SUPPLY CHAIN MISSION STATEMENT

• To create a competitive advantage for Welch’s through purchasing, manufacturing and distributing products and services which provide superior value to our customers.
SOME IMPORTANT DEFINITIONS

• Supply Chain Dynamics
  – The flow of materials from vendors to manufacturing plants, and finally to the customer

  Dynamic Analysis → Multiple Time Periods

• Network Planning
  – The strategic location and size of manufacturing plants in relation to raw material sources and customers

  Static Analysis → Single Time Periods
Supply Chain Dynamics

- Production planning and scheduling
- Lot sizing
- MRP
- Continuous Replenishment Systems
- “Fits and Starts”
Manufacturing Cycle

Queue Time → Hold Time → Inventory

Decide to produce → Produce → Release → Ship to Customer

Time
Order Cycle Time

Consolidate Order

Receive Order

Order prep & Loading

Release to plant

Ship to Customer

Time
SUPPLY CHAIN PLANNING SYSTEMS

Corp. Logistics

Forecast

Continuous Replenishment System (CRP)

Plant Systems

Truck Loading System

Finite Production Planning System

Purchasing

Material Requirements Planning (MRP)

Vendor
NETWORK PLANNING

• Number and location of plants, vendors, DC’s
• Distance to customer
• Long-term expansion or contraction
THE IMPORTANCE OF NETWORK PLANNING

• Complex problem; timing, size, location
• Long lead-time for equipment additions
• Large capital expenditures
• Uncertain long-term demand projections
• Financial attractiveness versus risk
IMPORTANT SUPPLY CHAIN REFERENCES


STRENGTHENING GLOBAL EFFECTIVENESS: 
P&G APPROACH TO SUPPLY CHAIN ANALYSIS

• Streamline work process
• Drive out non-value added costs
• Eliminate duplication
• Rationalize manufacturing and distribution
PLANT CONSOLIDATION STRATEGY:

• Reduce manufacturing expense
• Reduce working capital
• Improve speed to market
• Avoid capital investment
• Fewer production line conversions because of new reformulation
• Eliminate the least productive sizes

• REDUCE COMPLEXITY
REASONS P&G CONSIDERED RESTRUCTURING

• Deregulation of trucking
• Trend toward product compaction
• Total quality, higher through-put and greater reliability of each plant
• Decrease in product life cycles
• Excess capacity in the system
WHAT P&G LEARNED

- Hard to develop an single model of the supply chain
- Mfg. And raw material costs dominated distribution costs by a large margin
- Sourcing decisions more sensitive to customer locations than DC locations
- Visual approach is the only way to do static modeling of the supply chain
NETWORK OPTIONS AT WELCH’S

• Tune-up existing plants
• Public warehousing
• Private warehousing
• New manufacturing plants
• Co-packer (contract) arrangement
• Focused manufacturing
• Combination strategy
CUSTOMER SERVICE ISSUES

• Process-oriented firms tend to locate near raw material sources; however, retail stores want short order cycle time

• Customer Service defined:
  – % of time in stock (Type I)
  – Cases ordered vs. cases Shipped (Type II)
  – Distance to customer (avg. miles)
VERTICAL INTEGRATION

• Stages of the Production Cycle
  – Basic Producer
  – Converter
  – Fabricator
  – Assembler
BILL OF MATERIAL STRUCTURE

Process

V

Few raw materials,
high volume

Discrete

A

Many raw materials,
Low volume
von Thunen’s Belts

- Early theory on location of agricultural production
  $$\text{Profit} = \text{Market price} - (\text{production cost} + \text{transportation cost})$$
  Agriculture locates in an area that maximizes profit
ANALYTICAL TECHNIQUES FOR NETWORK PLANNING

• Optimal Methods:
• Find the minimum of a total cost equation subject to constraints

Spreadsheet optimization
  • Linear programming
  • The transportation problem
  • The trans-shipment problem
  • Non-linear programming
  • Network flow programming
ANALYTICAL TECHNIQUES FOR NETWORK PLANNING (cont.)

- **Simulation Methods:**
  Sometimes use probability distributions to approximate cost through time. An experienced analyst can manipulate parameters to obtain a near optimal solution.

