Valuing the Trees Rather Than The Forest +

AI, machine learning & predictive modelling in forest asset appraisal

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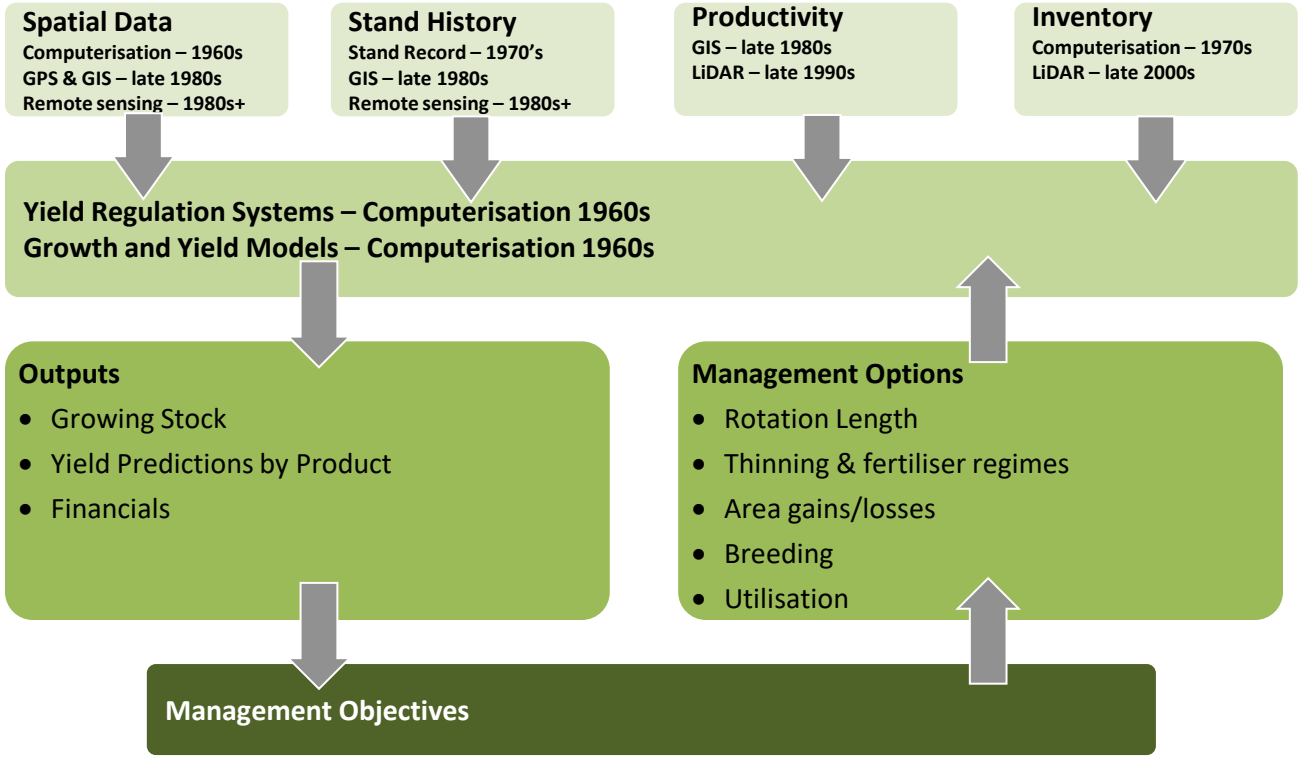
AI, machine learning & predictive modelling in forest asset appraisal:

