Adaptive Supply Networks:
supply network performance through technology and systems innovation

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Agenda

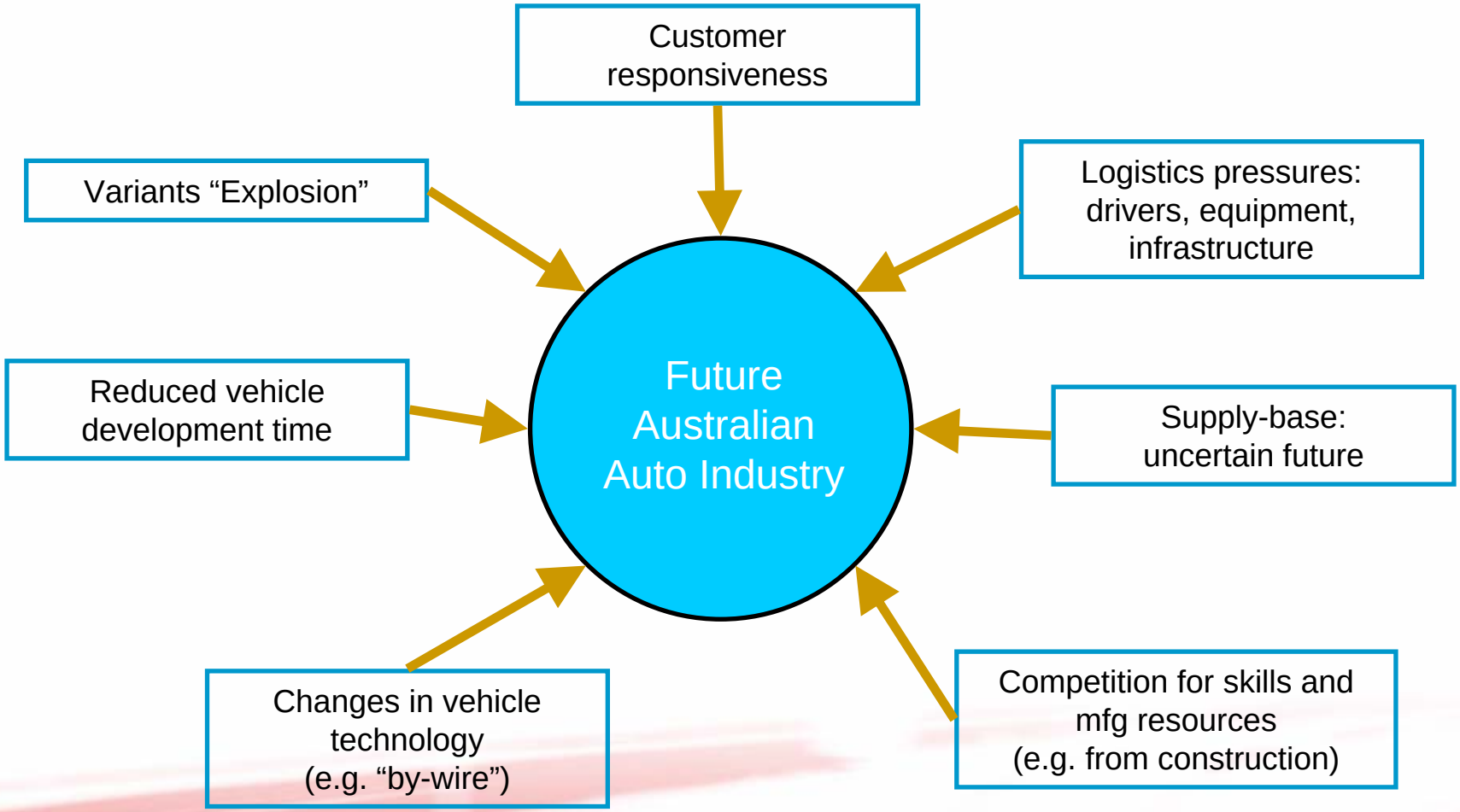
- Australian supply chains: pressures and critical concerns
- Scope for applying technology and systems innovation
- Successful techniques for step-changes in efficiency and supply-chain performance
- Practical observations: deploying technology, generating collaboration, and creating change




