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Abstract

Information technology (IT) costs often exceed budgets. Causes of incorrect IT cost estimation may either be suboptimal use of the knowledge on cost behavior or the appearance of unexpected situations. We develop a dynamic model that allows IT managers to test every possible scenario concerning cost occurrences. Users of the model would customize their inputs into the model to observe possible cost patterns. When the IT managers obtain a stable boundary of costs for their company's IT portfolio, they will be more confident of their control over IT costs.

Category: technical
Keywords: IT management and cost control, dynamic programming, DSS, simulation

I. Introduction and Research Objectives

The size and complexity of overall IS tends to be increasing in most of organizations for such reasons as the automation of internal processes, external expansions, and integration with other organizations (Benamati et al, 1997). Cost control is more critical than ever due to the heavy investment in IT for many organizations.

For example, for the booming IT outsourcing companies, it is often their responsibility to take charge of the entire life cycle of customer premise's current IS as well as future expansions. They are under the burden of making a profit, while managing the complex portfolio of a customer's IS. Cost control is critical for their success. But the difficulty lies in accurate cost projection and corresponding investment planning. Under the turbulent environment surrounding the technology, more realistic planning of IS cost management will benefit the parties involved by allowing them to meet the necessary budget requirements.

IT managers face various risks and uncertainties and are striving to overcome those difficulties (Benamati et al, 1997). Still unexpected costs occur (Lederer et al, 1990) due to such reasons as changing priorities, make or buy decisions, system malfunctions, or below-expectation performances. In other instances, managers do not have the knowhow to utilize their knowledge properly.

Previous studies on systems cost management mainly focus on software engineering (Banker et al, 1993, Boehm et al, 1998, Slaughter et al, 1998). These studies deal with the problem of improving software quality while reducing the cost. Though plausible methodologies for budget and quality control have been introduced, at least two areas of concern still exist. First, the studies basically aim at operational improvement rather than strategic concerns. Consequently, managers whose goal is to penetrate markets with low cost service have difficulty estimating realistic competitive service costs.

We intend to reduce the uncertainty by institutionalizing available information into a formal system. Managers' previous experience with regard to cost behavior will be optimally utilized. Existing cost estimation is no more than a monotonic projection of each cost factor throughout the system's life. We expect that our model will be able to take more dynamic and diverse situations into consideration space.

II. Dynamic Cost Control

Most of the IS cost management literature focuses on the software side. (for example, Banker et al, 1993) In practice, however, the costs of maintaining an entire IS entail more diverse factors than just software concerns. Hardware is one example. Smaller computers, broadly used in client/server or LAN, are being replaced every few years. And more attractive network choices with reduced prices and improved technology appear every other day. Occasionally, advances in technology spur changes in the software platform. Proliferation of Internet and Intranet use has induced broad application of new software platforms such as JAVA. As a result of the interdependence and interconnection between software and other technology components, software costs alone do not seem to represent as much of the system's total cost and complexity as before.

While some service providers focus on the costs of software maintenance, while treating hardware as any other depreciable fixed asset, there are others who prefer to trail costs according to the service types. These types may include server management, LAN service, WAN service, help desk, and DB service. Corresponding costing systems in general tend to be diverse and often complex. Our model is unique in that these hard-to-configure cost factors can be structured according to the company's convention and can still be considered representative of the likely behavior of the total cost.

Dynamic programming (DP) is used in our model. DP has broad applications when the problem consists of finding the optimal path from point A to point B in a given space. The space could either be temporal or spacial in most cases. In a time space application, there is a start time t_0. Period 1 is defined between t_0 and t_1. At time (stage) 1, there are multiple states given to the decision maker and the decision maker has to determine one of the states as the choice to be maintained during period (stage) 2 between time 1 and time 2. At time (stage) 2, t_2, the decision of selecting a new state has to be made for the following period, etc. until the end of the time space under consideration.

In our case, time space may be the system's life cycle. Each state is a combination of cost components that are being used by the company. One state may be composed of a certain amount of system development and system maintenance costs, new purchases and maintenance of hardware, network additions and maintenance, outsourcing costs, and others. The next state in the same stage may be different from the first due to the substituting of some hardware components with software. A third state may be an alternative composition of each component, etc. The composition of any number of systems that is feasible at each stage can be enumerated. Without using DP, such complex calculations as those we have to consider are not often possible due to the computational overload. Selected states constitute the investment path and corresponding total costs. If the objective is to minimize costs, the resulting path represents the lowest cost system management.

