Decision Support System for Wamakersvallei Winery

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Overview

- Overview of recent studies
- Brief history of Wamakersvallei
- Scheduling and Quick Rescheduling
  - Problem description
  - Solution techniques
- Layout problem
  - Problem description
  - Facility layout types
  - Possible solution techniques
- Decision Support System

Wine Supply Chain Council

- International wine supply chain research network
- Established July 2006
- Current members:
  - Supply Chain & Logistics Institute – Georgia Tech, USA
  - Dept of Industrial & Systems Eng – Catholic Univ of Chile
  - Logistics & Quantitative Methods – CSIR, SA
  - Adaptive Supply Networks – CSIRO, Australia
- Aim: collaborate on issues in global wine supply chains and share learning

Catholic Univ of Chile research

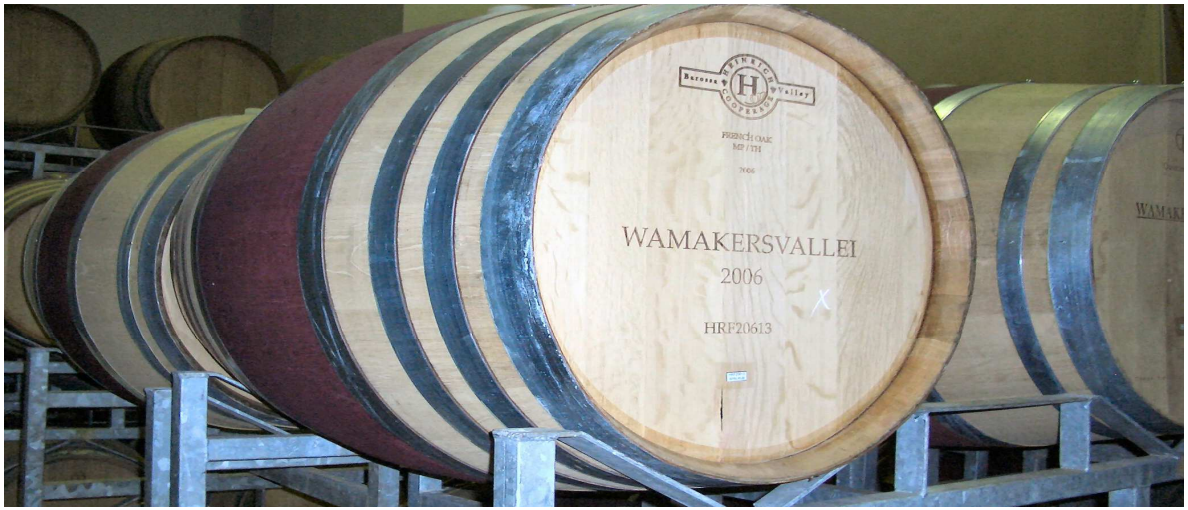
- No planning tools for harvest & intake planning
- Developed optimization model – balance harvesting costs with grape quality
- Aim: which blocks to harvest and when to do it
- x_{jtkb} = amount of grapes harvested from block j in day t with harvest mode k and destination b
- Mixed-integer programming with quality loss function for grape quality and TSP formulation for routing problem
- Solved daily with rolling time horison
- Schedule proposed by model provides good basis for decision makers to derive final schedule

CSIRO research

- Development of DSS to coordinate operations of grape growers, harvester operators, grape transporters and wineries for Orlando Wyndham Group (OWG)
- Grape supply network: 520 growers, 3123 blocks, 35 grape varieties, 33 areas, 104 wines; 186 harvester operators & 91 transport entities – also used by other wine companies
- Simultaneous planning of harvesting and intake of grapes into wineries
- Rule-based system with 250 rules for intake planning

Wamakersvallei Winery

- Situated in Wellington
- Town was founded in 1840, but has viticultural heritage dating back to the 1600's
- Wamakersvallei wine cellars was founded in 1941
- A co-operative with approximately 80 suppliers



