Labor Forecasting at Eli Lilly and Company

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Outline

• About Eli Lilly and Company
• The Tippecanoe Manufacturing Facility
• Decision Science Team
• Forecasting Challenge
• Solution and Recommendations
• Lessons to Learn
Human Resource Planning
Eli Lilly and Company

- Founded May 10, 1876
- More than 42,000 employees worldwide
- Approximately 8,400 employees engaged in research and development
- Clinical research conducted in more than 50 countries
- Research and development facilities located in 9 countries
- Manufacturing plants located in 13 countries
- Products marketed in 143 countries
Developments at Eli Lilly

- Alimta®, the first and only chemotherapy regimen approved by the FDA to treat patients with malignant pleural mesothelioma who are not candidates for surgery
- Symbyax™, for bipolar depression
- Cialis®, a distinctive new treatment for erectile dysfunction from the Lilly ICOS joint venture
- Stratterra®, the first FDA-approved nonstimulant, noncontrolled medication for the treatment of attention-deficit hyperactivity disorder in children, adolescents, and adults
- Forteo®, first-in-class medicine for osteoporosis patients that stimulates new bone formation
- Xigris®, the first treatment approved for adult severe-sepsis patients at a high risk of death
- Evista®, the first in a new class of drugs for the prevention and treatment of postmenopausal osteoporosis
- Zyprexa®, breakthrough product for schizophrenia and acute mania associated with bipolar disorder
- Humalog®, a fast-acting insulin product
- Gemzar®, for pancreatic and non-small-cell lung cancer, one of the world's best-selling oncology agents
- Humatrope®, therapy for growth hormone deficiency
- Prozac®, which revolutionized the treatment of depression
- Humulin®, human insulin, the first human-health-care product created by biotechnology
- Ceclor®, which became the world's top-selling oral antibiotic
- Iletin®, the first commercially available insulin product, in 1923
Eli Lilly Statistics

Employees

- Indianapolis: 14,159
- Indiana (excluding Indianapolis): 5,556
- U.S. (excluding Indiana): 4,758
- Outside U.S.: 21,667
- Worldwide total: 46,140

Products sold: 138 countries

Financials-2003
(dollars in millions, except per-share data)

- Net sales: $12,582.5
- Net income-as reported: $2,560
- Earnings per share-as reported: $2.37
- Dividends paid per share: $1.34
- Capital expenditures: $1,706.6
Research and Development at Lilly

2005 Expenditures
$3,025.5 million/year
$252.1 million/month
$58.2 million/week
$11.6 million/workday

R&D as a percentage of sales 20.7%

Staff
Employees engaged in Lilly R&D activities 8,336
Percent of total work force 19%

Cost of New Pharmaceutical
Average cost to discover and develop a new drug $800 million to $1 billion
Average length of time from discovery to patient 10 to 15 years
Tippecanoe Laboratories

- 8th largest employer in county
- $170 million dollars per year economic impact
- Current pharmaceutical pipeline consist of
  - 40 entirely new molecules
  - 25 additional uses for current products.
- Products treat diseases in the areas of Cancer, Cardiovascular, Central Nervous System, Endocrine and Infectious Diseases.

General Information
- Location: Lafayette, Indiana
- Number of Employees: 1,200 associates
- Started Production: May 10, 1954
- Facilities: 130 buildings, covering 500 acres
- Additional Areas:
  - 800+ acres of farm land
  - 1,000 acres of wildlife habitat
On site

• **Products Made at Tippecanoe Laboratories**
  – Operating 24 hours a day, seven days a week, Tippecanoe Laboratories makes intermediate and active ingredients for most of the pharmaceuticals Lilly manufacturers in the United States.
  – Evista® (raloxifene hydrochloride, Lilly)
  – Gemzar® (gemcitabine hydrochloride, Lilly)
  – Zyprexa® (olanzapine, Lilly) **Animal Health**
  – Micotil® (tilmicosin, Elanco)
  – Tylan® (tylosin, Elanco)

• **Recent Developments in 1980s and 1990s**
  – $167-million five-story, flexible bulk pharmaceutical production facility
  – $38-million development center, where new products are scaled up from laboratory-size quantities to full-scale production.
  – $600 million in capital construction took place at the site.
Decision Science at Eli Lilly

• Team of (~15) consulting professionals working on areas including
  – Risk analysis for investment
  – Portfolio management
  – Strategic decision making
  – Decision tool development
Problem Description

• Each pharmaceutical product goes through several stages of manufacturing
  – Using different apparatus / facilities
  – Requiring various levels of labor, testing and supervision

• Each resource (facility / worker) is able to perform certain functions
  – Some people are qualified to supervise
  – Some areas of factory are specified for certain products or processes
  – Production lines need to be shut down and cleaned between different chemical processes
What is the demand?

• Production demand is determined from the head office
• This demand is known one or two months in advance, with a ‘best guess’ of the next year’s schedule available
Objective #1

• Meet all demand at minimum cost:
  – Cost of labor for workers
  – There is a (huge) cost when products do not meet their targets for release
  – People must work overtime to meet demand, costing more for their time
Objective #2

• Meet an uncertain demand with minimum expected cost
  – Same costs, but demand is not certain
Objective #3

• How many people should be hired?
  – Given the uncertain demand and expected costs

• Workers…
  – are ‘in training’ for first six months on the job
  – Can perform work on only one production line in first year, then learn more
  – can become supervisors after 3-5 years
  – Might retire or leave for another job
  – Are expensive to lay off (last resort)
• Lilly had spent hundreds of thousands of dollars on supply chain management and enterprise resource planning software
  – Tippecanoe had not adopted the software because it was too complicated and took too long to learn
## Sample Drug Demand Profiles

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## Sample Demand

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## Sample worker profiles

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Demand Simulation

- Crystal Ball Example
Recommendations

• Use forecasts including uncertainty for demand
• Don’t just take ‘expected demand’
  \[ E[f(x)] \neq f(E[x]) \]
• Incorporate Staff level uncertainty into model
Conclusions

• Expensive ERP and SCM software is only useful if people are able to use it
  – User interface is key
  – Training is needed

• Simple models can help make complex decisions