BUSINESS CASE STRUCTURE AND IT PROCUREMENT: USING DECISION THEORY TO EVALUATE INFORMATION SYSTEMS

Kevin J. Leonard, Faculty of Medicine, University of Toronto

ABSTRACT

Information Technology (IT) can be used to improve the efficiency and effectiveness of the delivery of healthcare. In this paper, we propose methodology to address the question: "do these types of benefits outweigh the costs over the life of a project?" Ultimately, it is our objective to develop a generalized healthcare business case model to evaluate IT cost effectiveness.

INTRODUCTION

Most strategic investment decisions incorporate a business case evaluation where all of the future benefits are weighed against current and future costs. The objective, of course, is to only invest in initiatives that have more benefits than costs. During the development of these types of Business Cases, the accurate evaluation of benefits and of costs is of utmost importance. Incorrectly calculating the costs or the timing of the benefits may lead to decisions that differ from optimal.

Business Cases for initiatives surrounding new technology or new information systems (IS) are no different. Although cost components of technology are usually straightforward, such as with the hardware, programming and the like, the benefits are extremely difficult to measure (Leonard, 1998). For instance, how do you put a price tag on the "ability of someone to do their job better"; or how do you calculate "people enjoying their jobs more and, consequently, are more effective"? As a result, many initiatives have begun with little knowledge of the magnitude of the benefits and, most importantly, the timing of their arrival. Many initiatives are defeated before they ever begin due to the fact that the expectations have not been managed and the time commitment has not been appreciated. What is needed is the ability to create standards of measures of performance such that the resulting benefits of increased efficiency and effectiveness can begin to be evaluated.

MEASURING THE COSTS

As stated, the costs associated with Information Systems can be listed fairly accurately. They include:

- Explicit supplier costs associated with hardware and software
- Service contracts with external suppliers
- Allocation of personnel salaries during design and development
- Travel costs (for both internal and external personnel)
- Implementation costs and pilot testing (i.e., overtime, perhaps running 2 systems in parallel)
- Long term management and maintenance costs – internally and externally
- Calculation of opportunity costs (including cost of capital).

Perhaps, the one cost that is most often overlooked is that of the opportunity cost. Money that is invested in long term projects – such as the development of information systems – are consequently not available to invest in other initiatives. These other "initiatives" have a potential inherent return on investment (ROI) associated with them. In order to estimate total true costs comprehensively, an estimate for ROI must be incorporated in the calculations.

MEASURING THE COST SAVINGS

The benefits from IT investment, for the most part, are harder to identify. Below we provide two broad categories. Within each of the categories, we provide examples. A complete listing is not possible as they will vary according to the specific organization or departments involved.

Reduction in personnel (i.e., downsizing)

This is clearly the most obvious benefit and the one that is often cited – sometimes to the exclusion of all others. As an example, the efficiency gains from the new system will require 3 less staff. These staff positions can be eliminated, each with an estimated annual cost (salary and personnel benefits) of, say, $50,000 each, then resulting in a cost savings of $150,000 per year. If the project is evaluated over a four-year timeframe (due to the amortization schedule associated with the project), the savings could be further refined based on the present value of the human resources (HR) savings over that time.

A second cost consideration related to personnel requires no reduction in staff. The benefits in this case can be seen with improvements in quality, response or performance. These are best described, however, in the second category.

Performance improvement

A second category of cost savings and benefits fall under the general heading of performance improvement. Unfortunately, the evaluation of performance improvement requires a measurement of current practices as well as future performance. The difference between these two observations represents the performance improvement (or decline). The measurement of current practices however necessitates the development of standards and measures. If performance standards do not exist, then comparisons across institutions or timeframes make no sense because the unit of measure may vary in calculation or in composition. Further one reason for this lack of standards and measures is poor information systems. Consequently, performance improvement due to improved IS/IT is a very difficult component to integrate into the calculation of benefits in Business Cases.

Listed below is a sample of the type of measures that could be used. Once again, inherent in the development of these standards is agreement on data capture and quantitative analysis.

- Reduction in time to get job done (i.e., cycle time)
- Increase in percentage of tasks with no errors (improvement of quality)
- Increase in staff satisfaction
- Increase in patient satisfaction
- Reduction in re-admissions
- Reduction in length of stay
- Reduction in adverse events
- Improvement in Balanced Scorecard performance.

As an example, consider the treatment of asthma cases in an emergency department (ER). Incorporated in this treatment is the multiple components of cycle time: time waiting before seeing a provider; time with physician or other provider; time doing the diagnostic tests; and treatment time (incorporating treatment both in the ER and the training required to perform follow-up treatment in the home). To be able to calculate such a benefit, one would need to establish the standard of time calculation, the method of data capture and the system by which current measures could be generated and compared to historic values (or other benchmarks). Finally, a method for assigning a dollar value to the improvement is also required if benefits are to be ultimately compared with costs.