Supply Chain Pressures

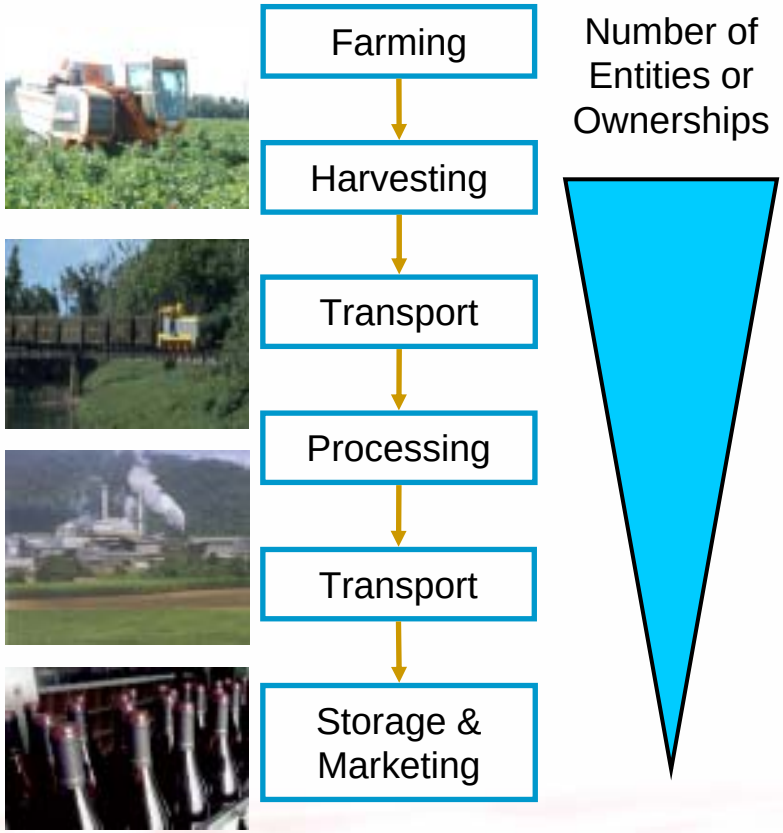
- Many Australian companies face supply chain pressures that demand innovative responses
- These pressures can be characteristic of their industry, scale of operations, systems and/or business objectives
- Meeting the challenge requires coordinated action on several fronts

Australian Automotive Industry



Agriculture Chains

- Subject to hard-to-measure variability
  - Climate, soil, yields, delays, quality
  - Spatial and temporal scales
- Many drivers and linkages across the chain/network
- Often separate and disparate ownerships across the chain
  - “Inverted pyramid” structure
  - Differing financial and social goals
  - Change must be “holistic” and address a wide range of concerns
- Benefits to industry can lead to losses to some sectors
  - Leads to lack of trust between sectors



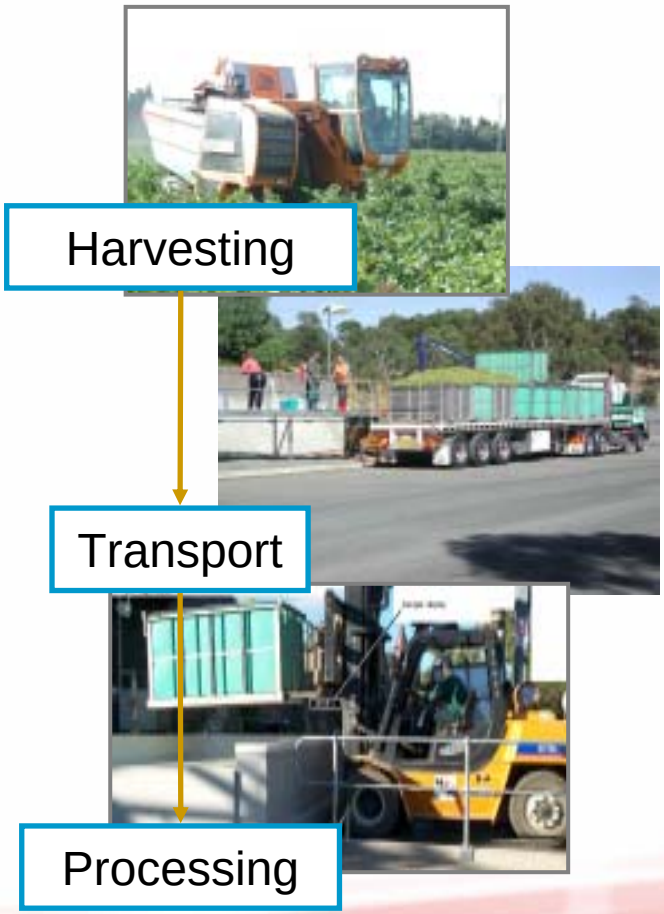
Mining and Bulk Materials

- Efficiency: maximising throughput and activity coordination in the supply-chain
  - optimising capacities and handling policies
  - decision-making systems and structures for adaptiveness and flexibility
  - innovations in operations management
- Investing in new capital assets: expensive!
- Managing and targeting grade:
  - stockpiling and blending
  - selection of process alternatives and products
- Managing variability and optimising as a supply chain, rather than acting locally at discrete steps in the process

