

**Michał Biernacki**

Wrocław University of Economics

---

## THE PLACE OF QUANTITATIVE METHODS IN LIFE CYCLE COSTING (LCC) APPLIED IN TRAVEL AGENCIES

---

**Summary:** The strategic planning in travel agencies is based on the assumptions of Life Cycle Costing, which makes use of sales volume forecasts (forecasting both sales revenue and costs). The paper aims at discussing the place of the individual forecasting methods in the Life Cycle Costing (LCC) applied in travel agencies. There are presented some of the existing methods and models which are the most popular in practice, especially in travel agencies. There is showed a way and possibility of choosing a right method for this kind of companies.

**Key words:** Life Cycle Costing, tourism service, forecasting, accounting, cost accounting.

### 1. Introduction

When evaluating capital investment options, using Life Cycle Costing (LCC) may help firms determine the possibility which is most cost effective. Rather than evaluating projects solely on the basis of initial costs, Life Cycle Costing looks at the total cost of owning, operating and maintaining a project over its useful life (including its fuel, energy, labour, and other components). Life Cycle Costing calculates operating and maintenance costs incurred during the lifetime of the project plus the initial capital costs.

This kind of costing system often shows that a project with a higher initial cost may be much more financially beneficial in the long term. It is especially useful for evaluating energy efficiency projects since they often require a higher initial investment, but have lower operating and maintenance costs over the life of the project. Thanks to Life Cycle Costing enterprises can collect money in the short-term but they will be predicted for paying more for the project through higher energy costs and other operating costs over the life of the project [Baussabaine 2004, p.7-9].

Life Cycle Costing may be understood differently. The varied approaches to the specificity of this model lead to a situation where the procedures to be met by travel agencies and/or to guide travel agencies while implementing the model may be different.

Life Cycle Costing is interpreted in practice and the relevant literature as:

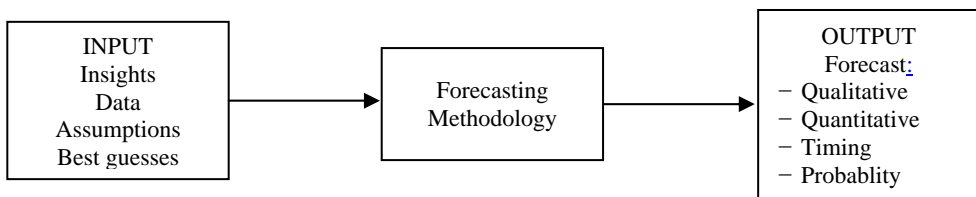
- evaluation account of investment undertakings – ex ante account (the so-called Anglo-Saxon approach);
- ex post approach costing – aggregating all costs incurred by the enterprise related with the given product;
- a compilation of the two costing examples above.

Life Cycle Costing performed ex ante has the fundamental importance for the strategic planning in travel agencies, which is translated into the need to prepare a sales volume forecast which covers forecasting of both sales revenues and costs of the provided service.

This article presents main goals, scopes of the forecasting methods, which are applied in Life Cycle Costing (LCC) applied in travel agencies. There will be applied research methods such as methods of deduction and literature review with practical assessment.

## 2. Forecasting methods in Life Cycle Costing

Life Cycle Costing systems are toughly dependent upon forecasts about the future, the expected lives of components, or about future maintenance expenditure. Forecasting and predicting will be no more than expert judgment, best guesses, or hunches. Others will involve the use of forecasting methodology. Figure 1 shows the relation and sequence of forecasting.



**Figure 1.** Forecasting process

Source: [Flanagan et al. 1989, p. 49].

A vital element in forecasting is the ability to understand trends combined with the ability to show what could happen in the near and long future. This requires assembling the exercise of imagination and insight from the mass of available information and knowledge from data which is a vision of the future direction of development. (What will happen with our product when energy prices changes in the future). Forecasting relies upon the assumption that future costs can be predicted to some extent by referring to patterns of cost that have existed in the past. Such assumptions only hold true if no outstanding technological leap occurs and the existing stimuli remain constant both in type and degree [Flanagan et al. 1989, p. 48-49].

Historical data can be obtained from a variety of sources such as internal data, clients and in some cases the design teams themselves. The value of historical data is relevant in that the values of initial capital cost and subsequent running cost can be categorized for certain groups of element of the product and this comparison can then be used to identify the elements which will benefit from a life-cycle cost approach [Baussabaine 2004, p. 17].

