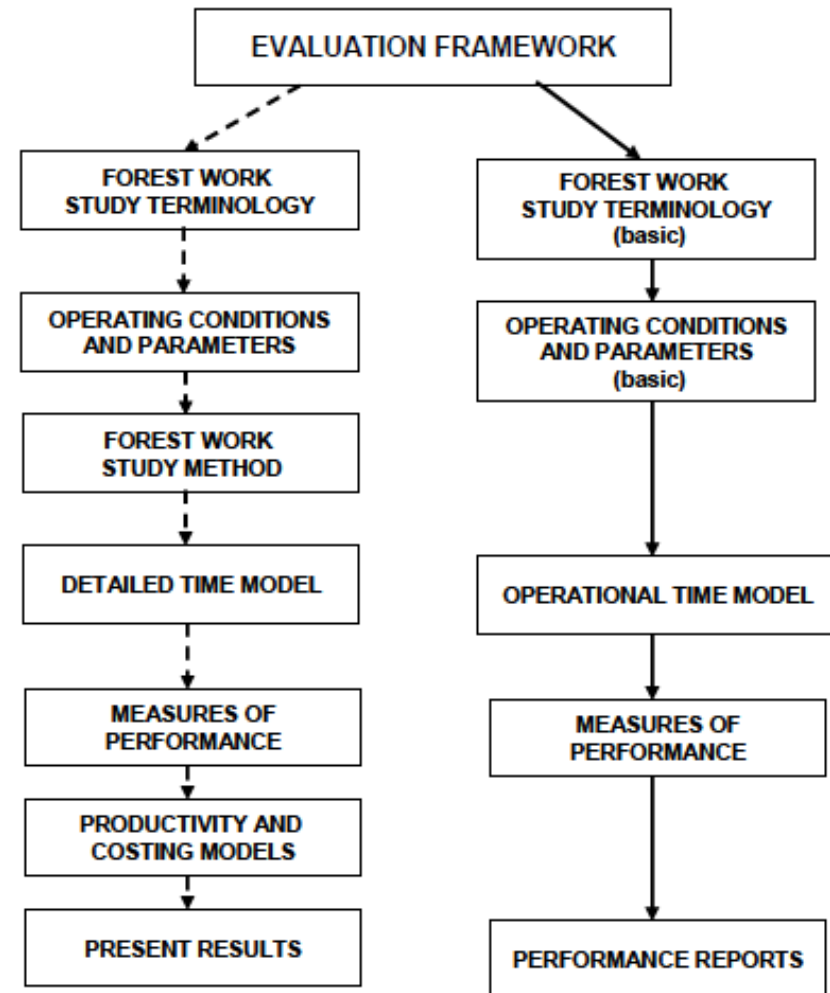
Harvesting machine evaluation framework for Australia

M. Acuna, E. Heidersdorf

October 2008


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--- Detailed  
— Operational


# Machine evaluation toolbox


 **Machine Evaluation Toolbox**


Select What you need by clicking on one of the pictures

 Introduction to machine evaluation







 Select an evaluation method

 The tools you need by evaluation type




 The tools you need by machine type


 **Harvester – Instantaneous observation**

**FIELD FORMS**

- Background Information Form  
- Harvester Instantaneous Observation Form  
- Blank Instantaneous Observation Form  

