Cost benefits analysis in the design and evaluation of information systems

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INTRODUCTION

In June of 1969, a report¹ was prepared for the Federal Hospital Council by the staff of the Health Care Technology Program of the National Center for Health Services Research and Development. The report entitled Summary Report on Hospital Information Systems, has as primary objectives—“to give a broad view of the components of automated information systems, to briefly evaluate the cost and effectiveness of such systems, and to estimate their future importance.”

In meeting the first and last objectives, the report is quite good and should be read by all who are interested in the field. It is in the areas of cost and effectiveness that the report is weak. This in no way should be considered a reflection upon the authors, who fully recognize the paucity of data in these matters. In fact, the authors wisely address, first the moneys being spent on hospital information systems, and then independently, their general performance and acceptance. Indeed, among the quite excellently thought out conclusions is the following:

"The discrepancy which exists between the apparent success and enthusiasm for the use of the computer (sic) in the business and chemistry applications as opposed to the patient management areas suggest that the need for and utility of the computer were more easily recognized, which resulted in a high degree of motivation to see these projects through to a successful operational stage. It might then be assumed that the lack of success in other areas has been a result of an inability on the part of our hospitals to precisely define either the need or practical utility that the computer can serve in other patient management areas. We would be willing to speculate that until such time as other medical services, independent of external pressures, are capable of first recognizing and then demanding more efficient utilization of their time and services, attempts to automate these activities will continue to fail.”

It is the author’s judgment that, concomitant with the increased recognition and demand of other medical specialties for computer applications is the need for reliable and acceptable methods of assessing the practicality and effectiveness of those applications. The paper attempts to address such methods of assessment. Specifically, we will discuss absolute cost effectiveness—the measure of worth of applying technology to the enhanced transfer and processing of information. The segments of technology include analysis, design, implementation, operation and maintenance. These are measured in the utilization of available resources employed to each technology segment—people, equipment, material and facilities.

The paper will not address relative cost effectiveness—the optimization of resource selection. For such discussions, the reader is referred to a paper² on the subject published by the author. In what follows, a case will be presented for the establishment of absolute cost effectiveness parameters during the planning and design of a hospital information system.

THE ANALYSIS OF COST EFFECTIVENESS IN DESIGN

The steps in cost effectiveness analyses take the following general sequence:

- Selection of Domains of Analysis
- Analysis of “Current” Operations
- Determination of Absolute Cost Effectiveness
- Relative Cost Effectiveness
- Refinement of Absolute Cost Effectiveness

Note the relative cost effectiveness (optimization of
valid areas of measurement the domain of analysis. The criteria for selecting valid areas for current (manual, automated, or modeled) and new (improved manual or automated) information handling applications are as follows:

First, each application must have a common, definable entry and output. Second, the designed change must have some implication to benefits. Third, the application in the current system must have a functional equivalence relationship to the new system.

Some examples may be in order:

Application: Laboratory Order to the Lab
Criterion 1—Order entered at ward 1, order output at Lab
Criterion 2—Faster turnaround time, reduce transcription, error.
Criterion 3—The current system requires the physician to write the order, the nurse to transcribe it, the ward clerk to send it through the tube, the secretary to log it, separate it, and send it to the proper department(s).

The new system may require the physician to enter the order directly into a device. The nurse and the proper laboratory department(s) receive it via output devices. But the function was equivalent. This would identify a valid area for our domain of analysis.

**Domain of analysis**

In order to attain a valid measure of worth, it is essential to compare old apples to new apples or manual oranges to automated oranges. We call the sum of all

<table>
<thead>
<tr>
<th>PROCESS</th>
<th>ADMISSION CLERK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reservations</td>
<td>3</td>
</tr>
<tr>
<td>Bed Availability Check</td>
<td>.33</td>
</tr>
<tr>
<td>Nursing Unit Check</td>
<td>.33</td>
</tr>
<tr>
<td>Bed Control Card</td>
<td>.33</td>
</tr>
<tr>
<td>Type Daily Admissions List</td>
<td>.5</td>
</tr>
<tr>
<td>Type Transfer List</td>
<td>.15</td>
</tr>
<tr>
<td>Notify Surgery and Nursing Units of Room Change</td>
<td>.15</td>
</tr>
<tr>
<td>Check Discharges, Pull and Mark for Information Desk</td>
<td>1</td>
</tr>
<tr>
<td>Emergency Admissions</td>
<td>.25</td>
</tr>
<tr>
<td>Assign Bed and Notify Units</td>
<td>1</td>
</tr>
<tr>
<td>Prepare Pre-Admit Form</td>
<td>.5</td>
</tr>
<tr>
<td>Handle Patient Transfer Requests</td>
<td>1</td>
</tr>
<tr>
<td>Call for Pre-Admit Information</td>
<td>10</td>
</tr>
<tr>
<td>Search for Pre-Admit Information</td>
<td>5</td>
</tr>
<tr>
<td>Type Admission Form</td>
<td>10</td>
</tr>
<tr>
<td>TOTALS</td>
<td>33.55</td>
</tr>
</tbody>
</table>