Common SC Issues

- “Local” versus “global” (network-wide) decision-making
- Demands and material flows: reacting versus managing
- Getting trustworthy and actionable information about the supply network
- Establishing and sustaining meaningful collaboration
- Dealing with operational complexity
- Dealing with variability in processes, products and systems

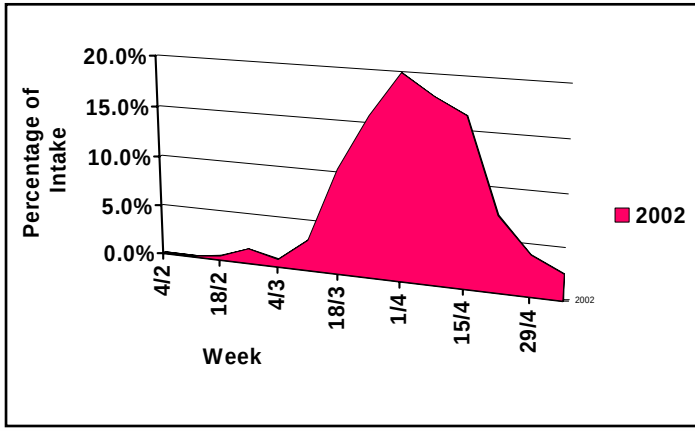
Wine: Orlando Wyndham

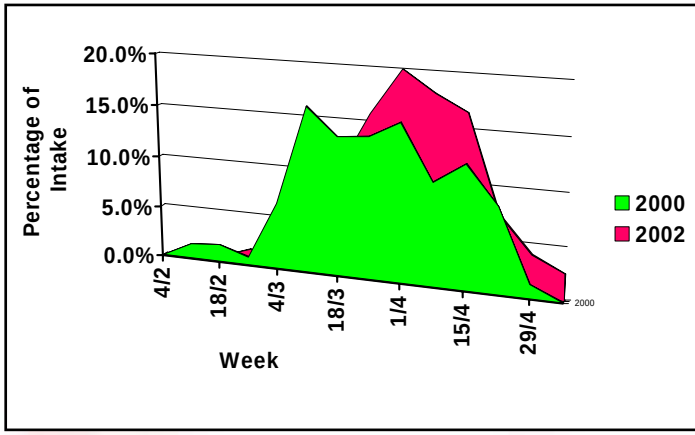


- Maximise realised value of highly-perishable grape assets
- Retain corporate memory by encoding knowledge and processes
- Future growth: scalable systems retaining flexibility and efficiency
- Initiatives
  - RFID-tagged grape bins
  - Grower relationships
  - Twice-weekly sampling and maturation prediction for grapes
  - Automated winery-gate systems
  - Comprehensive and clean database
  - Adaptive Supply Network developments

Wine: Complexity and Variability

- Raw materials supply for 2005
  - 156,000 tonnes, 35 varieties, 33 areas
  - 520 growers, 3123 harvest units
- Harvesting and carrying
  - 186 harvester operators, 91 transport entities
- Processing
  - 6 Orlando Wyndham processors, 9 contract processors
  - 104 unique wines (specific varieties, areas, quality, style)
- Seasonal
  - Each vintage differs
  - Systems rolled out for vintage
- Communications chaotic, frequent and asymmetric

