

## **Introducing Learning-by-doing into the Break-even Analysis Model**

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**Michael Tannen**

**University of the District of Columbia**

Break-even analysis, also known as Cost-Volume-Profit analysis, is a widely used structure that allows managers to anticipate how changes in volume (output) of a product may affect revenue, cost and resulting profitability. Constructed more than one hundred years ago as a managerial accounting tool, usage has spread into operations management, managerial economics, finance, and other business applications. Longevity is attributable to ease of use and relevance to organizational goals such as introducing new products, altering existing ones, adjusting volume of existing ones, entering new markets, and outsourcing (make-buy) decisions. Illustrations of current popularity include numerous “how-to-do it” examples on the internet, recent articles in popular, well regarded business periodicals, and discussion in operations management texts.

Warnings abound, though, regarding the model’s limitations. An important one focused on here is that variable cost per unit remains constant. This simplifies model structure and allows use of accounting data when relevant. But it ignores the ergonomic emphasis on the effect of learning by doing, as well as multidisciplinary regard for experience, formal and informal job training, and “continual improvement” in teamwork and workplace and workflow design. Evidence specifically focused on learning considered below has indicated variable cost per unit falls for individuals and work groups as more production occurs over time, rapidly at first, more slowly later. But more recent studies have extended use of the concept to apply to entire organizations. Evidence to date indicates the learning rate differs among organizations, resulting in efficiency and competitive advantages for faster learning groups.

The analysis below focuses on including the learning effect in the break-even model, and indicate the extent to which it reduces the output level required to: (1) break-even, (2) achieve a target level of profit, or (3) reach a higher target at the same level of output. Also demonstrated is how it (4) shrinks the range over which outsourcing is the cheaper alternative to in-house production, and (5) when an organization can conduct production on more than one site, learning rates may differ across sites, which can affect the optimal allocation of production. Qualitative impacts of this modification are as expected from introducing a cost-reducing factor, but the analysis also shows the quantitative extent of the reduction in all three output determination problems is substantial, with about a one-third anticipated reduction in necessary output likely on average.

Including the learning factor in the model obviously complicates it, which could detract from its appeal. On the other hand, incorporating falling unit cost due to learning has become a staple of some contracting (e.g. some U.S. Government agencies) and organizational planning, questioning the usefulness of the traditional model. The analysis below suggests an approach that may provide a workable compromise, yielding a more flexible model structure that in the end is not much more complicated or difficult to use than the traditional model.