| NUMBER OF PERSONNEL | 4 |

**Figure 2**—Result of cost analysis, current costs admissions and reservations information handling, current system in hours per day

**ADMITTING CLERK**

<table>
<thead>
<tr>
<th>PROCESS</th>
<th>1974</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reservations</td>
<td>1</td>
</tr>
<tr>
<td>Bed Check</td>
<td>.1</td>
</tr>
<tr>
<td>Nursing Unit Check</td>
<td>0</td>
</tr>
<tr>
<td>Bed Control Card</td>
<td>0</td>
</tr>
<tr>
<td>Type Daily Admission List</td>
<td>0</td>
</tr>
<tr>
<td>Transfer List</td>
<td>0</td>
</tr>
<tr>
<td>Notify of Room Change</td>
<td>0</td>
</tr>
<tr>
<td>Check Discharges for Information</td>
<td>0</td>
</tr>
<tr>
<td>Emergency Admissions</td>
<td>.1</td>
</tr>
<tr>
<td>Assign Bed</td>
<td>.33</td>
</tr>
<tr>
<td>Prepare Pre-Admit Form</td>
<td>.5</td>
</tr>
<tr>
<td>Handle Patient Transfer Requests</td>
<td>.5</td>
</tr>
<tr>
<td>Call for Pre-Admit Information</td>
<td>5</td>
</tr>
<tr>
<td>Search for Pre-Admit Information</td>
<td>.5</td>
</tr>
<tr>
<td>Enter Admission Data</td>
<td>10</td>
</tr>
<tr>
<td>Set Up Admit Package</td>
<td>3</td>
</tr>
<tr>
<td>Notify of Patient Arrival</td>
<td>.33</td>
</tr>
<tr>
<td>Indicate if Admit Lab.</td>
<td>.33</td>
</tr>
<tr>
<td>TOTAL</td>
<td>21.69</td>
</tr>
</tbody>
</table>

| NUMBER OF PEOPLE | 3 |

**Figure 3**—Result of cost analysis—New system, admissions and patient logistics information system, requirements in hours per day
Figure 1 lists the major functional areas in a teaching hospital where significant numbers of such areas of analysis have been found.

Cost analysis—Quantitative benefits

Hard savings

For each area in our domain of analysis, a cost analysis is performed. The sequence is as follows:

- Selection of Applicable Procedures
- Determination of “Current” Resource Requirements
- Statement of Growth Assumptions
- Extrapolation of Resource Requirements to Operational Era
- Determination of “System” Resource Requirements
- Comparison of Extrapolated “Current” to “System”

Each procedure in the area is defined together with the current required resources to accomplish the procedure over an operational duration (minute, hour, shift, day, week, month). An extrapolation of required hospital resources is then determined for the same operational time frame as the new system (2 years hence, 5 years hence, etc.).

The new information system design will point to a different set of resources to accomplish the tasks. During this phase of the analysis, no attempt is made to include development and operational costs for the information system; only those differences in carrying out the tasks in the domain are compared.

The cost entities included in these analyses are personnel salaries, overhead and fringe benefits; disposable material such as forms or cards; equipment capital costs, rentals, and maintenance; facilities requirements for offices, storage, equipment, etc. These cost entities must be established for both the extrapolated “current” operations as well as the “system” operations.

Figures 2, 3 and 4 demonstrate the results of such an analysis for admitting clerks.

Figure 2 demonstrates the procedures identified for analysis and the present and extrapolated labor.

Figure 3 demonstrates the same procedures but with the labor resources required in the new system.

Figure 4 compares the two and summarizes the potential hard savings.

