



## *Business Decision Modeling throughout the Ages*

### **A Brief History**

#### **Historical Objective**

Until the middle of the last century, most industrial enterprises employed only a few workers. As companies expanded, however, it became less feasible for one person to manage all of the new managerial functions of the business effectively. New scientific methodologies were developed to provide assistance to each new type of managerial function as it appeared.

As more specialized forms of management emerged, so did more specialized subfunctions, such as statistical quality control, equipment maintenance, marketing research, and inventory control. Whenever a managerial function is broken down into a set of different subfunctions, a new task—the executive function of management—is created to integrate the diverse sub-functions so that they serve efficiently the interests of the business as the whole. The executive function evolved gradually, as did organizations themselves. However, increasing demands were made on the manager, who in turn sought aid from outside the organization, which gave rise to management consultants.

#### **Origins of Business Decision Modeling**

Business decision modeling can be partially attributed to World War II, since many operations sought to bring mathematical or quantitative approaches to bear on military operations. Business decision modeling has characteristics that include economics (known as econometrics), psychology (psychometrics), sociology (sociometrics), marketing (marketing research), and corporate planning problems. The growing complexity of management has necessitated the development of sophisticated mathematical techniques for planning and decision making.

Some areas of business decision modeling, such as inventory and production control, and scheduling theory, have grown into subdisciplines in their own right and have become largely indispensable in the modern world. The potential of computers and information systems as new tools for management forced the non-technically trained executives to look for help in the utilization of the computer.

#### **Optimal Information Area**

Operational Research Society website

<http://www.orsoc.org.uk/home.html>

OpsResearch.com website

<http://www.opsresearch.com/OR-Links/index.html>

Professor Hossein Arsham's Applied Management Science

<http://ubmail.ubalt.edu/~harsham/opre640/opre640.htm#rintsites>

## Step 1: Problem Identification

Identifying the problem that exists is the first step in the business decision modeling process. Many experts believe this is the most critical step. If we do not identify the problem correctly all of the subsequent steps are worthless. A statement of purpose, thesis, or set of goals is generated here.

## Step 2: Problem Definition

Once we have identified the problem we must clearly define the pertinent variables, those variables' parameters or limits, and any assumptions regarding the real world that apply to the situation at hand. If we do a poor job of defining the problem, our model may be inappropriate. Definitions regarding the problem must be linked to the problem identification and set of goals established therein.

## Step 3: Problem Modeling

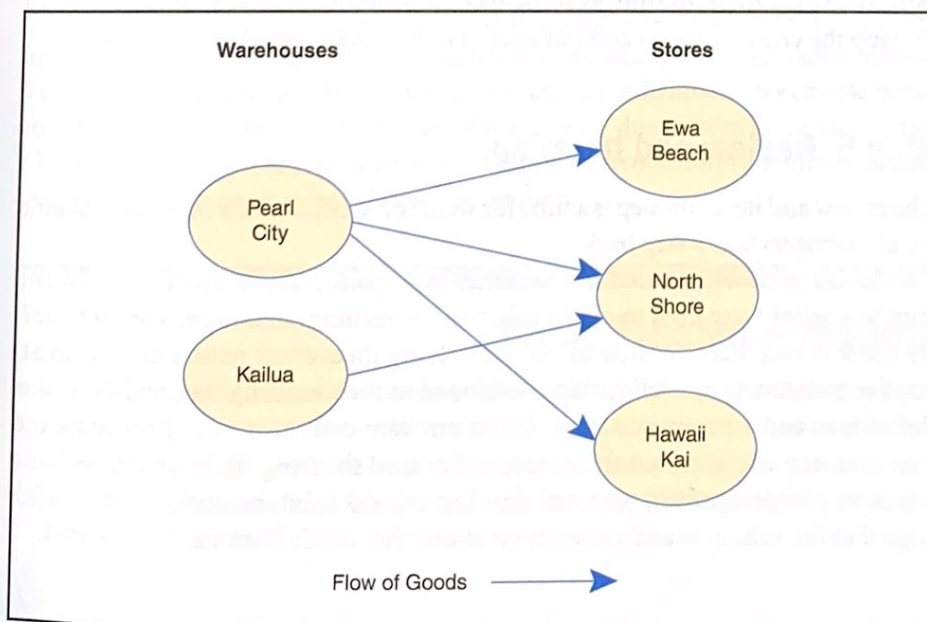
Problem modeling can take on two common forms: the abstract, or high-level, model and the numeric, or concrete, model.

Individuals or groups attacking a problem many times begin with the abstract model and work towards a more specific model.

Models can be of a high-level/abstract nature or a more numeric/concrete nature.

### ABSTRACT, OR HIGH-LEVEL, MODELS

Examples of abstract models are flow diagrams and charts or graphs that physically describe a system or set of components or put structure to the definitions created in the problem definition section. Figure 1.2 is an example of a high level flow diagram used to model the transfer and shipping of goods in a particular region.



**FIGURE 1.2**

High-level Flow of Goods Model

## NUMERIC, OR CONCRETE, MODELS

High-level models are used primarily in the early stages of the business decision modeling process but many times are carried forward, added to, or modified and also used in the specific modeling stage. Most often the specific models used in business decision modeling are mathematical in nature. These models consist of mathematical relationships that integrate the variables, parameters, and assumptions from the problem definition step into a set of mathematical numbers and symbols. A simple example of a specific model is the relationship of revenues and costs to profit. The numeric model that computes the profit the firm generates is in general,

$$\text{Profit} = \text{revenue} - \text{costs}$$

In fact, businesses use the equation for profit all the time.

