

Enterprise information analysis studies have highlighted a gradual change in the data and information processing environment—a change in systems design and implementation from stand-alone, application-oriented systems, supporting primarily the operational and functional management levels, to data-base-oriented, data-managed systems, supporting the total organization. This shift has made many of the “traditional” financial analysis techniques used to justify a proposed system inadequate. Although a management study team that is developing an information systems proposal can choose from a variety of enterprise information analysis methodologies to assist them in the analysis of information needs, no such choice of associated (and generally accepted) disciplines or methodologies exists to support the financial justification of what has been proposed in the study team report. This paper explores the problems associated with moving from a “traditional” (data processing) financial justification of a system that is based largely on measurable costs and benefits to a financial justification of a system based largely on an assessment of intangible costs and benefits, technological change, and risk and uncertainty. A taxonomy is provided which can be used to supplement the value analysis found in the Business Systems Planning methodology. Extensive references are included as a guide to supplementary reading.

Enterprise information analysis: Cost-benefit analysis and the data-managed system

by M. M. Parker

In order to survive in today's rapidly changing business environment, an enterprise must be able to evaluate change and react quickly to it. The objective of enterprise information analysis is to provide a way to meet executive management's need for information about the overall performance of the enterprise to be used in support of the planning and control functions.

In the past, enterprise models and economic environment models have been used with some degree of success to answer “what if” questions in support of strategic planning. However, their use has been limited, primarily because of the substantial development cost

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and the difficulties not only in establishing the data relationships but also in interpreting the output of the model.¹ A more common approach has been that of simply choosing subenterprise or application areas to study and then attempting to integrate these various studies into overall strategic and operating plans. This approach was successful if the application area was basically self-contained but was not at all successful when the area was subject to a variety of external influences over which minimal control could be exercised. These external influences ranged, in the case of subenterprises, from operating restrictions placed on the subenterprise by the parent company to governmental regulations regarding product marketing. In a similar manner, because these studies used a "bottom-up" approach, conflicting requirements for the same data created problems during the integration of application studies and implementations.

In an attempt to categorize and resolve the areas of conflict and to avoid duplication of effort, the study definition gradually expanded from application sets, in which department (organization) lines were ignored, to the enterprise itself. These techniques are being increasingly applied to the analysis of information requirements of the enterprise. A recognition of the definition, management, and control of information and its flow as a critical factor in the degree of success of an enterprise has led to the codification of "top-down" study techniques for enterprise information analysis.

Business Systems Planning (BSP) and Business Information Control Study (BICS) are two methodologies that have been developed for use in enterprise information analysis. Both are "top-down" enterprise study methodologies that attempt to describe a business at its highest level in terms of information or data requirements. BSP is a methodology to assist an organizational entity in developing and establishing an information architecture through use of "business processes" and "data classes" that will satisfy its near and long-term informational needs. A management study team conducts interviews, analyzes the information gathered, and prepares a written report to management. The report, ideally, is not only used as input to both strategic and tactical planning, but is also used during the turn-over phase from planning to implementation. The BSP study generally lasts two to three months. In contrast, BICS employs an analysis technique that uses a series of predetermined questions to bound the informational needs of the organization. It, too, uses a management study team, but the duration is significantly shorter primarily because the BICS discipline provides the study team with a generic data model of the business which the team then verifies, whereas BSP discipline builds an enterprise-specific model through the discovery process. Like BSP, the BICS report can be used as information for the strategic planning process, or the study itself can be the result of a strategic plan. (Further details on BICS and BSP are included in the paper by Zachman,² which appears in this issue.)

Completed enterprise information analysis studies have highlighted a gradual change in the data and information processing environment—a change in systems design and implementation from single, stand-alone, application-oriented systems, supporting a specific management level, to data-managed systems, supporting the organization as an entity. This shift has made many of the “traditional” financial analysis techniques used to justify a proposed system inadequate because of changes in the support of management levels and in the characteristics of the system after it has been implemented.