We use the term “hard” to describe cost savings which can be taken to the bank—reduction in personnel, material, equipment. In Figure 5, the column labeled “Reduction Assumed” (R) includes all such savings in costs per full operational month.

Partial time savings

The most common source of error found in reviewing cost effectiveness analyses, has been in the quantification of part-time labor savings. It is tempting to sum all the minutes and hours of partial time saved and to include the total in the quantitative benefits. The error

<table>
<thead>
<tr>
<th>Area</th>
<th>Total Information Processing</th>
<th>Total Potential Savings</th>
<th>Reductions (R)</th>
<th>Partial Assumed Time</th>
<th>Partial Saved (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Office</td>
<td>$20,050</td>
<td>$11,785</td>
<td>$8,300</td>
<td>$3,455</td>
<td></td>
</tr>
<tr>
<td>Admitting</td>
<td>3,650</td>
<td>2,000</td>
<td>1,310</td>
<td>660</td>
<td></td>
</tr>
<tr>
<td>Pharmacy</td>
<td>8,110</td>
<td>5,900</td>
<td>5,500</td>
<td>460</td>
<td></td>
</tr>
<tr>
<td>Laboratory</td>
<td>25,142</td>
<td>12,315</td>
<td>9,700</td>
<td>2,615</td>
<td></td>
</tr>
<tr>
<td>Nursing Units</td>
<td>127,400</td>
<td>85,400</td>
<td>15,000</td>
<td>70,400</td>
<td></td>
</tr>
<tr>
<td>Surgery</td>
<td>2,990</td>
<td>1,500</td>
<td>1,250</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>Radiology</td>
<td>3,342</td>
<td>1,928</td>
<td>1,040</td>
<td>888</td>
<td></td>
</tr>
<tr>
<td>Dietary</td>
<td>2,150</td>
<td>1,575</td>
<td>1,200</td>
<td>375</td>
<td></td>
</tr>
</tbody>
</table>

TOTALS $192,834 $122,463 $43,300 $79,163

Figure 5—Summary of cost analyses for selected major hospital entities, full operating system dollars per month
in doing this is that it implies perfect management—certainly an ideal but never a reality. For it would mean that all of the partial times could be used fully in performing other functions resulting in equivalent benefits. We have found that an administrative efficiency factor should be used to weight such potential benefits properly.

Figure 5 shows the relationship among four quantifiable factors for major areas of a 400 bed hospital.

“Total Information Processing” are those labor dollars spent in the current system within the domains of analysis.

“Total Potential Savings” are all the hours of labor dollars saved by the new system.

“Reductions Assumed” are the savings which we have called quantitative benefits (R).

“Potential Time Saved (P)” are the partial hours of labor dollar savings.

It is the last figure (P) which we will penalize by assigning a 33 1/3 percent Administrative Efficiency Factor. In other words, for every hour of partial time saved, 20 minutes are utilized effectively. Note from the figure that the greatest P exists at the Nursing Units.

Intangible benefits

Perhaps the most difficult role of the analyst is the assignment of values to benefits which are not explicitly measured in terms of identifiable resources. One can simplify the problem monumentally by dividing such benefits into two general types:

- Plausible Quantitative Measures—These can be associated with a product of the information flow which is in itself measurable. Examples of these are benefits which can be measured as factors of revenues or costs (improved bed utilization resulting from more timely and effective bed reservation and surgery scheduling systems).
- Judgmental Criteria—These are the most difficult to measure and are used as supportive (or deciding) arguments when all measurable data have produced a borderline or negative cost effectiveness picture. Examples include enhanced care of high risk patients, availability of processing power for research support, etc.

Several examples of assigning quantitative values to intangible benefits are described below

(1) If increased administrative effectiveness can be measured as a percentage of management time, that factor of administrative payroll can be taken as a benefit.

(2) Increased bed utilization enhances the effectiveness of patient management. The resulting higher census and better scheduling can be measured as an increase in hospital revenues.

(3) The transition to, and the operating environment of, a new system can profoundly effect the rate of personnel turnover. The increase or decrease of such turnover can be measured in terms of personnel acquisition costs.

As implied in the last example, such measurements can produce negative results. The Quantitative Benefit (Q) is the sum of these measurements \( \sum EiXi \) and is given one-sixth the weight of the hard benefits.