Winemaking Process

- The process can be divided into three phases

Viticultural Maintenance → **Harvesting** → **Making the wine**

From April onwards

From mid January to March

Starts after harvesting

At the wine cellar

Grapes arrive at weighing station for documentation

Grapes go into one of three tipping bins

At the wine cellar

- Scheduling done manually by winemakers, viticulturist and manager based on large amount of data
- A farmer is notified that he should deliver *x* tons of grapes from a given block (selection of vineyard) the next day by SMS
- Harvest manually or by machine
- If workers do not show up for work, the desired amount of grapes will not be harvested
- Quick rescheduling becomes top priority in order to avoid unused tank space (when full capacity is ideal)

Scheduling and Rescheduling

- Scheduling
  - Create a schedule for which blocks (grapes) should go to which tipping bin
  - The schedule is only to assist, not to dictate
  - For scheduling two aspects is considered
    - The availability of facilities in the cellar in order to avoid bottlenecks
    - The optimal ripeness of the different grape cultivars
- Quick rescheduling
  - Quick rescheduling in order to assist winemakers in situation where the schedule needs to be changed on the spot

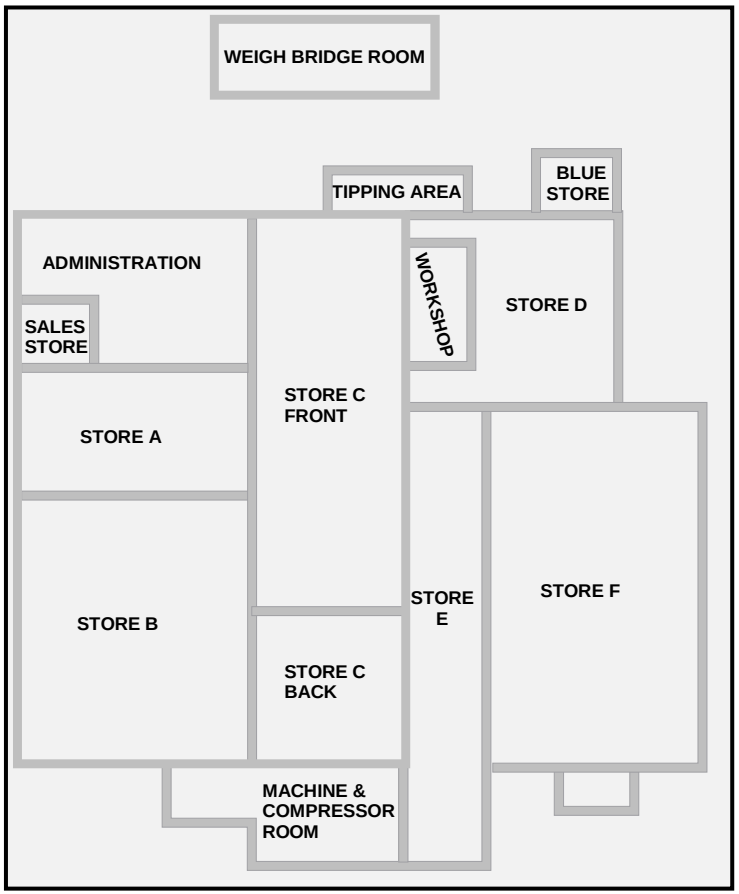
Scheduling problem

- Both the scheduling and rescheduling at the cellar may be formulated as existing *scheduling problems*
- Definition of the scheduling problem
  - The process of determining when project activities will take place depending on defined durations and precedent activities. Schedule constraints specify when an activity should start or end based on duration, predecessors, external predecessor relationships, resource availability, or target dates

Possible solving techniques

- Same techniques may be considered for both the scheduling and rescheduling problems
- Rescheduling should focus more on grape availability – not available facilities inside the cellar
- Exact solution techniques
  - Rule based programming
  - Branch and bound
- Meta-Heuristics
  - Tabu search