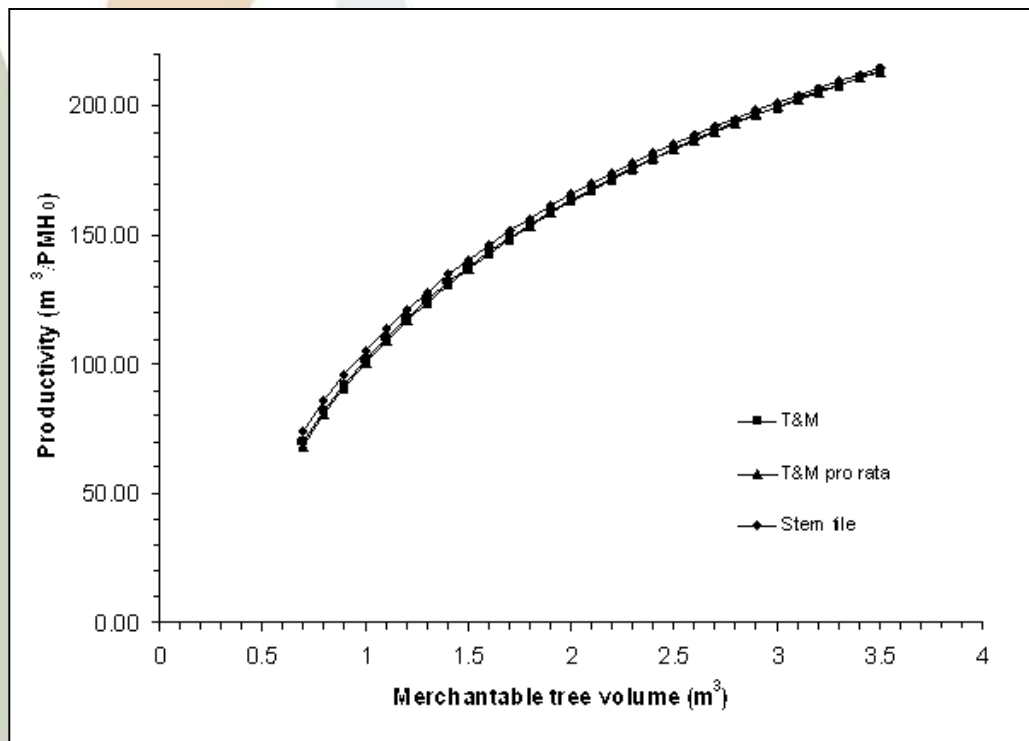
**CALCULATION TOOLS**

- Sample size Calculator 
- Random Time Interval Generator 
- Instantaneous Observation result calculator 

 **EXIT**  
To previous menu



# Productivity from stem files



- Stem files found to provide accurate productivity models for harvesters in R.Pine
  - Quicker and lower cost
  - Very large pool of data available
  - No Hawthorne effect

# Productivity from stem files

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- Evaluation and method to be published
- Method to be passed to industry as Excel tool



# OBS

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- Better management of operations
  - Improved machine utilisation (+20%)
  - More effective machine utilisation
  - Better machine productivity (+10%)
  - Better delay management

# OBS guide



- Brief description
- Examples
- How to use/implement
- Pros and cons
- Case studies



Application	Onboard computers (Most to least suitable)
Estimate harvester productivity	1. <a href="#">Manufacturer</a> 2. <a href="#">Purpose built</a> 3. <a href="#">GPS</a>
Estimate forwarder/skidder productivity	1. <a href="#">Manufacturer</a> 2. <a href="#">Purpose built</a> 3. <a href="#">GPS</a>
Identify inefficiencies (underutilisation, bottlenecks)	1. <a href="#">Vibration</a> 2. <a href="#">Purpose built</a> 3. <a href="#">Manufacturer</a>
Assess alternative harvest methods	1. <a href="#">Manufacturer</a> 2. <a href="#">Purpose built</a>
Assess downtime (delay causes)	1. <a href="#">Purpose built</a> 2. <a href="#">Manufacturer</a>
Assess long-term performance	1. <a href="#">Vibration</a> 2. <a href="#">Purpose built</a> 3. <a href="#">Manufacturer</a>
Continual improvement	1. <a href="#">Purpose built</a> 2. <a href="#">Manufacturer</a>
Assess productivity under different working conditions	1. <a href="#">Manufacturer</a> 2. <a href="#">Purpose built</a>
Cost model (rates)	1. <a href="#">Manufacturer</a> 2. <a href="#">Purpose built</a>
Reduce fuel consumption	1. <a href="#">Manufacturer</a> 2. <a href="#">Purpose built</a> <sup>2</sup>

# Machine productivity

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CRC has done 70+ machine performance and productivity studies with industry partners in the last 4 years