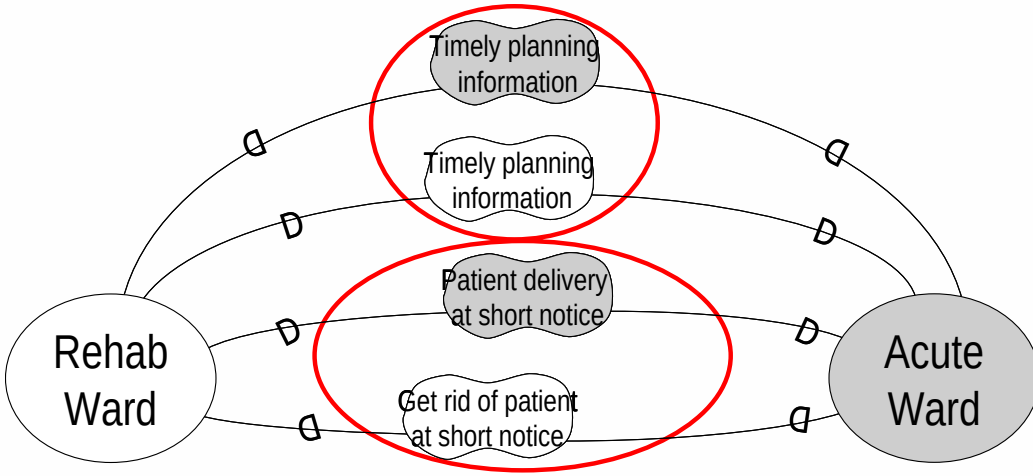


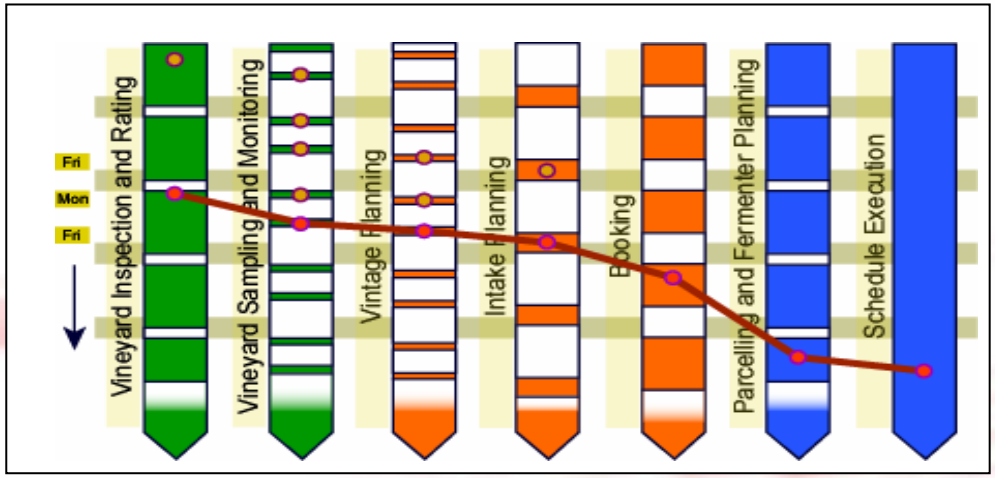


Collaboration in Wine and Health

- Health: local views and misunderstandings, leading to conflict and sub-optimal outcomes

- Wine: intermittent planning and localised visibility
  - Winemakers react to intake stream
  - Communications along chain are data-poor
  - Existing systems permit inter-dependency to be ignored





Information

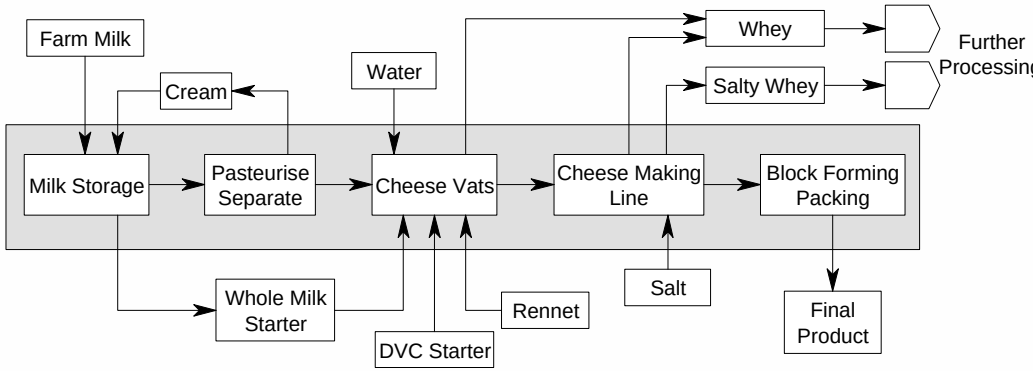
- Wine: sampling sugar levels
  - (Intake-side) supply network innovation is highly dependent on having good information about the maturity of grapes
  - Knowledge about the state of the network's assets distinguishes Orlando Wyndham from its competitors
- Dairy: production data
  - optimum product mix: 10%-20% more revenue by milk volume
  - Optimisation is impossible without detailed quantitative information about process inputs, outputs and costs
- RFID, GPS, automated sampling and monitoring:
  - just noise, when as raw data
  - if turned into actionable information, can be pivotal in unlocking supply chain value and building a major competitive advantage