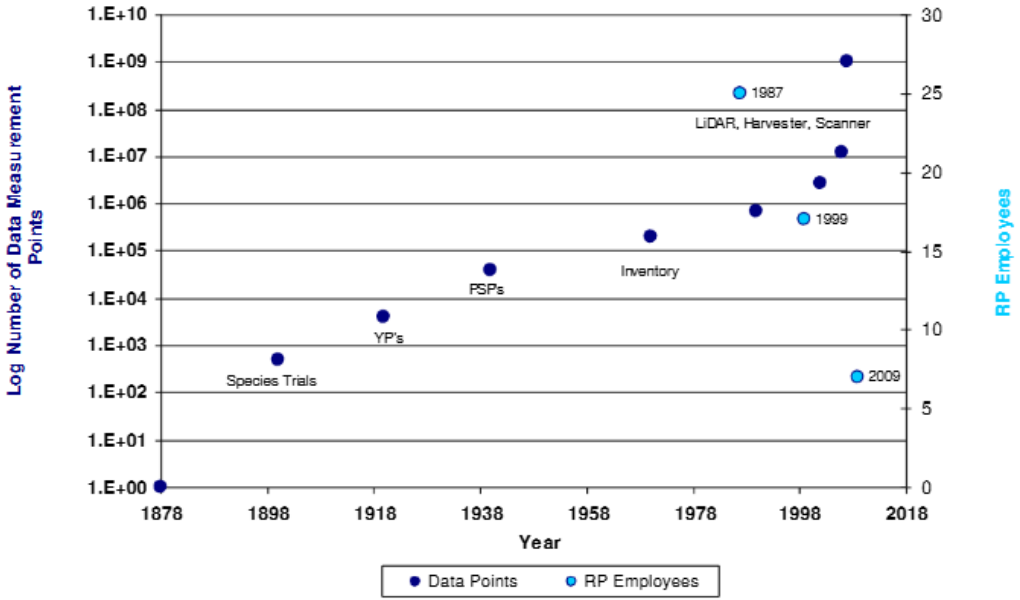
Resource Assessment & Modelling 2026+

- **Find & characterise needles in haystacks – lots of AI & ML**
- **Managing continuous data, sensors, algorithms & systems updates**
- **Overwhelming data quantities**
- **Systems so complex no one person understands them all**
- **Consistency between systems & 'new components'**
- **New components – carbon, environment, water, natural capital**
- **Compliance, regulation & investor confidence**

South Australian Resource Management Systems – Ongoing Computerisation/Digitisation