Layout Problem at Cellar



An old concrete storage room will be renovated sometime during 2008

Facility Layouts

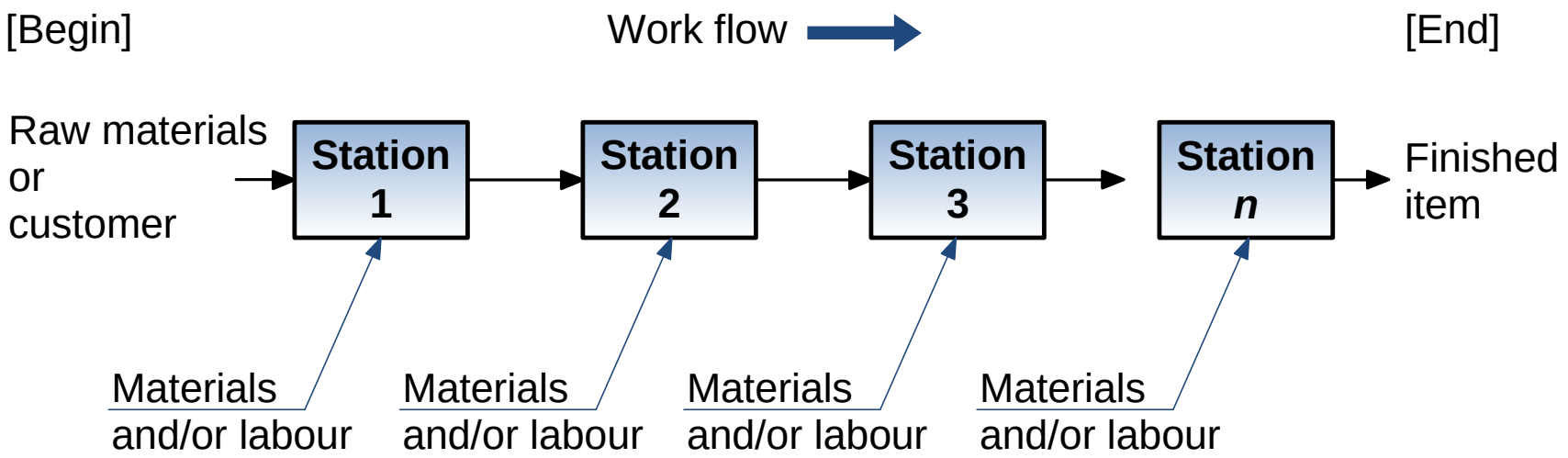
- Configuration of departments, work centres and equipment with particular emphasis on movement of work (customers or material) through the system
- Four types of facility layouts
  - Fixed-position layout
  - Product layout
  - Process layout
  - Hybrid (or Combination) layout