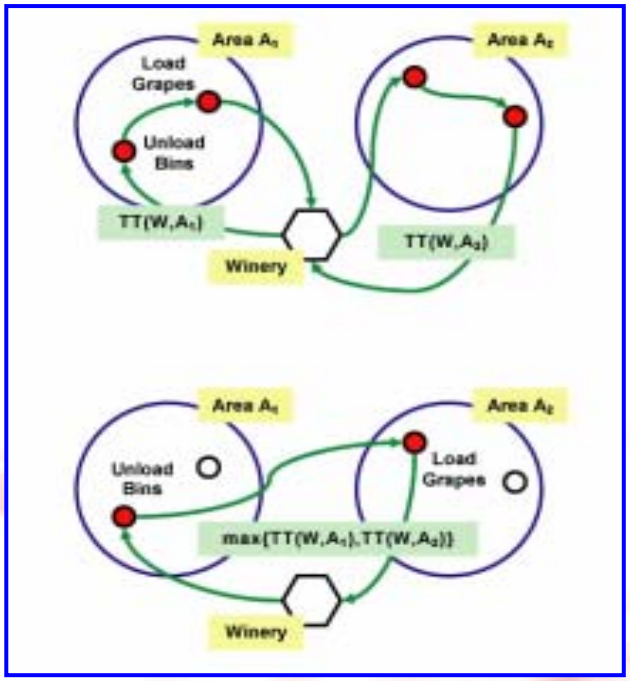
ASN Approaches

- Adaptive supply networks: partners adapt quickly and flexibly to the challenges in their shared environment
- CSIRO: technologies for decision harmony where there is appreciable diversity in stakeholder capabilities and goals
- Techniques, technologies and methodologies
  - Mathematical techniques (e.g. optimisation)
  - Principles and practice of collaboration
  - Technology in software and smarter information use
  - “Hands-on” and “holistic” deployment and delivery

Mathematical Techniques

- Mathematical modelling
  - e.g. dairy operations, transportation times
- Optimisation, statistics and simulation
- Turning data into information and decisions
- Supply networks:
  - Coordination
  - Complexity
  - Coupled systems
  - Variability





Optimisation: THL/Britz

- A large fleet of recreational hire vehicles
- Many products, many vehicle types, 60% of bookings start and finish in different places.
- Perishable product: <u>right vehicle, place, time and cost.</u>

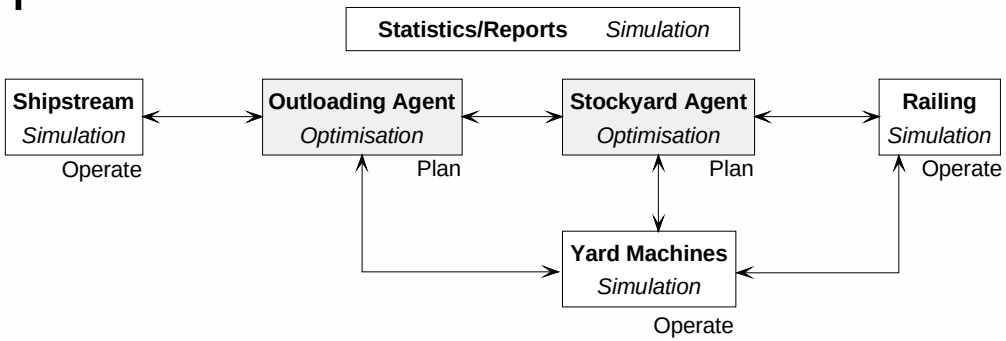
- Optimisation engine (VASS) embedded in enterprise-wide system
- Full optimisation daily
- Rescheduling every time a booking is made through the call centre (i.e. an integral part of booking process)
- Benefits:
  - reduced dead-heading, substitution-cost (opportunity) and improved asset utilisation.
  - 7% saving on operating cost.