The important part should not be underrated if it is played by professional experts. This is required and obligatory at all stages. In the selection of assumptions, determining and selecting the data is required and chooses the most appropriate predicting future techniques to use. Managers with biased assumptions may reach biased conclusions. People rather than analytical techniques make decisions in every situation. Assumptions have to be made when any quantitative or qualitative information is either missing or unreliable, and these must be based upon some logical foundation. An analyst should always ask three questions and try to answer them: What should/could/happen(s)? Most assumptions could be tested and analyzed by the use of sensitivity analysis.

The relevant literature features many different classifications of forecasting methods which are or may be applicable while implementing Life Cycle Costing.

The most often occurring division is the classification of methods into:

- quantitative methods,
- qualitative methods.

The quantitative methods which are possible to apply in Life Cycle Costing of a service include:

- time-series models – models with a constant forecast variable level, models with a trend, models with seasonal fluctuations and periodical fluctuations, autoregressive models; econometric methods – cause-and-effect models or symptomatic models;
- analogy models – spatial analogy or historical analogy;
- models with leading variables;
- cohort analysis models;
- market tests.

Qualitative methods permitting to prepare forecasts in Life Cycle Costing, in turn, include:

- opinions of sellers,
- opinions of the management,
- surveys of buyers intentions,
- heuristic methods [*Prognozowanie gospodarcze...* 2005, p. 43].

The most often observable situation in the practice of travel agencies is when a forecast of each variable is obtained by a different method, and it happens that even several methods are applied for forecasting a single variable. It is the case then of the combination of methods, which consists in applying various methods in individual phases of constructing a forecast or in averaging forecasts obtained by different methods [*Prognozowanie gospodarcze...* 2005, p. 44].

### 3. Estimating costs and revenues in Life Cycle Costing

Cost estimating is a very popular activity as various kinds of costs have to be predicted every day. An estimated cost has to be as close as possible to its actual one. It may lead to a consequence of a severe degree. More specifically, the success or failure of an organization may depend on the quality of cost estimates. There are several methods and procedures developed over the years for estimating costs. Each of them has its strong and weak points. Some cost forecasting methods or procedures may be very suitable for one type of application and less effective for another. Therefore, one should take a great degree of care in applying those techniques. Managers working in cost estimating area have come up with several different cost estimation methods, models, and procedures. The article presents some of the existing methods and models which are the most popular in practice.

According to J. Emblemstvag, in the service of Life Cycle Costing the estimation of sales revenues and costs in successive periods of the product market phase may be performed with the use of multiple methods incorporated in the three basic groups:

- analogy models,
- parametric models,
- engineering models [Emblemstvag 2003, p. 36-38].

The first ones are considered the simplest forecasting methods. They are based on the analogy between a given product, being an object of calculation in Life Cycle Costing, and a product similar to it in terms of the manufacturing process. In such an approach those methods, with use of expert knowledge, may be essentially applied in order to estimate costs and revenues of new products. The second group of methods (parametric methods) permit to determine Life Cycle Costs and revenues based on the correlation between the estimated data and the parameters characteristic for the given object. In order to determine appropriate correlations real historical data are used here, so that quantitative methods could be subsequently applied, above all the regressive analysis. Those methods should not be thus applied in the case of new products since it is impossible to describe them with the use of formalised mathematical correlations. Engineering methods, also known as detailed methods, serve above all for estimating costs based in detailed information related to the material consumption standards, labour intensity standards, etc. Due to such a definition they are primarily applicable in production enterprises, not service enterprises such as travel agencies [Emblemstvag 2003, p. 36-38]. Therefore, the choice of an appropriate forecasting method should be supported by a model quality assessment, and more precisely by an assessment of its consistency with the empirical data and an assessment of a forecasting method value.

It should also be mentioned that the forecasting methods applied in Life Cycle Costing depend on the behaviour of variables up to the point and the anticipated actions of the travel agency in the period covered by the forecast. In a situation when the hitherto structure of tourism service costs incurred by the tour operator is stable,

forecast models may be applied only for overall costs, while forecasts for individual cost types may be obtained by determining the indicators of their share in overall costs. However, when individual costs of a tourism service are changed in accordance with different trajectories, forecasting models should be built individually for them.

The other cost estimation method is referred to as cost indexes. This is a dimensionless number used for the purpose of adjusting an item's cost from one period to another. The index allows to estimate the cost of a similar item without going through the rigour of detailed costing. The following equation can be used for converting costs from one period to another:

$$C_k = C_m \times \left( \frac{I_k}{I_m} \right)$$

where:  $C_k$  – the cost [PLN], in year  $k$ ,

$C_m$  – the cost [PLN], in year  $m$ ,

$I_m$  – the value of the index for year  $m$ ,

$I_k$  – the value of the index for year  $k$  [Dhillon 1989, p. 82-101].