DP is a useful tool when multiple states of time sequential monetary flows through multiple periods need to be considered in order to find the optimal flow path, as observed in Kort (1994) where DP was adopted to solve financial problems. Since cost management has similar characteristics to such a study, our study would also benefit by using DP.

III. The Model

The current period is period 0. Each cost components combination is unique, which is the present situation. Cost components may vary in each company depending on each company's control and cost accounting structure. For the purposes of our model, we define hardware costs (C_h), software costs (C_s), labor costs (C_l), and overhead/other costs (C_o). A planning period of N is assumed for cost control purposes. The first planning period is period 1. Period N may or may not coincide with the life of software or hardware because the system has to be continuously operational. A certain part of each cost component may be maintained, improved, or replaced during planning period N. New systems may be added, too. Such changes have to be planned and executed throughout the planning period. We define that,

Each planning period = n, n = 1, 2, …, N.

We assume cost components of the system as,

$$C = \{C_h, C_s, C_l, C_o\},$$

though cost components may be defined differently for some companies. In general, there is more than one option that is capable of producing the level of service required. For example, in the case of two mainframe-based options and one client/server option for hardware, $\bullet C_h \bullet = 3$. There may be software options that correspond to each hardware option.

In order to attain the required service quality during planning period 1, the manager will consider all of the possible states during stage 1 (planning period 1). Each of the states is a combination of the cost components that produces the required service level. The option could be total outsourcing, too.

The maximum number of states at period n $= \bullet C_h \bullet * \bullet C_s \bullet * \bullet C_l \bullet * \bullet C_o \bullet$.

The state at period n-1 is represented by (n-1, i), i = 1, 2,…, I. Accordingly, the state during period n is (n, j), j = 1, 2, …, J. Transition from (n-1, i) to (n, j) implies two cost requirements. They are IS service costs during period n and transition costs to move to a new state j from the current state i. This latter cost may include hardware/software improvements, recruiting, or additional training.

We represent the stage costs between (n-1, i) and (n. j) as,

$$C(n,i,j) = F_{nij}(C_h, C_s, C_l, C_o),$$

where F( ) is the company specific cost function for operating the system state (n-1, i) toward (n, j),

n = 1, 2, …, N, i = 1,2, …, I j = 1, 2, …, J.

Expected accumulated costs until the beginning of period n is,

$$AC(n.j) = F_{nij}(C_h, C_s, C_l, C_o) + AC(n-1, i)$$

By the logic of DP, total cost, TC, would be

$$TC = AC(N,j).$$

Situation specific conditions and constructions should be added. For example, states (n-1, i) through (n-1, I) may represent higher quality systems than those represented by (n, 1) through (n, i-1) if the company is considering two service-level options at period n. Then the expected savings in company-wide expenses on increased revenue should be subtracted from C(n,i,j) through C(n,i,J). Costs will be discounted to reflect the effect of time. Some of the paths may not be allowed if it is practically infeasible.

VI. Usefulness of the Research

Managers face the complex task of estimating the budgets of the IS portfolio for the future. Estimating the overall cost, while the systems in the IT portfolio are in different stages in their life cycles, is a complicated task considering the internal and external uncertainties. Managers are not confident on their estimation of the IT budget in general.

As noted, our model is useful in that it allows managers to take any possible situation into consideration to observe the consequent cost effects. Another useful aspect of using the model is that it allows sensitivity analysis. By changing the variables in the cost function, future IT service demand, or capital cost, the likeliness of the resulting total cost can be observed. The risk level or stability of a project may be reevaluated after observing variances in the results. The desirable time to begin preparing for major modifications to the system may be determined. Y2K experiences might be useful by supplying necessary knowledge and data.

Managers would be able to translate company specific situations into the model for optimal use.

V. Current Status and Future Plan of the Research

We are in the process of preliminary testing with this model based on the actual data we have on hand. Replacement versus maintenance, fluctuation in IT service requirements, reduction of prices in some of the cost components, Y2K-like situations, and changes in capital costs or discount rates are some of the situations we intend to simulate. Since various cost accounting models are being tested at this time, detailed case examples could not be provided. We expect that further experiments of actual data would provide us with a better insight into the model's potential use, part of which may be presented in the Conference. We hope that when practically operationalized, our model would provide IT managers with a meaningful insight into the cost pattern and eventually, a realistic budget.

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