![Diagram](Diagram.jpg)
ANALYTICAL TECHNIQUES FOR NETWORK PLANNING (cont.)

- **Heuristic Methods:**
  - Defined as “rules of thumb”, heuristics serve to reduce the average time to search for a solution
- **Kuehn-Hamburger**
  - Locations with the greatest promise are those located near concentrations of demand
  - Near optimal warehousing systems can be developed at each site if the warehouse with the greatest cost savings is added
  - Only a small subset of all possible warehouse locations needs to be evaluated to determine which warehouse should be added.
WAREHOUSE NETWORKS CLOSEST TO THE U.S. POPULATION

<table>
<thead>
<tr>
<th># of Warehouses in the Network</th>
<th>Shortest Av. Dist. to the U.S. Population</th>
<th>Best Warehouse Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>821</td>
<td>Terre Haute, IN</td>
</tr>
<tr>
<td>2</td>
<td>470</td>
<td>Chillicothe, OH Fresno, CA</td>
</tr>
</tbody>
</table>

Source: Chicago Consulting
Physical Model of Euclidean Distance Problem

\[
\min f(x,y) = \sum_{i=1}^{n} w(i) \sqrt{(x-a(i))^2 + (y-b(i))^2}
\]

Requires an iterative procedure
DYNAMIC CAPACITY EXPANSION POLICY
An Optimal Solution

• Develop a cost function for plant expansion
• Take the first derivative with respect to the decision variable
• Set to zero
• Find optimal plant size and time interval between expansions

Welch’s Approach to Network Planning

- **LOCATE4 (CSC, Inc.)** - Distribution planning software, Linear Programming and Least Cost Simulation
- PC Based, Windows (written in FoxPro)
- Costs include: production, fixed, transportation, warehousing and inventory
- Multi-echelon, static network planning
- Aggregate production capacity considered
NETWORK MODELING ISSUES

• Data gathering
• Product group structure and aggregation concerns
• Production costs, standard versus actual
• Raw material costs
• Transportation rate information, commodity flows and lane capacity
The Welch Supply Chain

customer

17

TW17

WD17

WF17

WD2

WF2

OWD2

OWD2

WD4

WD4

OWD4

OWF4

P17

P2

P4

customer

customer

4

TW4

The Welch Supply Chain
SYMBOL KEY

P = Plant
WD = Inside warehouse dry
WF = Inside warehouse frozen
OWD = Outside warehouse dry
OWF = Outside warehouse frozen
TW = mixing warehouse (dummy node)
17 = Kennewick, WA
2 = Lawton, MI
4 = North East, PA
HISTORY OF LOCATE APPLICATION

• Run first models in 1990
• Two major plant location studies
• Change the assignment of products to plants
• Change the assignment of territories to plants
• Evaluate “product platforms”
RECENT NETWORK MODELING RESULTS

• Shift service to Georgia from PA Plant to MI plant
• Single serve platform - 85% of demand in the West comes from only six cities
  More 2.5 times more single serve sold in NYC than the entire state of Texas
• Renegotiate rates with house carriers
• Change consolidation patterns
SUPPLY CHAIN DYNAMICS AT WELCH’S

• Capacity becomes very important in all production and inventory management decisions
• Changes in demand ripple through the supply chain
• Finite capacity systems must exist in all levels of planning
• Production planning versus MRP
CHARACTERISTICS OF A “GOOD” SOLUTION

• Use costs of set-ups and inventories as a criterion
• When a set of demands is infeasible:
  - Indicates which periods require additional capacity
  - Provides a schedule for the revised capacity
• Accessible
  - Can be implemented in EXCEL7.0 spreadsheet
  - Does not require specialized math programming software of knowledge
• Permits “what-if” analysis in terms of cost consequences
• Provides schedules without excessive computer time
METHOD SELECTED

• Rule based method (heuristic)
• Modified Dixon-Silver Heuristic (1981)
  - Provides good solutions for zero set-up times
  - Conceptually simple
  - Easy computations
  - Modest computer resource requirements
  - Uses the proven Silver-Meal (1973) lot-sizing method
• Modifications Required:
  - Account for set-up times
  - Detect infeasible demand patterns
  - Implement in an EXCEL 7.0 environment