An equation for cost effectiveness \( E/C \)

The analytic expression

\[
E/C = \int_0^L \frac{B(t) dt}{C(t)}
\]

where \( B(t) \) are the accrual of benefits, \( C(t) \) are the accrual of costs, and \( L \) is the life of the system including development and implementation.

The author has used two approximations to this equation in performing cost effectiveness analyses.

Approximation #1

\[
E/C = (C_{av})^{-1} \int_0^L B(t) dt
\]

\[
= (C_{av})^{-1} \sum L B(t) \approx \frac{\sum p (B_{max})}{L C_{av}}
\]

where

\[
B_{max} = R_{max} + \frac{P_{max}}{3} + \frac{Q_{max}}{6}
\]

The benefits and costs per month accrue over the years of development, implementation, and operation. Using \( B_{max} \) as the fully accrued monthly benefits and \( C_{av} \) as the average monthly system costs over \( L \) years, one can approximate the integral such that

\[
E/C = \frac{\sum p (B_{max})}{L C_{av}} \quad \text{where} \quad \sum p
\]
equals the percentages per year of benefits accrued.
In the example which follows, we have used an $L$ of 7 years and a $\sum p$ of 4.5 (made up of .1, .2, .4, .8, 1, 1, 1).

If

$$E/C + \frac{\sum p(B_{\text{max}})}{L(C_{\text{av}})}$$  \hspace{1cm} (5)$$

is greater than 1, the system is judged as cost effective. Examining the end points of this equation is an interesting exercise. Should there be no partial time saved ($P$) or qualitative benefits ($Q$), then the hard benefits ($R$) must exceed the total cost of the new system ($C_{\text{av}}$) over the system lifetime span. $C_{\text{av}}$ includes all the costs of all the resources as indicated under Hard Savings in the discussion of Cost Analysis—Quantitative Benefits. Now let us assume no hard benefits and no qualitative benefits. Then the total partial labor saved would have to exceed three times the $C_{\text{av}}$. In our example from Figure 5, $P$ equaled approximately $80,000. The average monthly cost of the major system was $40,000. Without the other two factors exceeding $35,510, the system would not have been judged as cost effective since—

$$3C_{\text{av}} = 120,000$$  
$$P = 80,000$$

$$\frac{4.5(80,000)}{7(120,000)} = \frac{9}{21} = .429$$

$$\frac{4.5(R + Q/6)}{7(40,000)} > .571$$

$$R + Q/6 > 35,510$$

Then $E/C > 1$

Although unlikely, the other extreme case would mean there were only qualitative benefits. Using the same example, $Q$ would have to exceed $360,000 if $R$ and $P$ were zero, in order for $E/C$ to be greater than 1.

The actual example turned out the following results:

$$E/C = \frac{4.5}{7(40,000)} \left( 43,000 + \frac{80,000}{3} + \frac{185,000}{6} \right)$$

$$= \frac{4.5}{280,000} (108,000)$$

$$= 485,000$$

$$= 280,000$$

$$= 1.73$$

The following table indicates the cost effectiveness values for our example under varying extremes:

<table>
<thead>
<tr>
<th>$R$</th>
<th>$E/C$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.04</td>
</tr>
<tr>
<td>0, $P$ = 0</td>
<td>0.64</td>
</tr>
<tr>
<td>0, $Q$ = 0</td>
<td>0.43</td>
</tr>
<tr>
<td>$P$ = 0</td>
<td>1.3</td>
</tr>
<tr>
<td>0, $Q$ = 0</td>
<td>0.69</td>
</tr>
<tr>
<td>$Q$ = 0</td>
<td>1.12</td>
</tr>
</tbody>
</table>

These figures indicate that for our example, cost effectiveness could not be achieved by considering one benefit category only and cost effectiveness could be achieved considering any two benefit categories. Approximation #1 was found to be most useful in determining cost effectiveness of integrated hospital information systems.

**Approximation #2**

$$E/C_L = \frac{R_L}{C_L} + \frac{P_L}{C_L} + \sum_{L}^{L} \frac{p(Q_{\text{max}})}{LC_L}$$  \hspace{1cm} (6)$$

where $R_L$ and $P_L$ are the cumulative benefits up to time $L$, $C_L$ are the cumulative costs up to time $L$, $Q_{\text{max}}$ are the full qualitative benefits being derived at time $L$, $E/C_L$ is the cumulative cost effectiveness calculated at time $L$, and $L$ is an integer year of system life such that $0 < L \leq L_{\text{max}}$.

