

Forestry automation and robotics

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Outline

- Early automation
- Forestry
- Mining
- Issues
- Future



Early forestry automation



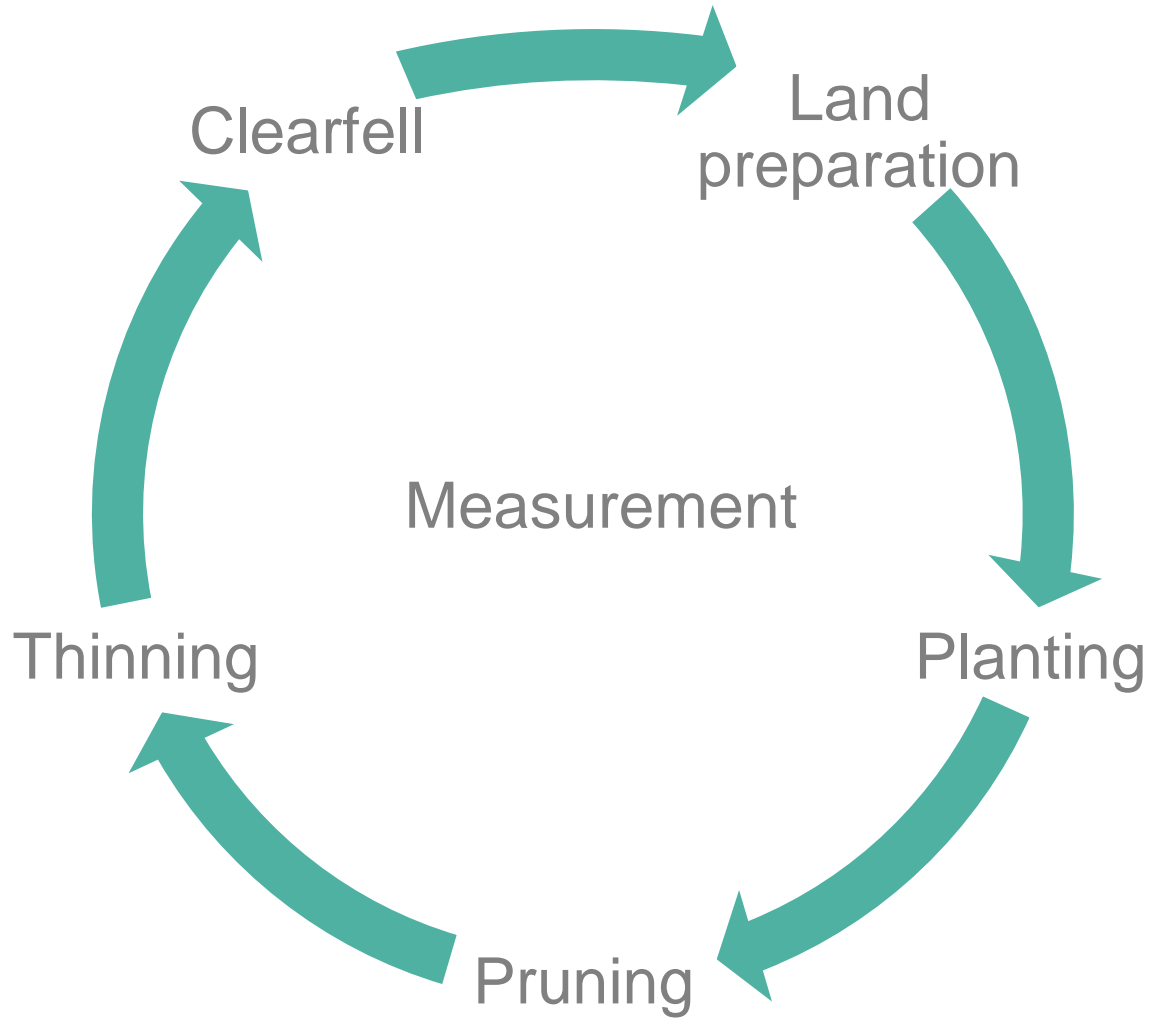
<https://nz.pinterest.com/pin/122582421085215385/?lp=true>



- Autonomous navigation
- Self fuelling
- 'Return to home' feature
- Personality
- Relatively quiet operation
- Carbon neutral