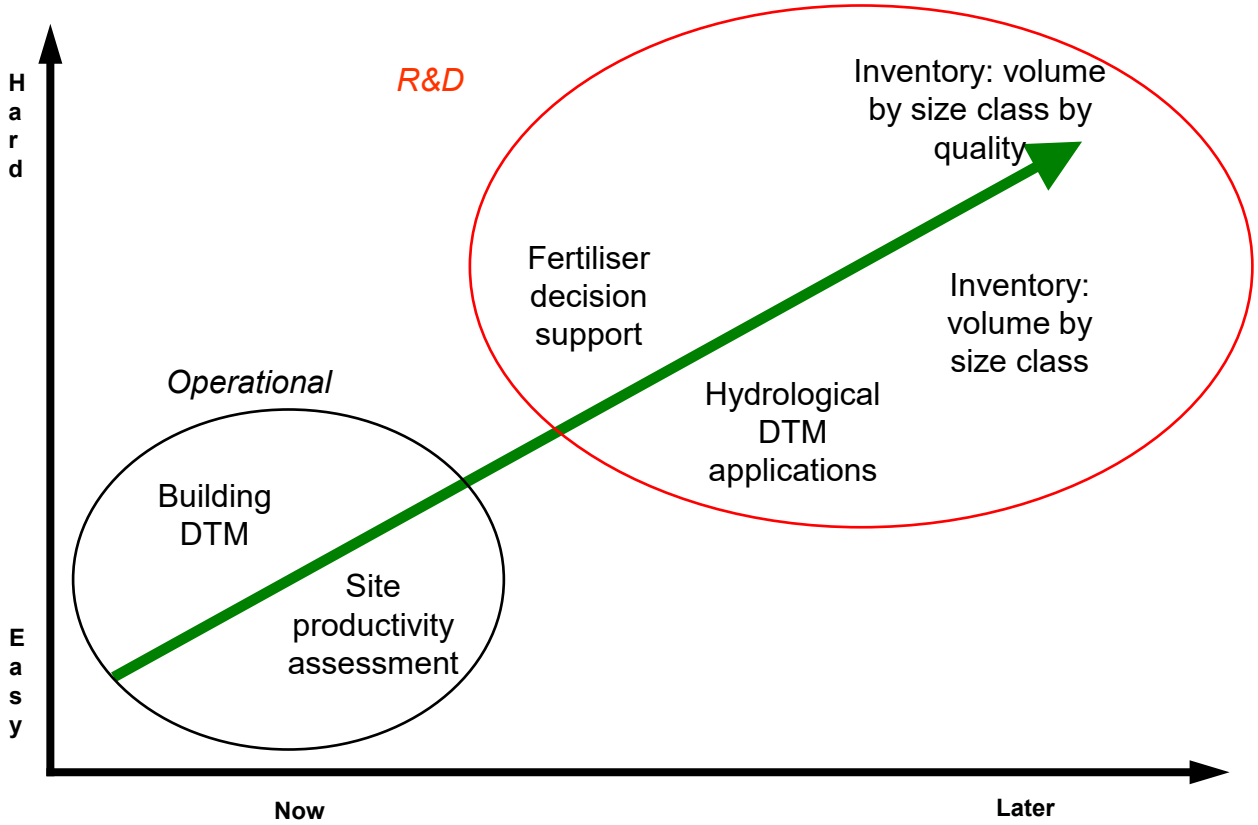


Example 2A: LiDAR for Plantation Yield Mapping - Number of Technical Employees



O'Hehir, J.F. (2010) Future Visions: Opportunities, Current and Future, for Precision Forestry Application in South Australia. Precision Forestry Symposium, 1–3 March 2010, Stellenbosch, South Africa.

Rombouts circa 2008 – South Australian Plan



The digital forest – the digital tree - there's been a big shift

If more granularity is sought these problems need resolution:

- Forests:
  - Position, geoposition
  - Point cloud to products – algorithms – industrial systems
  - Ground/drone/satellite are complementary - data fusion
  - Relationship to historic growth and yield data
  - Disturbance agents
  - Growth - estimating future states
- Sites:
  - Climate
  - Genetics
  - Management
  - Disturbance 1) Catastrophic 2) Lesser
- Systems:
  - Data quantity & cost
  - Processing to woodflows & other products
  - Imputation because not everything can be measured

Development & Adoption Motivations - New Technology

Spatial

- Resource asset location – GPS/LiDAR
- Productive land definition – asset boundaries - GPS/LiDAR
- Additional datasets – soils, productivity, non-productive areas, other assets, disturbances, exclusion zones - remote sensing
- Planning – operational & strategic

Stand History

- Record of management activities – remote sensing

Inventory

- Growing stock volume and characteristics – markets/products – tree structure - LIDAR

Yield Regulation Systems

- Growing stock volume & characteristics – projections – diameters, lengths, quality, wood properties
- Strategic & operational woodflows, asset valuation, budgets, carbon, water, biodiversity
- Climate risk disclosure – a game changer – process-based growth models – APSIM/3PG