**Factors of Approximation #2**

(a) $R_L/C_L$

This is the cost factor; if $R_L$ is greater than $C_L$, the system actually saves money. If the quality of performance is about the same, a system with $R_L$ greater than $C_L(R_L/C_L > 1)$ would be cost effective.

(b) $P_L/(3C_L) + \sum_{L}^{L} \frac{p(Q)}{LC_L(\text{6})}$

This is the quality factor; if it is greater than zero, quality of performance will increase; if it is greater than one, the system is cost effective even if there are no cost savings.

**Example Using Approximation #2**

For $R_L$, $P_L$ and $C_L$ we have used real data from an actual analysis of a clinical laboratory system.
For $\sum p$ we used the following:

First year, $p_1 = .132 \quad \sum p = .132$
Second year, $p_2 = .4 \quad \sum p = .532$
Third year, $p_3 = .875 \quad \sum p = 1.407$
Fourth year, $p_4 = 1 \quad \sum p = 2.407$
Fifth year, $p_5 = 1 \quad \sum p = 3.407$
Sixth year, $p_6 = 1 \quad \sum p = 4.407$
Seventh year, $p_7 = 1 \quad \sum p = 5.407$
Eighth year, $p_8 = 1 \quad \sum p = 6.407$
Ninth year, $p_9 = 1 \quad \sum p = 7.407$

for $L$ we have used 1 through 9
for $Q$ we have used the following:

1971 Management Payroll $= 500,000$
Management Effectiveness Increase .2
$Q_1 = .2(500,000) = 100,000$
1971 Non-Professional Payroll $= 2,020,000$
Operational Effectiveness Increase .09 (accuracy, duplications, etc.)
$Q_2 = .09(2,020,000) = 182,000$

We have extrapolated $Q$ according to the anticipated growth of payroll.

\[
\begin{align*}
E/C_1 &= \frac{10}{100.3} + \frac{26.8}{3(100.3)} + \frac{.132}{100.3} \quad (280) \\
&= .1 + .09 + .06 \\
&= .25 \\
E/C_2 &= \frac{54.8}{243.1} + \frac{139.6}{3(243.1)} + \frac{.532}{2(243.1)} \quad (590) \\
&= .23 + .19 + 1 \\
&= .52 \\
E/C_3 &= \frac{147}{406.6} + \frac{294.8}{3(406.6)} + \frac{1.407}{3(406.6)} \quad (925) \\
&= .32 + .24 + .17 \\
&= .73
\end{align*}
\]

Figure 6—E/C years 1–3

Cost effectiveness calculations

Figures 6 and 7 show the cost effectiveness of the system for the first three years of operation. According to our definition, if the system had a life span of 3 years, it would not be considered cost effective.

In the fourth year, there is marginal cost effectiveness. For life spans of 5 through 8 years, the cost effectiveness is good. In the ninth year it becomes excellent.

Analysis of the factors

Figure 8 summarizes the factor values which make up the total cost effectiveness.

The $R$ factor, the cost savings, becomes marginally cost effective in 1978 and good in 1979.

This says that the system actually pays for itself in real dollar tradeoffs starting with a life span of eight years.

The $P$ and $Q$ factor, the qualitative benefits, do not become cost effective through the nine-year life span. This says that there must be cost savings for the system to be cost effective.

\[
\begin{align*}
E/C_4 &= \frac{315}{556.1} + \frac{432}{3(556.1)} + \frac{2.407}{4(556.1)} \quad (1275) \\
&= .56 + .26 + .23 \\
&= 1.05 \\
E/C_5 &= \frac{441}{695.3} + \frac{566}{3(695.3)} + \frac{3.407}{5(695.3)} \quad (1630) \\
&= .65 + .27 + .27 \\
&= 1.19 \\
E/C_6 &= \frac{622}{857.4} + \frac{712}{3(857.4)} + \frac{4.407}{6(857.4)} \quad (1805) \\
&= .72 + .28 + .25 \\
&= 1.25 \\
E/C_7 &= \frac{799}{901.1} + \frac{862}{3(901.1)} + \frac{5.407}{7(901.1)} \quad (2190) \\
&= .89 + .32 + .29 \\
&= 1.5 \\
E/C_8 &= \frac{982}{939.1} + \frac{1017}{3(939.1)} + \frac{6.407}{8(939.1)} \quad (2580) \\
&= 1.04 + .36 + .37 \\
&= 1.77 \\
E/C_9 &= \frac{1160}{962.1} + \frac{1177}{3(962.1)} + \frac{7.407}{9(962.1)} \quad (2980) \\
&= 1.21 + .41 + .42 \\
&= 2.04
\end{align*}
\]

Figure 7—E/C years 4–9
The $E/C$ column adds the two factors for the resultant cost effectiveness.