Forestry cycle



Planting



http://www.uavcropdustersprayers.com/uav_planting_trees



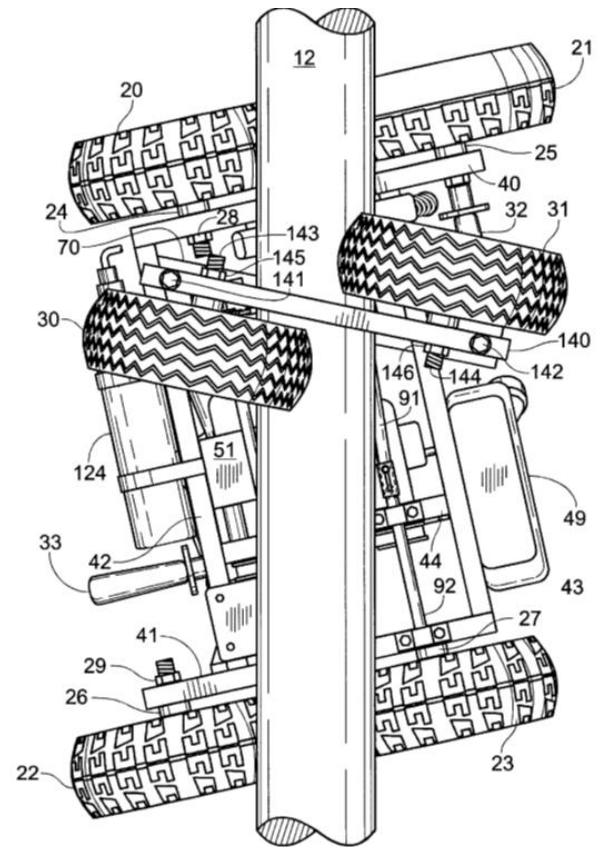
<http://pixgrove.blogspot.co.nz/2010/09/tree-planting-robot.html>

<http://vancouver.sun.com/news/staff-blogs/robots-are-coming>

Pruning



<https://www.electronicproducts.com>



<https://www1.gifu-u.ac.jp/>

Harvesting

- Motor-manual
 - Operators exposed - hit by trees and rolling logs
 - Cycle time of minutes
- Mechanised
 - Operators in machine cabs
 - Intense – cycle time of seconds
 - Overuse injuries



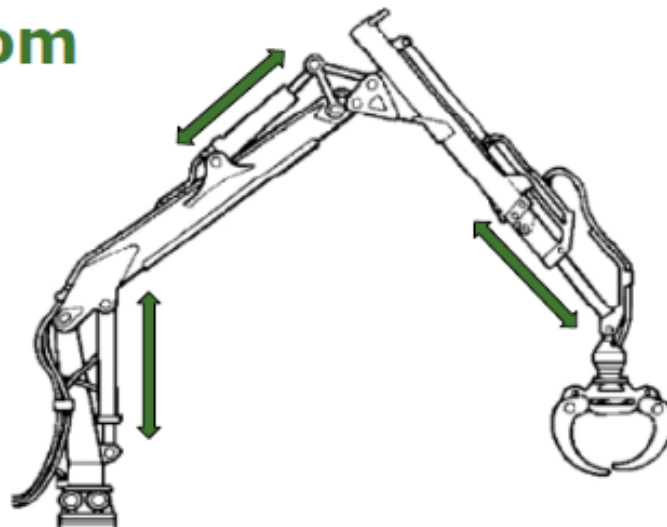
Automation

- “Faster and faster work – operator becomes the bottle neck”
Ola Ringdahl, PhD May 2011, Umeå, Sweden
- Automation introduced to reduce workload and improve productivity
- Boom tip control



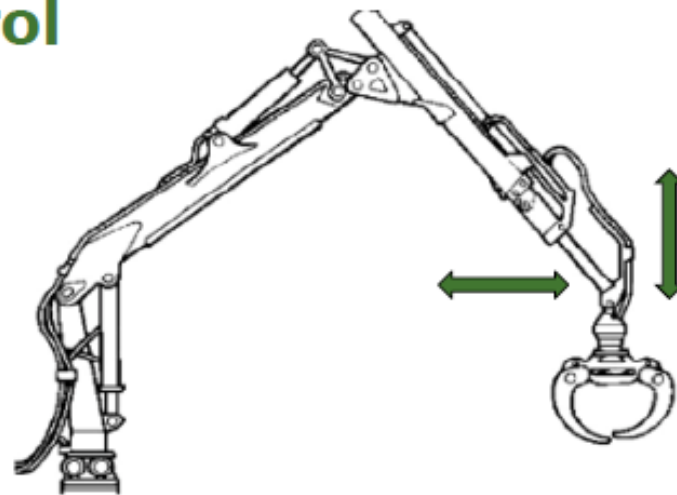
Conventional Forwarder Boom Control

- Operator controls lift, jib and extension cylinders in order to achieve desired boom tip speed and position