Next method is used to approximate cost estimates for equipment or for plants where cost data for similar projects of different capacity than desired are known. The cost-capacity relationship is described as follows:

$$C_n = C_{ol} \times \left( \frac{C_{Pn}}{C_{Pol}} \right)^k$$

where:  $C_n$  – the estimated cost of equipment/desired capacity  $C_{Pn}$ ,

$C_{ol}$  – the known cost of similar equipment/plant of capacity  $C_{Pol}$ ,

$k$  – the cost-capacity factor (usually it is near 0.6) [Dhillon 1989, p. 82-101].

The following cost estimation method is known as the Turnover Ratio Method. It is most efficient for estimating firm costs but probably it is the least accurate. The turnover ratio is expressed as follows:

$$TR = \frac{GAS}{FCI}$$

where:  $GAS$  – the gross annual sales given by: the unit selling price of the annual production rate,

$TR$  – the turnover ratio (the value vary from about 0.2 to 8.0),

$FCI$  – the fixed capital investment [Dhillon 1989, p. 82-101].

The last most popular estimating cost method can be called the Probability Cost Estimating Technique. It is based on a procedure developed for Program Evaluation and Review Technique (PERT). This kind of method calls for making three cost estimates: optimistic (lowest cost), most likely (cost), and pessimistic (highest cost). This formula is used to estimate mean for a cost element:

$$EL = \frac{LC + 4ML + HC}{6}$$

where:  $LC$  – the lowest cost,  
 $HC$  – the highest cost,  
 $ML$  – the most likely cost,  
 $EC$  – the mean cost of the element.

Similarly, the variance  $\alpha^2$  of the cost element is given by

$$\alpha^2 = \left( \frac{HC - LC}{6} \right)^2$$

That is why the total expected cost, TEC, is as follows:

$$TEC = \sum_{i=1}^k EC_i$$

where:  $k$  – the total number of cost elements,  
 $EC$  – the expected cost of element  $i$  [Dhillon 1989, p. 82-101].

At the same time, multiple methods are applied for forecasting sales revenue on tourism service. The application of specific methods often results from the specificity of the market, as well as the accuracy of the existing forecasts and the ease of application of the given method, credibility of the obtained forecasts, and the costs of using the method [Makridakis, Wheelwright 1989, p. 350].

The relevant literature describes two possible approaches for obtaining forecast results of sales of a certain product of a travel agency on a certain market. These are the following approaches:

- bottom up – consisting in dividing the given market into segments and determining future sales volume separately for each segment. The overall forecast is an accumulation of partial forecasts;
- top down – consisting in creating a sales forecast at the level of the entire enterprise, in order to disaggregate it into smaller organisational units based on certain criteria, e.g. existing sales volume, ending with a forecast for sales of a single product on a certain territory [*Prognozowanie gospodarcze...* 2005, p. 306-307].

In the practice of travel agencies only the first approach is observable, although the second one could be also applied from the theoretical point of view.

#### 4. Forecasting stages in Life Cycle Costing

Formulating a forecast for Life Cycle Costing of a service requires taking appropriate measures grouped in successive stages. It can be assumed, thus, that the general conduct scheme comprises the following actions:

1. formulating a forecasting objective,
2. providing forecasting premises,
3. collecting, statistical editing and analysing forecasting data,
4. selecting the forecasting method,
5. constructing a forecast,
6. evaluating the admissibility of the forecast,
7. applying the forecast,
8. verifying the forecast [Dittmann 2006, p. 35-47].

The foregoing stages should be applied for forecasting both costs and sales revenues during the entire life cycle of a service.