Types of Facility Layouts

- Fixed-position layouts

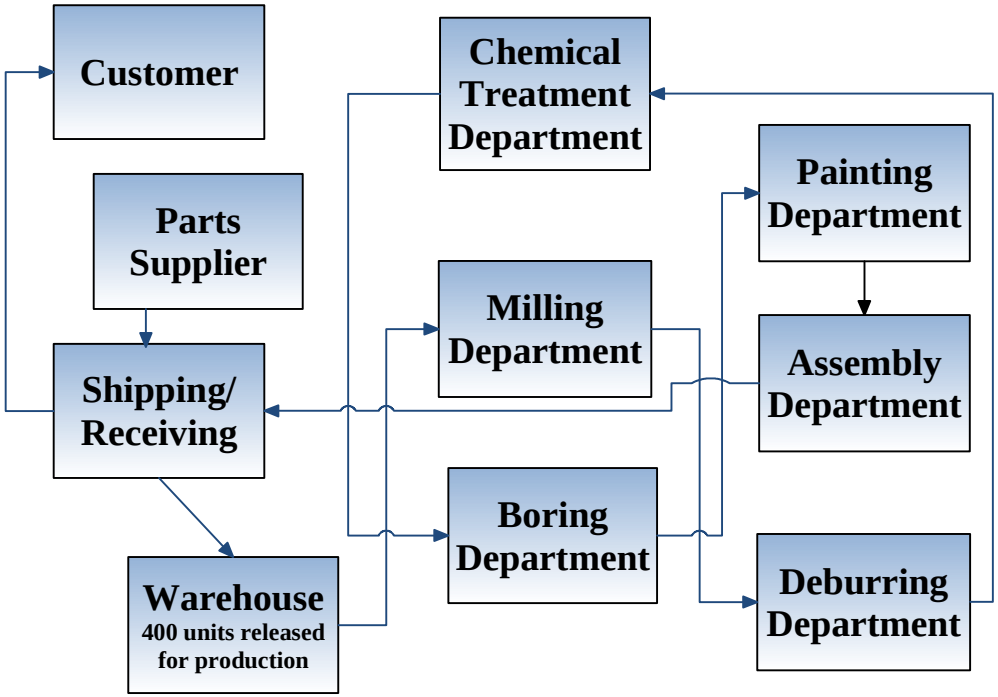
Types of Facility Layouts

- Product layouts
  - Standardized processing operations to achieve smooth, rapid, high-volume flow
  - Typically uses production or assembly lines
  - Example: Automated car wash



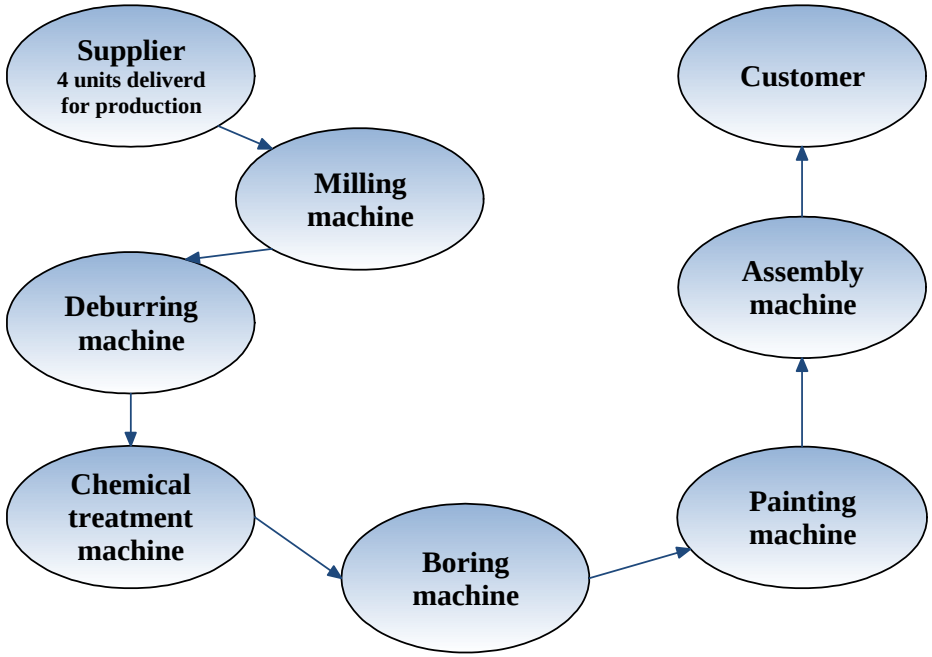
Types of Facility Layouts

- Process layouts
  - Handles varied processing requirements
  - Discontinuous workflow
  - Functional groupings in which similar kinds of activities are performed
  - Nonrepetitive processing – one machine for specific operation



Types of Facility Layouts

- Hybrid (or Combination) layouts
- Cellular layouts
  - Workstations are grouped according to the process requirements for a set of similar items, *part families*, that require similar processing
  - Groups are called *cells*.
  - In a cell, the layout can be almost identical to product layout.



Facility Layout at a Winery

- Three things to consider
  - What type of facility?
  - What would be a good layout?
  - What about the pipelines?
- May be used to evaluate a current layout
- Cellular layout

Solution techniques

- Exact methods
  - Mathematical programming
  - Graph theoretic
- Meta-heuristics
  - Many derived heuristics such as CRAFT, CORELAP, ALDEP, FACOPT, etc.
  - Simulated Annealing Algorithm
  - Genetic Algorithm
  - Tabu Search

Decision Support

- EzyWine data may be easily exported to Excel, therefore VBA may be used
- Decision support possibilities
  - Scheduling
  - Quick Rescheduling
  - Layout problem
- Typically used by winemaker, viticulturist or cellar manager

References

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