IBC - Intelligent Boom Control

- Operator controls boom tip directly instead of controlling individual cylinders
 - Joystick 1: Boom tip forwards and backwards
 - Joystick 2: Boom tip up and down
- Includes cylinder end dampings



Industries investing in automation & robotics



Mining



Military





Mining teleoperation

- Remote operator
- Radio link
- Out of sight of machine



Mining teleoperation

- Roy Hill Remote Operations Centre – Perth
- 400 operators
- 15 mines, 31 pits, 4 ports, 1600km railway
- 1300 km from Pilbara mines



Source:
http://www.riotinto.com/annualreview2011/images/business_review/_iron.jpg

New Zealand forestry teleoperation



Source: www.stuff.co.nz

Forestry teleoperation

- Limited field of view for the operator
- Orientation issues – am I on a slope?
- Camera viewpoint so operator can understand where machine is
- Poor depth of field perception making it difficult to see hollows and rises in the terrain



Teleoperation John Deere 909

Nelson 2017



Mining autonomous machines – with human supervision

- Autonomous haul trucks
 - 10 to 15 % decrease in fuel consumption
 - 15 % decrease in tyre wear
- Autonomous long-distance haul trains
- Automated drilling and tunnel-boring systems



Forestry automation



- Log making and bucking
- Stem location and grappling



Future forestry technology concepts

Mixture

- people on site in cabs
- machines only on site

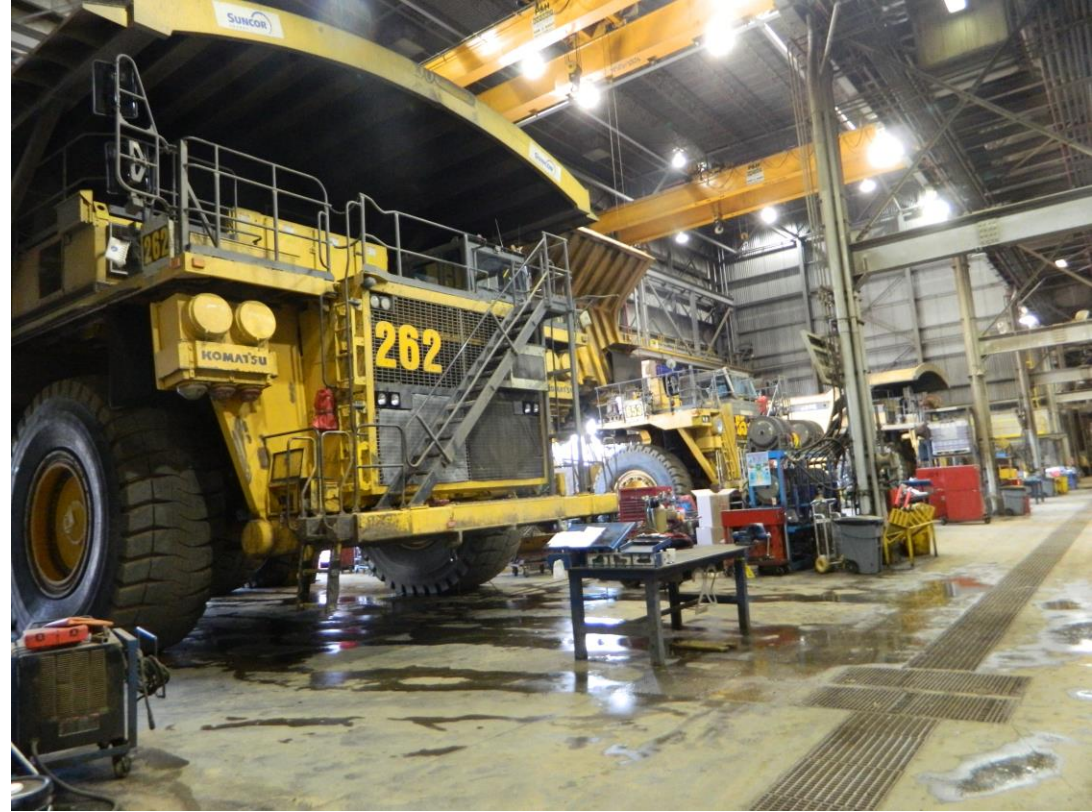
Always maintenance in the forest



Employment

Mining experience

- Less operators
- More maintenance staff
 - Highly complex systems requiring upkeep
- More data staff