Current LiDAR & other sensor adoption/adaption in the (AU&NZ) forest industry

Spatial Systems

- ARC/ESRI/GIS/GPS

Stand History

- GIS

Inventory

- Tree mapping - PINT
- Overlapping Features Inventory

Yield Table Generators

- YTGEN

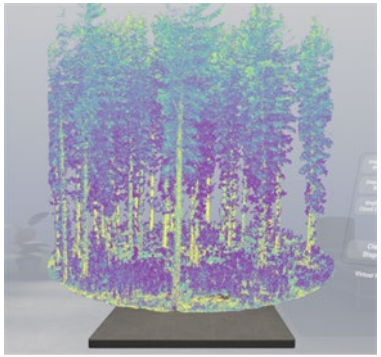
Growth & Yield Models

- Proprietary

Optimisation Systems

- Woodstock
- TigerMoth

Digital forest



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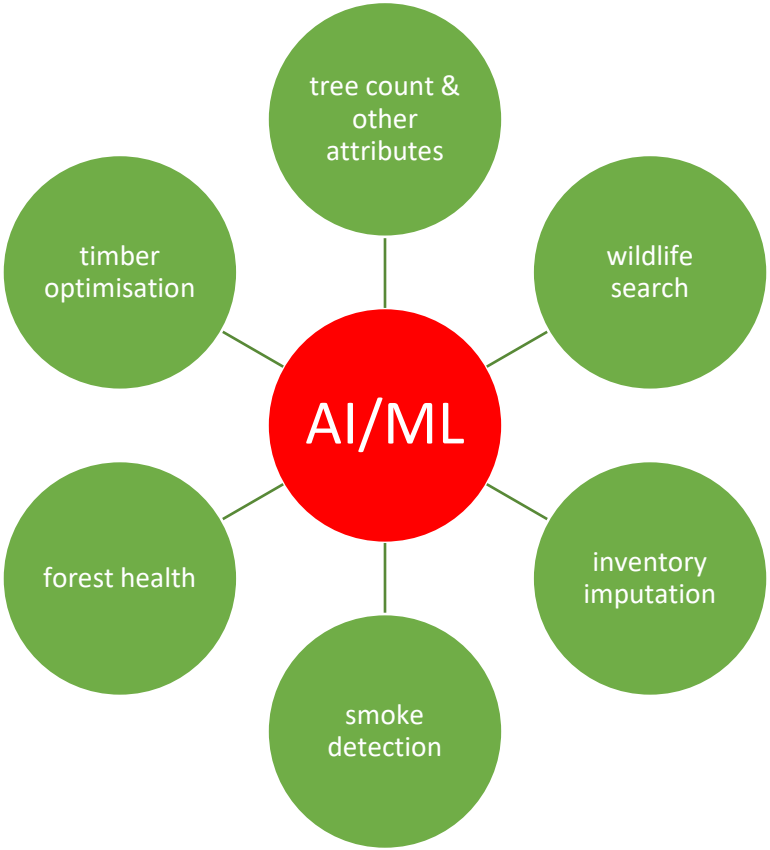
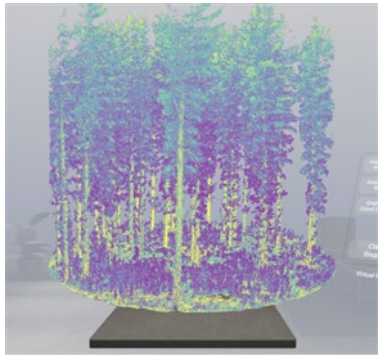
Current AI/ML – data collection & analysis



Systems 2050

Digital forest



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AI/ML applied & potential

- Smart allocation of sensor resources - planning & collection of raw data
- Data analysis & examination stage e.g. LiDAR dots converted to DBH, PINT, etc
- Formulation of plans & management action stage - data interpretation for humans – immersive analytics & digital twins
- Execution of decisions, including testing the effectiveness of plans – automation of operations – potentially autonomous

Individual & integrated asset modelling system

- Trees
- Products
- Chemicals
- Carbon
- Biodiversity
- Water
- Recreation

Features of Systems 2050

- **Consistent Data Alignment / the GPS under canopy problem - aligning data to the same tree consistently is key, if you can't get back to the same tree 30 years later the whole system falls apart.**
- **High precision scanners - already pretty good**
- **Improved scan processing tools - new methods, & site-specific tailoring will be beneficial to all growers.**
- **Continual monitoring + data retention > best practice for how to store this big data & make it accessible for future use.**

Features of Systems 2050

- **Precision forestry > optimised tree selection (individual tree property & stand context informed selection), silviculture, and forest growth**
- **Precision modelling > long term digital forests create high fidelity long term datasets for modelling all the captured aspects of site, tree growth, health, and yield. Also enables higher fidelity ecosystem and biodiversity monitoring.**
- **Improved pattern recognition and outlier detection > more data means more baseline to contrast outlier against, a population of red-tailed black cockatoo moving east instead of west might not look particularly noteworthy until it's contrasted against ten years of measurements.**
- **Historical data > more data means more accurate alignment with climate models, growth models, etc**
- **Historical context > operators capturing context for decision making today means operators two decades later can review that context, see exactly what the first operator saw, & contextualise their decisions.**

Current status & future implications

- **History has seen more & more data acquisition that was then stripped back & aggregated to process in legacy systems**
- **AI activity to-date in data acquisition & analysis**
- **AI potential in systems, planning & execution needs discussion & a plan**

- **Success will be:**
  - Identifying individual assets & aggregating post processing
  - High potential automation

- **Failure will represent continued data acquisition with no plan on systems needed**