Another perspective is to consider an overall change in performance regarding criteria within a Balanced Scorecard. The concept of the balanced scorecard pertains to the philosophy that an organization delivery healthcare should be effective across measures within many dimensions – i.e., financially, patient and staff satisfaction, mortality. Perhaps overall combined benefits should be based on a dollar value relationship derived from a Balanced Scorecard improvement or decline.

INFORMATION SYSTEMS ARE NEEDED TO ILLUSTRATE THE BENEFITS OF INFORMATION SYSTEMS

Inherent in the objective to fully define benefits emanating from IT adoption is the need to create information systems that can manage and measure these very same improvements. The best way out of this circular logic is to point to other similar projects and successful implementations. Unfortunately, there are too few success stories to point to - therefore, we are faced with the problem of quantifying the appropriate benefits from scratch.

The creation of standards

Benchmarking in healthcare (perhaps through the use of standard Balanced Scorecard components) is filled with difficulties because of the diverse data capture techniques and the various data coding options (Leonard, Tan and Pink, 1998). The need to build business cases and to justify IT expenses has been well documented (Pawola and Klineman, 1996). In a recent study (Leonard and Keller, 1998), when comparing performance internally across other Diagnostic Imaging (DI) departments or areas, or externally across other hospitals, it was quickly realized that few standards exist in performance measurement in this discipline. The ability to see a long term objective being realized (accurate performance measures) provided enough motivation for the DI user/managers in nine hospitals throughout Canada to begin work on key standardized performance indicators for DI departments. At present, however, we are far from readily measuring IT effectiveness gains and incorporating them into the listing of benefits within the Business Case structure due to a lack of data standardization.

DECISION ANALYSIS

The concept presented here is to apply the Decision Analysis process of evaluating information to the benefits component of the Business Case for IT procurement. Although Bayesian statistics and prior probabilities have been a routine component of Decision Theory for some time (see Winkler and Hays, 1975, among many others), applying Bayesian methodology to calculate the benefits within a Business Case structure is new.

In some detail, within Decision Analysis theory, one critical element is the calculation of the Value of Perfect and Sample Information through Bayesian statistics incorporating prior and posterior probabilities. For the Business Case, the objective is to estimate the value of having accurate and timely information. The objective here is to consider merging these two disciplines to demonstrate a novel approach to evaluating the Value of Information using Decision Theory and applying it to IT Business Cases. It is hoped that this type of cost-benefit analysis will then be applied in future IT (as well as other investment) cost effectiveness evaluations.

In order to incorporate Decision Analysis theory, we must be able to identify a distribution of outcomes that are quite possible from the IT adoption. For example, let us consider three measures and the corresponding realistic savings after sufficient time following IT implementation. These are:

- reduction in human resources salary by 10%
- reduction in ER waiting times by 5%
- reduction in DI costs (due to elimination of duplicate testing) by 20%.

These savings can only be calculated if we have the standards and benchmarks available on an industry wide level. In other words, it must be clear how the ER waiting times are calculated. Once agreed to, then the benchmark (baseline performance) must be identified so that the reduction of 5% can be acknowledged.

To recap, the initial step must be to identify possible outcomes emanating from IT adoption. This further requires the establishment of both standards measure and the benchmark levels for comparison. To complete the Business Case, one must now incorporate the Decision Analysis (i.e., Bayesian) by assigning probabilities to the likelihood of achieving certain levels. For instance, a 5% reduction in ER waiting times may have a probability of 0.25 whereas a 2% reduction may have a 0.5 chance of occurring. This can be approached in a number of ways – such as pilots, preliminary samples and questionnaires (Leonard and Keller, 1998). Incorporating probability and outcomes then becomes straightforward in a Decision Tree structure. Of course, the key to the calculation will be assigning the right dollar values associated with the different levels of improvement - i.e., is 5% reduction worth 3 times as much as a 2% or should the weighting be less?

DISCUSSION

A completed decision tree is not presented here. The goal of the paper is to propose a methodology. This methodology contains inherent assumptions. Although these assumptions can be debated, it is quite straightforward that the true IT benefits cannot be enumerated without a comprehensive information system. To date, the cost savings for IS are solely extended to human resource reduction. This paper, perhaps through constructive debate, will at the very least illuminate the thesis that all benefits that are derived from better information should be calculated as part of an IT procurement business case.

There are a number of other assumptions and parameters concerning this project that should be highlighted.

- The distribution of the cost savings will be, at best, an approximation. There is no way to identify the potential outcomes with certainty.
- The time frame of any Business Case has not addressed with discussion focusing on financial savings estimated over a one year period. It is quite possible that savings could continue over a second fiscal year and beyond.
- The probability distributions are also estimates based on Bayesian prior probabilities. Much of the accuracy of calculations will depend on how close these estimates reflect reality.

In conclusion, the most important point in this paper is the application of Decision Analysis theory to the Business Case approach for new technology and/or information systems. It must be stressed that, as in any DA problem, access to, or knowledge of, approximate outcomes is critical for the calculations and subsequent analysis to be meaningful.

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