Potential problems and Human Factors

- Forestry is an outdoor occupation
- Sedentary office task
- Disconnect from reality
- Loss of situational awareness
- No travel
- Interaction with work mates



Mining machines with no cab “form and function” linked



Forestry environment

- Steep terrain
- Dense undergrowth
- Fragile soil
- Remote



Source: <http://www.tigercat.com/wp-content/uploads/2014/11/lh855c-big-wood-steep-terrain.jpg>

Arboreal locomotion

- Climbing

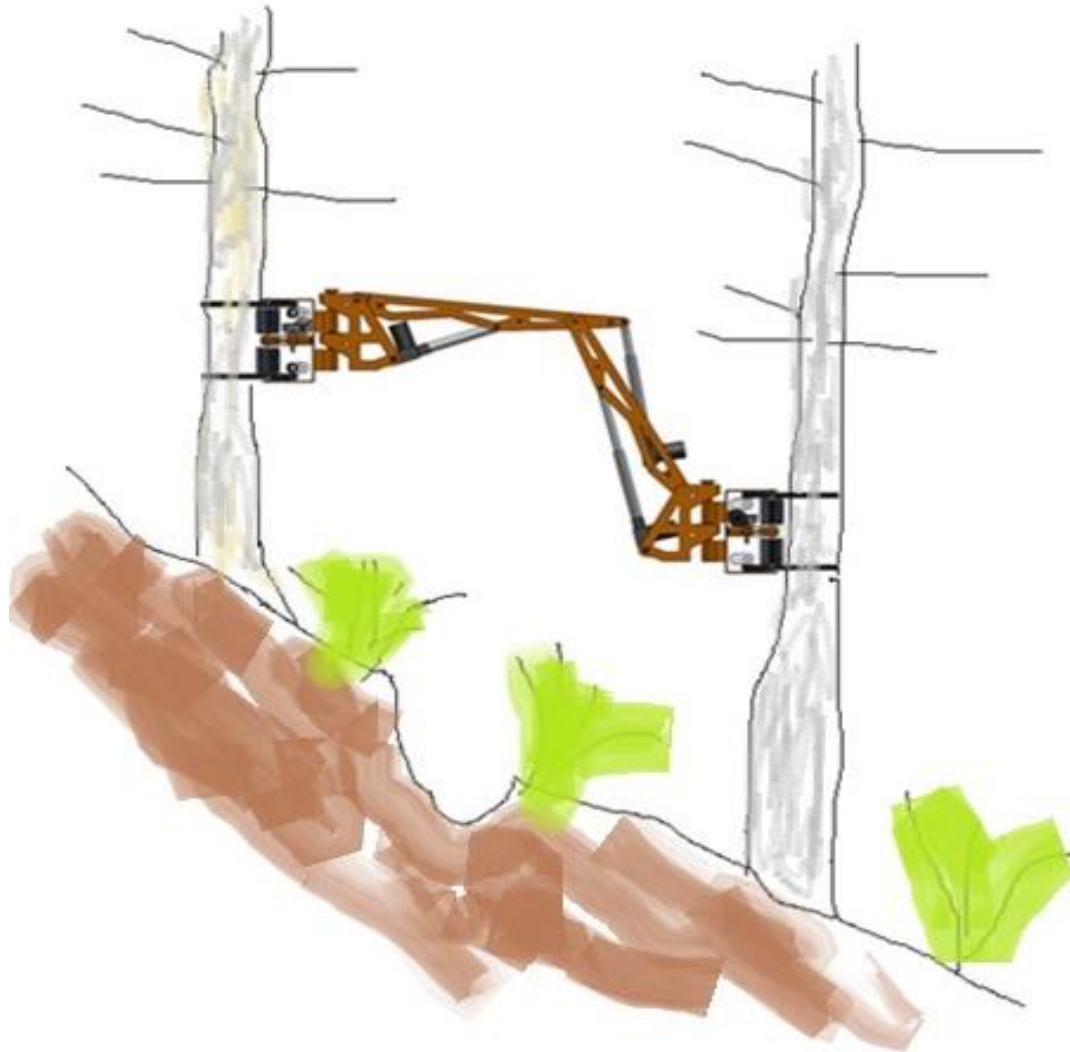


- Brachiation



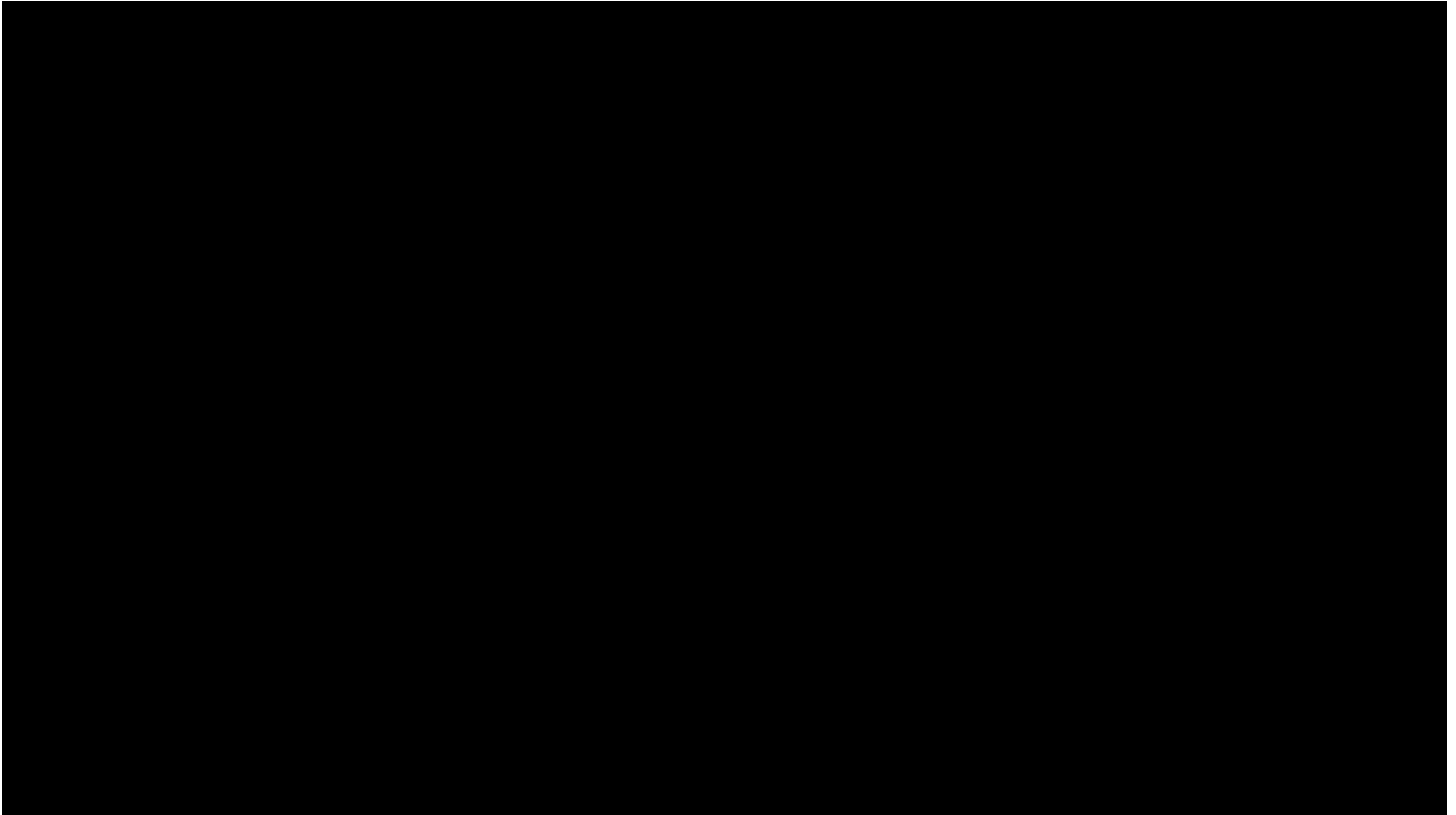
Forestry machines with no cab

“form and function are one” - Frank Lloyd Wright





Forestry machines with no cab



What have we learned from the mining industry

Robotics and automation:

- Reduce injury
- Appear to be inevitable
- Introduce new problems
- Open employment to wider range of people
- Reduce operator jobs
- Create new technical jobs
- Enable harvest of currently uneconomic forests
- Automation is a difficult technical problem



Biomimetics – learning from nature



amezor-iv.net



Stumps too high

Acknowledgements

- Forest Growers Research
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- NZ Forest Owners Association
- Ministry for Primary Industries
- Scion



www.scionresearch.com



Prosperity from trees *Mai i te ngahere oranga*

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