Overall, models can become very complex and can include numerous mathematical equations and relationships. The individual topics covered in this textbook will present numerous models for solving many different types of problems. Some of the models we will study tend to be very specific with strict assumptions and definitions, while others are general and can be applied across many situations, scenarios, and disciplines.

Financial profit is defined as revenues less costs and is considered a basic financial model.

## Step 4: Initial Model Results

After the problem has been identified, defined, and modeled, business decision modeling techniques are used to generate an initial solution. The word *initial* is used here because the next step in the business decision modeling process is the review and iteration step. Any business decision modeling professional would agree that rarely do we get everything perfect and generate the exact answer the first time around. Moreover, in real life problems are messy and unstructured, and it may take a number of attempts to generate a model that is adequate and/or produces a satisfactory solution. In sum, as students of business decision modeling, we must develop the critical process and not a set of individual stand-alone techniques.

## Step 5: Review and Iteration

The review and iteration step is a time for what some call a *reality check*. Why should we as managers take a step back?

As you probably noticed in the earlier examples, mathematical formulas and simple algebra were used to create solutions or recommendations. The term *reality check* is used here because of the underlying theoretical nature of mathematics, the mathematical relationships developed in the modeling step, and the earlier definitions and assumptions made in the problem definition step. The review and iteration step encompasses the concept of critical thinking. To be an efficient and effective problem solver, we must develop critical thinking and judgment with regard to the solutions and recommendations that result from the models used.

Managers must review model solutions, or "do a reality check," on the output.

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This critical thinking or judgment is manifested in this step by literally stopping, reviewing the last four steps, and asking yourself a series of questions like the following:

- Does everything look okay? That is, does it all check with reality?
- Did we get an answer that pertains to the problem/goals we identified in step 1?
- Have any of the assumptions or definitions from step 2 changed, or should new assumptions be introduced?
- Is the model we developed functioning properly; i.e., are the answers we obtain feasible and applicable to the real world?

Overall, one of the most compelling reasons for the review and iteration step is to avoid making recommendations or presenting solutions that have no basis in the real world. We must also note that no model is ever perfect, so it is advisable to conduct sensitivity analysis. Good business decision modelers always do a best-, most likely, and worst-case analysis. There will be numerous discussions of sensitivity analysis throughout the upcoming chapters.

## Step 6: Implementation

Implementation of the model, solutions, and recommendations is the last step in the business decision modeling process described in Figure 1.1. As future managers, we will be using the models developed and/or the results and recommendations from those models. In the business world, managers must make decisions in order to keep their businesses running, sell products, and service customers. This is in stark contrast to what many academicians or theorists consider the last step of the process.

The implementation step, although the final and possibly the most critical step in the process, is often ignored. At times, necessary changes to a so-called normal way of doing business are revealed and in turn certain individuals may choose not to adopt the results or recommendations of the process due to reluctance for change. This way of thinking needs to be avoided. If the process solution is not implemented; the entire process was a waste of time and money.

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## Basic Financial Models

Most of the basic business decision modeling models arising in business and economics applications involve the use of the profit equation. The next sections will detail the general profit equation and discuss cost and volume models, revenue and volume models, profit and volume models, and break-even analysis.

Basic financial models such as  $\text{profit} = \text{revenue} - \text{cost}$  are used in many places in the real world.

# PROBLEMS

1. Rick Miles runs a CD-making business. He forecasts demand for his CDs at 5000 for the next year. He charges \$20 per CD sold. It costs him \$2000 in fixed costs a year to run his business and \$2 per CD in variable costs.
  - a. What are Rick's revenues?
  - b. What are Rick's costs?
  - c. Does Rick make a profit?
2. The Scheinbach computer company manufactures computers wholesale. The company's fixed monthly cost is \$45,000, and its variable per computer cost is \$525. The company sells the computers for \$925. Determine the monthly break-even volume for the company.
3. Kathy runs her own computer education business. She needs \$4000 a year to pay the leases on the computers she uses. She estimates she will have 400 pupils for the next year. Each pupil pays \$200 for the education. However, it costs Kathy \$20 to \$30 per pupil in supplies and overhead.
  - a. What are Kathy's yearly revenues?
  - b. What are Kathy's average total costs? What is the range of Kathy's costs?
  - c. Does Kathy make a profit? What is the range of Kathy's profit?
4. Wayne owns a shaved ice stand. He sells 700 shaved ice cups per month at \$1.50 each, making the total revenue \$1050. Each shaved ice costs Wayne \$0.50 and he has fixed costs of \$750, making his total costs \$1100. Therefore, he realizes a loss of \$50 a month. Help him determine what his break-even point is.
5. HPU Graduates is a start-up microbrewery in Pahoia, Hawaii. Its fixed costs to produce beer total \$8000 per month. The variable cost to produce their beer is \$3.00 per case of beer. It sells its beer to one hotel only, and that hotel has said it wants 550 cases this month. What price does HPU need to charge to break even?