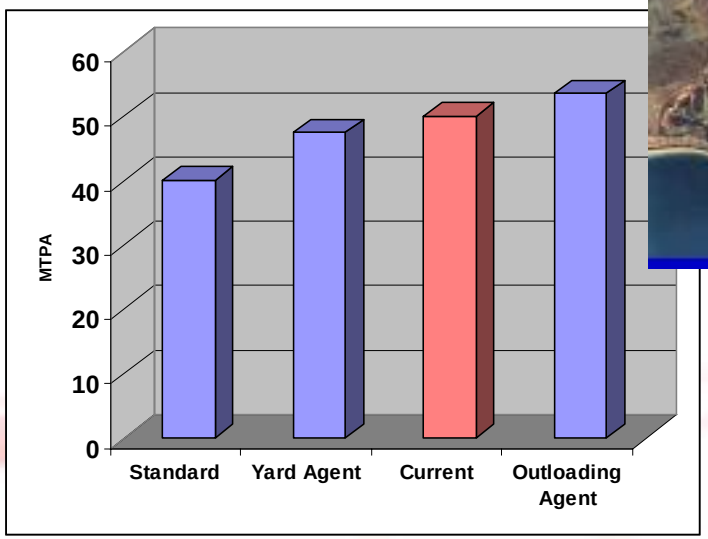
Optimisation: Wine Fermenters

- Fermenters packed with like material: parcels of grapes
- Parcels must satisfy winemakers' batching policies
- Minimising "ullage"
- Optimising the quality of mixes of grapes
- Winemakers: "*close to reality… could help streamline the entire harvesting/ delivery/ receival side*"
- Automated parcel planning
  - Backwards: harvest planning to satisfy winery intake
  - Forwards: optimal parcelling given harvest plan
  - Overall: introduction of detailed new information into the ops mgmnt process

Optimisation / Simulation

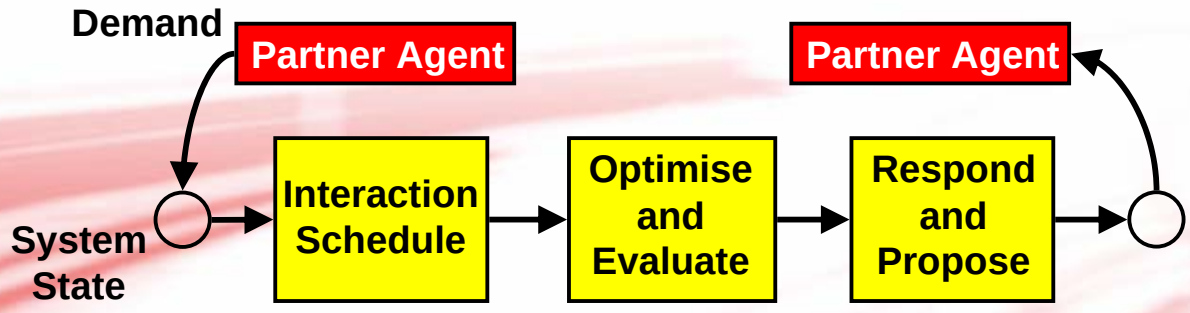
- Discrete event simulation is a standard technique for making strategic decisions
- When operations are complex, standard simulation fails
- Capital investment in a coal export supply chain
- “Intelligent simulations”: optimisation-in-simulation
- Quantitative accuracy





Negotiated Scheduling

- Supply networks today: scheduling as a unit is impossible
- Today, firms optimise locally and negotiation over supply and demand is ad-hoc, manual and slow
- *Negotiated scheduling*:
  - partners in a supply network integrate procurement, production and logistics using automated systems
  - a negotiation framework that supports the formation of detailed operational plans
  - mutually acceptable (goal satisfying) schedules

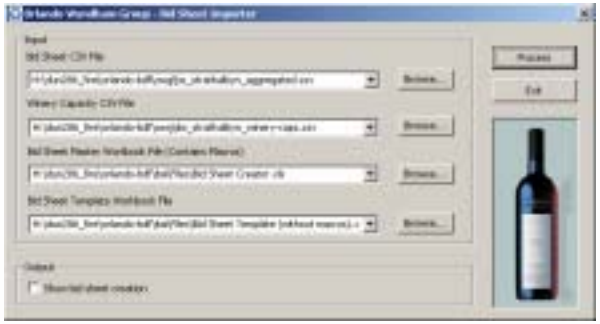


Collaboration

- Collaboration as a state has the following (according to Brna, 1998) :
  - Mutual agreement to collaborate
  - Maintenance of a model of other parties
  - Possessing a shared goal or intent
  - Holding beliefs about the shared goal
  - Maintaining a shared understanding of the problem
- Collaborators in supply chain planning:
  - Schedule activities in their own dynamic domain
  - Deal with dynamic information relating to resources and limitations.
  - Manage interferences and facilitate the meeting of their own goals, collaborators' goals and the shared goal.
- Systems can be designed from the ground up to support collaboration
- Techniques are available to "troubleshoot" collaboration issues