# ALPACA

## Australian Logging Productivity and Cost Appraisal Model

Version 1.1 Copyright 2007: G.E. Murphy & Associates

Analysis by: Mauricio Acuna

Date: April 30, 2008

Unit ID: Sawmill Gap

Location

- NSW  
 VIC  
 TAS  
 SA  
 WA

Analysis Type

- Single Machine  
 System Forecast



### Model Definition

Harvest Unit Details

Total Area  hectares

Percentage lost to gaps  %

Move-in/Out Distance  km

Stand Details

Merch. Volume  m<sup>3</sup>/ha

Removal Density  trees per ha

Conversion Factor  tonnes/m<sup>3</sup>

Species

- P.radiata     E. globulus     E. nitens  
 Other Eucalypt     Other Species

Harvest Type

- Clearfall  
 Thin  
 Other, e.g. Variable Retention

Dephased Operation

- Yes: Cold Deck  
 No: Hot Deck

Extraction Details

Average Extraction Distance  m  
Slope  %

Equipment Configuration Type

#### Ground based

##### CTL with Static Systems

- CTL at Stump  
 CTL at Plantation Edge

##### In-Forest Chipping

- IFC, debark at stump  
 IFC, debark at forest edge

#### Cable

- Medium Tower

Productivity Adjustment Factors

Tree Form	<input type="text" value="0"/>	%
Crew Experience	<input type="text" value="0"/>	%
Other	<input type="text" value="0"/>	%
Total	<input type="text" value="0"/>	%

Key Statistics

Daily Production  m<sup>3</sup>

Predicted Rate (includes OH's & Risk)  \$/m<sup>3</sup>

Harvest Unit Costs (\$)	
Fell	<input type="text" value="31,461"/>
Delimb/Buck	<input type="text" value="0"/>
Skid/Forward	<input type="text" value="27,239"/>
Chip in Forest	<input type="text" value="0"/>
Load	<input type="text" value="33,393"/>
Other	<input type="text" value="22,075"/>

Sub-Total

Transport (\$/m<sup>3</sup>)

Total

Extraction to Roadside or Central Landing

- Roadside     Central Landing

Days to Harvest Unit

Days to Log \*

# Fast Truck impact

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- This human expert centrally dispatched:
  - \$96,120 to implement
  - 54 logging trucks
- Optimised centrally dispatched:
  - \$76,740 (-20%)
  - 45 logging trucks

# Fast Truck the tool

## FastTRUCK 2.0

### Summary of results

Number of trucks	= 21
Total daily cost (\$)	= 26146 (\$10.3 / t)
Total daily volume (tonnes)	= 2550.0
Average truck utilisation (%)	= 91.7
Average truck utilisation over shift (%)	= 78.9
Average truck waiting time (minutes)	= 55.0
Average loaded running (%)	= 54.5