## 5. Forecasting for new products in Life Cycle Costing

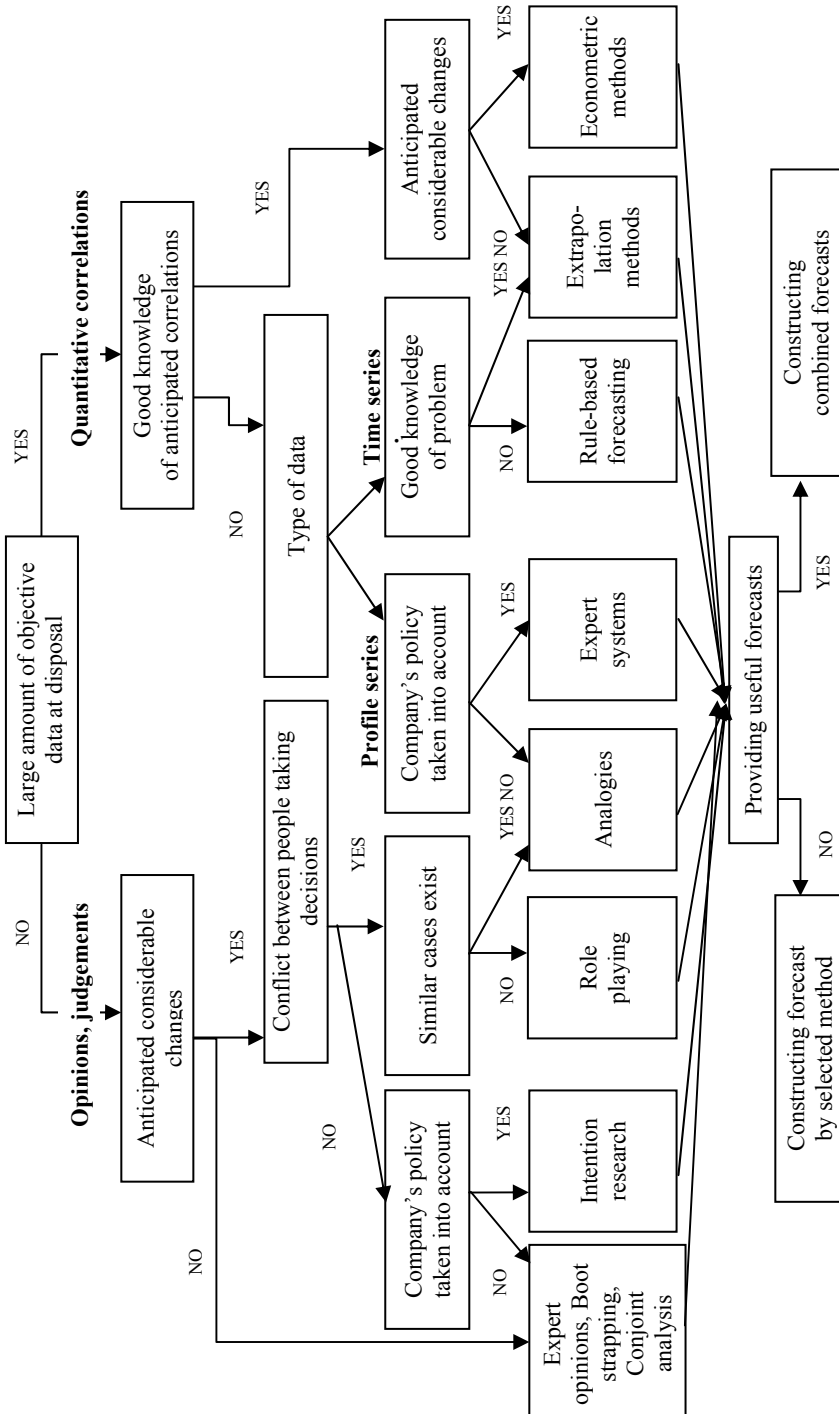
A particularly difficult problem encountered by travel agencies is forecasting the sales of new products. Tour operators do not have any historical material available that regards the sales in past periods at the moment, which results in the forecasting being based to a great extent on intuition. An often applied practice in such a situation is researching the market and the expectations of potential customers. However, such an approach requires, firstly, time, and secondly, high financial outlays. In addition, they may draw attention of the competition to the plans of the given agency and the adopted development strategy.

Quoting after D. Kwiatkowska-Ciotucha, the forecasting process of sales of new products may be divided into five stages:

- forecasting the feasibility of a given product;
- forecasting the extent of acceptability of a given product by customers;
- forecasting the usability of the product based on data from market pre-tests;
- forecasting the sales revenues based on the information from market tests;
- forecasting the sales volume based on first data from market [*Prognozowanie gospodarcze...* 2005, p. 314-315].

For the purpose of forecasting the sales and revenue from sales of new products, travel agencies very often use the so-called epidemic model developed by Bass in 1969. This model assumes that the sales curve of a new product has a shape analogous to the curve of the development of an infectious disease epidemic, and in other words – to Life Cycle Curve. At the beginning a slow “start of offer” takes place, during which customers become accustomed to the new product on the market, then a period of rapid sales growth is observable until the peak is reached, that is the market saturation, followed by a slow reduction of the sales volume until the exhaustion of the number of potential buyers of the given product [Lehmann 1989, p. 798].