Delivery and Adoption Mechanisms

- Smarts embedded in software tools which become part of everyday decision making
- XML: decouples IT systems and makes integration easier
- Clever data management: rule systems
  - Computing and inferring new information based on existing data
  - Wine: 250 rules govern >50,000 data elements and encode knowledge including like-with-like grape batching
- Adoption: researchers and technology developers need to engage with the supply network and take a hands-on approach!

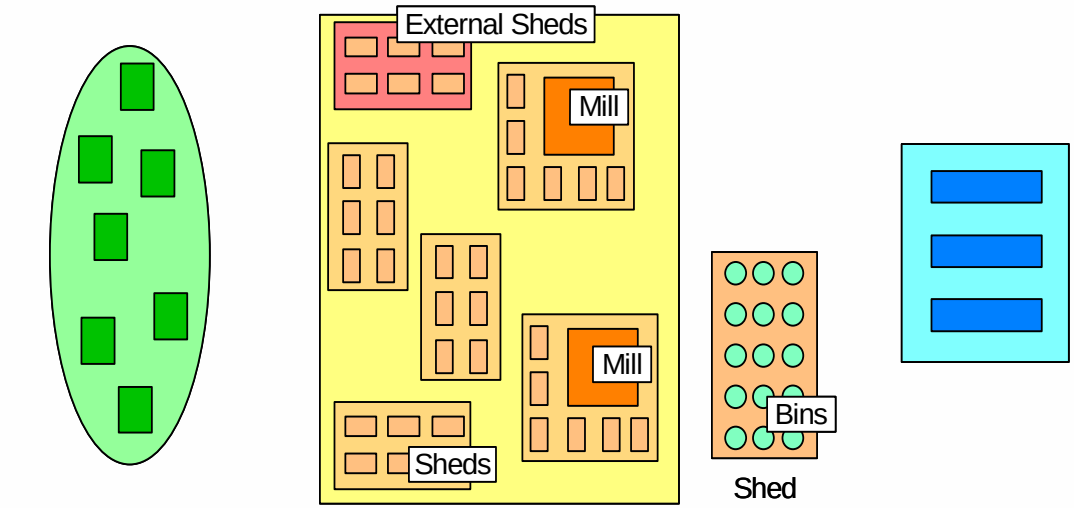


Practical Issues and Observations

- Shortcomings of technology in isolation
  - Compliance
  - Adoption
  - Usability
- Impact of ASN systems in a wine supply network
  - Collaboration
  - Data and information
  - Supply network performance
- Future Supply Networks

Rice Harvest and Processing

- Circa 1999, CSIRO developed a system for optimising a rice supply network
- Powerful optimisation software, detailed model, saved costs
- Failed after an initial success
  - Hard to use
  - Poor compliance
  - Not part of a broader system



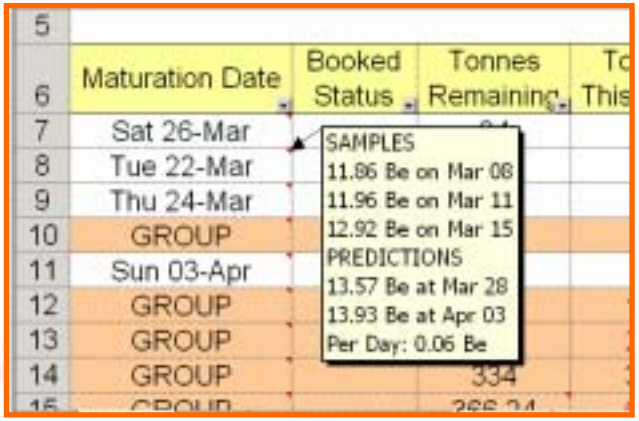
Some Details:
3600 Farms **20 Depots** **80 Sheds** **600 Bins** **6 Mills**
3 Ports **200 Products**
6 Time Periods

Wine: Intake Planning

- Supply network from growers to wineries
- Planning harvests and the intake of grapes into wineries
- Staged development: culminating in a negotiated scheduling system
- Automate major parts of the process
  - Data integrity
  - Time burden: intellectual vs routine activities
- Controlled and collaborative “bidding”
  - Reduce “overbidding”
  - Informed targets and astute operational compromises
- Address complexity through decision support
  - Smarter information use
  - Automated/optimised scheduling functionality