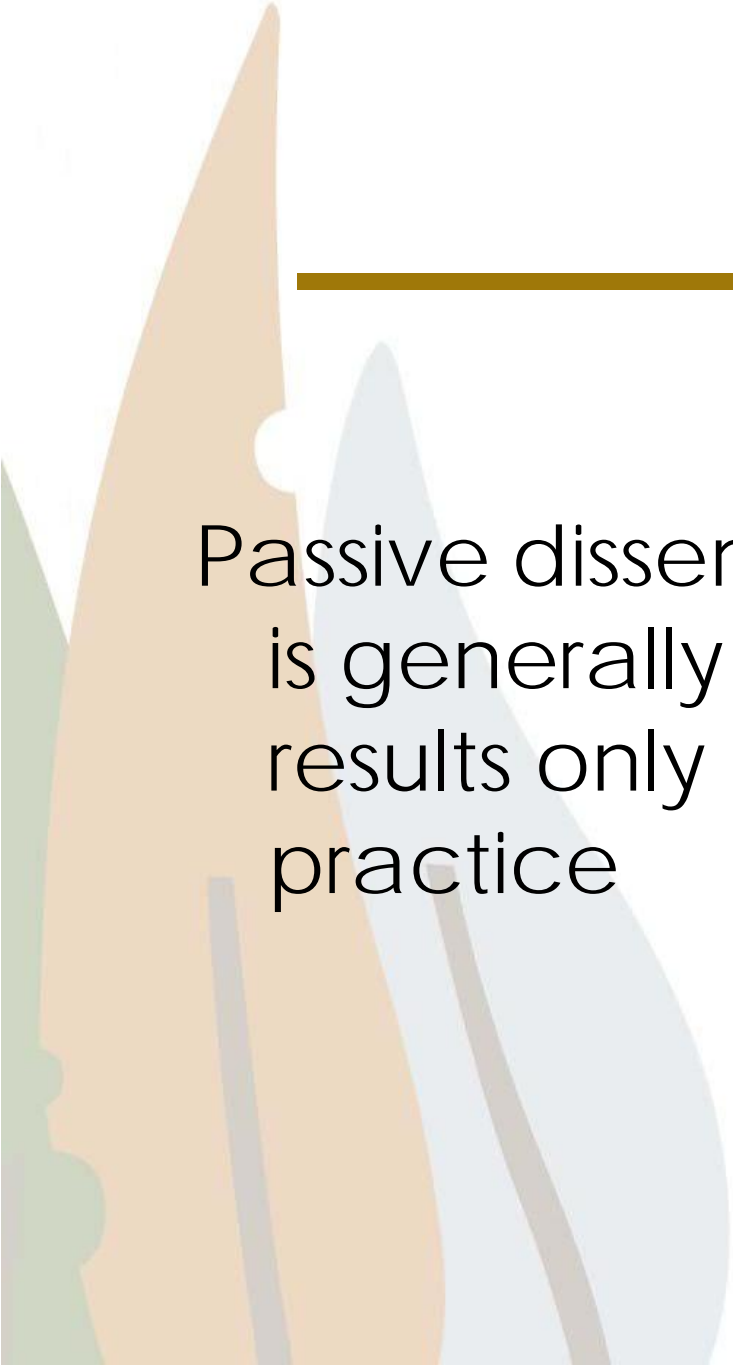
**FastTRUCK** version 2.1  
Optimal truck scheduling system



Developed by Dr. Mauricio Acuna  
CRC Forestry Harvesting & Operations Program

Truck	Truck ID	Total time (hours)	Total cost (\$)	Trips to custom.	Volume to custom. (tonnes)	Waiting time (minutes)	Utilisation (%)	Utilisation OS (%)	Running loaded (%)
1	1	9.9	1249.7	2	100.0	62.0	89.6	74.3	51.0
2	2	12.4	1372.8	3	150.0	49.0	93.4	96.1	44.4
3	4	8.9	1130.0	2	100.0	0.0	100.0	74.2	39.4
4	5	8.6	1143.1	2	100.0	16.0	96.9	69.0	60.3
5	6	11.3	1276.6	3	150.0	0.0	100.0	94.2	50.6
6	7	7.0	1019.4	2	100.0	26.0	93.8	55.0	71.6
7	8	8.0	1092.7	2	100.0	22.0	95.4	63.7	40.5
8	10	12.2	1371.0	3	150.0	90.0	87.7	89.4	53.7
9	11	12.8	1501.4	3	150.0	55.0	92.8	98.6	52.7
10	12	9.8	1196.7	2	100.0	15.0	97.5	80.0	53.5
11	13	11.9	1427.0	3	150.0	44.0	93.9	93.5	57.5
12	14	9.6	1121.8	3	150.0	27.0	95.3	76.0	63.0
13	15	8.6	1188.5	2	100.0	24.0	95.4	68.6	51.9
14	16	10.6	1216.6	3	150.0	26.0	95.9	84.6	57.7
15	17	11.3	1214.4	2	100.0	145.0	78.6	73.8	54.1
16	18	11.4	1335.5	3	150.0	21.0	96.9	91.7	71.4
17	19	8.4	1076.9	2	100.0	77.0	84.7	59.2	46.7
18	20	13.8	1522.4	3	150.0	136.0	83.5	95.7	68.4
19	21	8.4	1122.9	2	100.0	20.0	96.0	67.4	56.3
20	23	11.5	1312.9	2	100.0	135.0	80.5	77.2	52.0
21	25	11.8	1253.7	2	100.0	164.0	76.9	75.8	48.2





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Passive dissemination of knowledge,  
is generally ineffective and, at best,  
results only in small changes in  
practice

Bero et al 1998



# Improving forest operations management through applied research

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