Approximation #2 has been found to be most useful when the system life is not certain or when the accrual of benefits are known with more certainty as for a specific hospital area.

The application of judgmental criteria

Candidly, the relationship between the Cost Effectiveness equation and the Judgmental Criteria depends very much on the particular institution. In one case, the equation will or will not lend support to a hospital management and staff already convinced of the desirability of an automated information system and its potential to patient care and hospital efficiency.

On the other hand, such judgmental aspects could tip the scales in either direction when $E/C$ approximates 1.

In any case, the cost effectiveness analysis provides the data and the insight for optimal decision making.

EVALUATION OF SYSTEM $E/C$

It is one thing to a priori design a cost effective system; it is another matter to determine the validity of the design by an evaluation of cost effectiveness after the system has become operational. In the main body of this paper, the author has attempted to present a case for the establishment of $E/C$ parameters during the design. One of the arguments is to optimize the design. Another is to provide management with decision making tools. The third argument relates to evaluation. Without the data gathering pursuits of the design phase, the evaluation would have little with which to compare since the former “current” operation would have vanished.

The first step in the evaluation is the updating of the domain of analysis. In the great majority of the cases this is actually an expansion. Since the design phase, new applications will have emerged through improved technology or continued enlightenment of hospital personnel as to the potential benefits of the system.

The determination of system cost effectiveness starts with establishing the criteria for evaluation. They include the benefits expected from the design as well as unpredicted benefits or negative influences.

The other major criterion is the actual system cost. The determination of system cost will be a matter of record. The hospital can establish separate cost codes for all information system equipment, personnel, facilities, material, etc.

The determination of benefits will require the same kind of analysis performed during the design study on the current system. Measurement parameters will include:

- Personnel Time—the effort required to perform the activity.
- Classification of Personnel—the task may be performed by different classifications than previously.
- Transit and Cycle Times—most related to the qualitative measurements.
- Stagnation Points—the new system can have its own bottlenecks.
- Patient Status Factors—average stay, census, etc.
- Resource Allocations—reductions or increases in personnel, equipment, material, etc.
- Qualitative Assessments—selective survey.

Essential to the evaluation is the data collection methodology and the resources utilized for data gathering.

The control data for “current” operations and their domain equivalents for “system” operations should be gathered by the regular hospital staff. The new system will impose a set of unique man-to-man and man-to-machine interactions which will require trained observers. Both the “current” and “system” operations will require test and simulation models where data describing the effect of perturbations and contingencies can be examined. Finally, acceptance and comfort of the new system will require opinion and judgmental data collections from patients, practitioners, etc.

The steps in the evaluation are exactly the same as outlined for the Absolute Cost Effectiveness.

- Cost analysis of operational system.
- Compare with current (extrapolated) system from design study—results in $R$ and $P$.
- Determine qualitative benefits—$Q$. 
• Determine actual costs to develop, operate and maintain the system C<sub>a</sub>.

• Select the best approximation and calculate E/C.

• Acquire judgmental assessments.

SUMMARY

The absolute cost effectiveness analyses described in this paper result in a set of decision enhancing estimates regarding the worth of developing an information system. Implied in these data are the following criteria:

(a) Experience in hospital operations.
(b) Cognizance of current and anticipated information systems with hospital applicability.
(c) An information system design philosophy and plan with associated cost estimates.
(d) An existing library of departmental data.

Depending on the extent to which the criteria are met, an absolute cost effectiveness analysis and information plan can be performed in 2 to 4 months. In essence, the analysis provides balance sheets. It enables hospital management to attain a firmer understanding of the potential implications of the technology to the institution. It allows decision makers at every level a better picture of available design alternatives. And finally, it can provide the data to analyze the impact of the system during actual operation. In short, if used properly, cost effectiveness analysis can help take us out of the “pin the tail on the donkey” era of hospital information system design and implementation and provide the means for judging the impact of the system when in full operation.

REFERENCES

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2 I LEARMAN
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