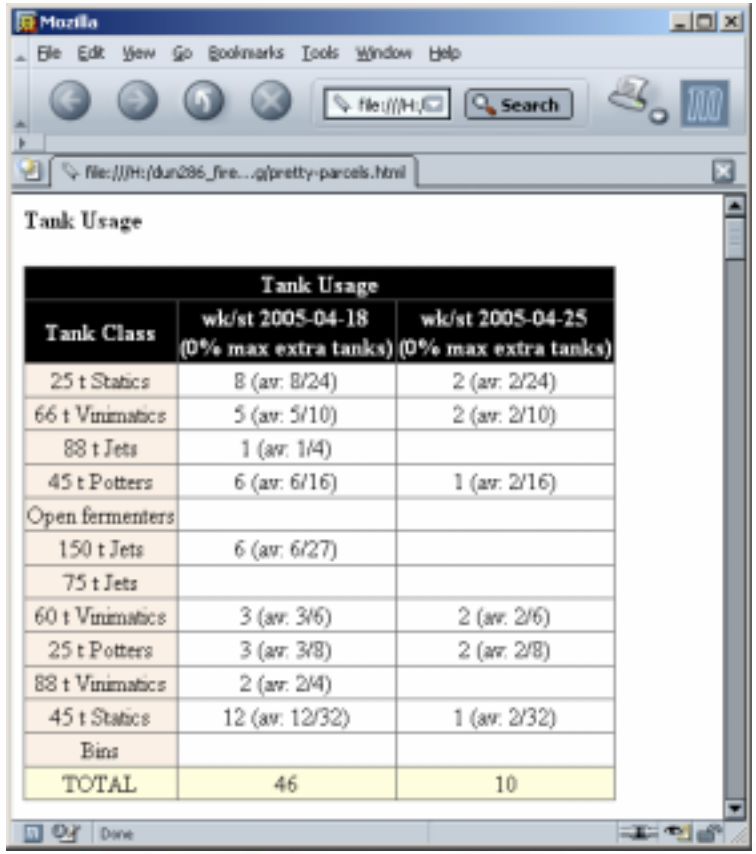
Wine: Collaboration and Information

- Reduced barriers between planning phases
  - Logistics coordinators, field officers, winemakers and viticulturists talking about new topics and interacting in new ways
  - Revamped central data store: a single version of the truth, now made much more accessable, with re-keying/re-formatting of data reduced by 80%
- Provision of valuable new information
  - The most crucial ingredient in getting fast and complete adoption of new tools and processes
  - Statistically-based maturity prediction, winery targets and vineyard data
  - OR scheduling capability “hidden” behind familiar and useful interfaces



Wine Supply Network Impacts

- Supply Network
  - Faster adaptation/response to seasonal differences
  - A new culture of collaboration and innovation
  - Increased harmony between participants' "local" and "global" objectives
- Improved planning performance:
  - better coordination
  - more certainty (less "flip-flopping")
  - largest vintage, but smoothest and most efficient of recent vintages



Tank Usage

Tank Usage		
Tank Class	wk/st 2005-04-18 (0% max extra tanks)	wk/st 2005-04-25 (0% max extra tanks)
25 t Statics	8 (av: 8/24)	2 (av: 2/24)
66 t Vinimatics	5 (av: 5/10)	2 (av: 2/10)
88 t Jets	1 (av: 1/4)	
45 t Potters	6 (av: 6/16)	1 (av: 2/16)
Open fermenters		
150 t Jets	6 (av: 6/27)	
75 t Jets		
60 t Vinimatics	3 (av: 3/6)	2 (av: 2/6)
25 t Potters	3 (av: 3/8)	2 (av: 2/8)
88 t Vinimatics	2 (av: 2/4)	
45 t Statics	12 (av: 12/32)	1 (av: 2/32)
Bins		
TOTAL	46	10

Future Supply Networks

- Data turned into actionable knowledge
- Automation replacing routine work
- Collaboration meaning more than sharing data
- Investment guided by intelligent simulations that are quantitatively reliable
- Partners linked by electronic negotiation systems that dynamically manage supply, production and demand
- Compliance to plans through proper consideration of diverse local objectives
- Adaptive supply networks: partners adapt quickly and flexibly to the challenges in their shared environment