At this point the method of selecting a forecasting method proposed by J. Scott Armstrong in the form of a “selection tree” presented in Figure 2 should be mentioned here. As it can be seen, the first criterion in selecting an appropriate method should be the availability of sufficient amount of objective data. If the entity has such data



**Figure 2.** Forecasting method selection tree  
 Source: [Kwiatkowska-Ciotucha, Zaluska 2003, p. 302].



at its disposal, it may select quantitative methods, if not – it has to resort to methods based on expert opinions and judgements [Armstrong 2001]. As far as travel agencies are concerned, it may be suggested that, answering subsequent questions, the most often used methods might be expert systems analogies.

## 6. Errors of prediction and forecasting

The process of predicting various costs and savings is fraught with errors, the root cause of uncertainty about the future. Prediction errors can be classified and recognized broadly as measurement and sampling errors. Errors of measurement can occur as a result of differences in measurement units, while sampling errors result from the fact that a sample may not be representative of its population. On the other hand prediction errors may occur as a result of incorrect assumptions about discount rates, inflation rates, lives of product and its components, period of analysis, energy increasing, and allowances for maintenance. The most important thing is to recognize where they are likely to occur and the likely magnitude of the error [Flanagan et al. 1989, p. 49-50].

## 7. Conclusion

A travel agency should consider several superior practical principles while selecting a given forecasting method, namely:

- tailoring the method to a specific service;
- comparing forecast errors obtained by different methods;
- estimating the usability for individual services and markets;
- estimating the value of alternative forecasting methods in terms of invested initial outlays and later profits;
- deciding on simple forecasting methods;
- preparing combined forecasts.

At the same time, also discount methods should be applied separately in the concept of Life Cycle Costing for new tourism services.

## Literature

1. Armstrong J.S., *Principles of Forecasting. A Handbook for Research and Practitioner*, Kluwer Academic Publishers, Norwell, Massachusetts 2001
2. Baussabaine H.A., Kirkham R.J. *Whole Life-cycle Costing. Risk and Risk Responses*, Blackwell Publishing Ltd Oxford 2004.
3. Dhillon B.S., *Life Cycle Costing. Techniques, Models and Applications*, Gordon and Breach Science Publishers, OPA, Amsterdam 1989.
4. Dittmann P., *Prognozowanie w przedsiębiorstwie. Metody i ich zastosowanie*, OE, Kraków 2006.

5. Emblemavag J., *Life Cycle Costing. Using Activity-Based Costing and Monte Carlo Methods to Manage Future Costs and Risks*, Wiley, Hoboken, NJ 2003.
6. Flanagan R., Norman G., Meadows J., Robinson G., *Life Cycle Costing. Theory and Practice*, BSP Professional Books, Oxford 1989.
7. Kwiatkowska-Ciotucha D., Załuska U., *Uwag kilka o wyborze metod prognozowania*, [in:] *Prognozowanie w zarządzaniu firmą*, ed. P. Dittman, Wydawnictwo Akademii Ekonomicznej, Wrocław 2003.
8. Lehmann D., *Market Research and Analysis*, Richard D. Irwin, Inc., Boston 1989.
9. Makridakis S., Wheelwright S.C., *Forecasting. Methods and Management*, J. Wiley and Sons, New York 1989.
10. *Prognozowanie gospodarcze. Metody i zastosowanie*, ed. M. Cieślak, Wydawnictwo Naukowe PWN, Warszawa 2005.

## MIEJSCE METOD ILOŚCIOWYCH W RACHUNKU KOSZTÓW CYKLU ŻYCIA WDROŻONEGO W BIURACH PODRÓŻY

**Streszczenie:** Planowanie strategiczne w biurach podróży opiera się na założeniach rachunku kosztów cyklu życia wykorzystującego prognozy wielkości sprzedaży (prognozowanie przychodów ze sprzedaży i kosztów). Artykuł ma na celu omówienie miejsca poszczególnych metod prognostycznych w rachunku kosztów cyklu życia (LCC) stosowanego w biurach podróży, a także ocenę oraz możliwość ich zastosowania przez touroperatorów. Prezentuje także procedurę wyboru odpowiedniej metody dla przedsiębiorstw z tak specyficznego segmentu rynku, jakim jest turystyka i działające tam podmioty.