Although the study team can choose from a variety of enterprise information analysis methodologies to assist them in analyzing information needs as they develop the information systems proposal, no such choice of associated (and generally accepted) disciplines or methodologies exists to support the financial justification of what has been proposed in the study team report. In this paper, we explore the problems associated with moving from a “traditional” (data processing) financial justification of a system, supporting operational and functional management and based largely on measurable costs and benefits, to a “nontraditional” financial justification of a system that (potentially) supports all levels of management and whose justification is based largely on an assessment of intangible costs and benefits, technological change, and risk and uncertainty. Also, we discuss the proposal for a skeletal taxonomy which can be used to provide an initial assessment to supplement the value analysis included in the Business Systems Planning methodology.

Cost-benefit analysis considerations

Cost-benefit analysis is defined by Prest and Turvey³ as “. . . a set of questions, the answers to which constitute the general principles of cost-benefit analysis:

1. Which costs and which benefits are to be included?
2. How are they to be valued?
3. At what rate are they to be discounted?
4. What are the relevant constraints?”

Cost-benefit attributes

A “cost” or “benefit” is defined as a measurement of the amount of resources required to procure a “product.” Costs are normally expressed in terms of quantitative dollars required, whereas benefits take the qualitative form of cost-saving, cost-avoidance, and intangibles. Cost-saving and cost-avoidance examples of benefits are obvious and can be assigned a monetary value with relatively little effort. They represent the types of benefits traditionally included in cost-benefit analyses for data processing stand-alone systems. It is

the less obvious, or "intangible," benefit that is the most elusive to the analyst in defining and determining a value and in obtaining agreement that the value assigned does, in fact, represent the benefit. Intangible benefits in business computing include such items as improved utilization of assets and improved information, which, when applied, would "help most in planning and decision-making by reducing mistakes and increasing the reliability of estimates."⁴ The former has some quantitative element of measurability, but the value of the latter would be very difficult to assess. The importance of this latter type of "intangible" benefit has grown with the justification of data-managed systems and their increasing sphere of influence within the enterprise, encompassing all levels of management.

Ginzberg⁵ has proposed the following taxonomy into which information systems benefits can be grouped: mandatory information needs, information processing efficiency, improved asset utilization and resource control, improved organizational planning, increased organizational flexibility, promotion of organizational learning and understanding, increased accuracy in clerical operations, information available on a more timely basis, and availability of new or better or more information. Ginzberg's taxonomy can be further expanded by the addition of three benefit types that were identified by Naylor and Schauland⁶ in published survey results of corporate planning model users. These benefit types are the ability to investigate an increased number of alternatives, a higher-quality and better-informed decision-making process, and faster decision-making (Figure 1). Although each of the criteria set forth by Ginzberg, and by Naylor and Schauland, seems to form a natural structure for assessing benefits for a data-managed system, the problem is that they all fall into the "intangible" category of benefits and are among the most difficult to assign a monetary value that will be universally acceptable. These elements should not be considered a comprehensive list, but the taxonomy can be used to trigger thinking about benefits that might not have been previously considered and/or included in a value analysis.

Problems associated with cost-benefit analysis

Many factors require consideration by the study team prior to the undertaking of a cost-benefit analysis in support of a proposed system, but there are six which, if ignored, could seriously affect not only the credibility, but the validity of the study. They are (1) present value, (2) technological forecasts, (3) discount rates, (4) intangible costs and benefits, (5) risk and uncertainty, and (6) application to computer-based systems.

1. The use of net present value, which is implicit in the cost-benefit analysis technique, is based upon the assumption that all of the costs and benefits are measurable in a monetary sense. Development of monetary benefits associated with information used in

Figure 1 Taxonomy for intangible benefits

MANDATORY INFORMATION NEEDS
 INFORMATION PROCESSING EFFICIENCY
 IMPROVED ASSET UTILIZATION
 IMPROVED RESOURCE CONTROL
 IMPROVED ORGANIZATIONAL PLANNING
 INCREASED ORGANIZATIONAL FLEXIBILITY
 PROMOTION OF ORGANIZATIONAL LEARNING
 AND UNDERSTANDING
 INCREASED ACCURACY IN CLERICAL
 OPERATIONS
 MORE TIMELY INFORMATION AVAILABLE
 AVAILABILITY OF NEW/BETTER/MORE
 INFORMATION
 ABILITY TO INVESTIGATE INCREASED NUMBER
 OF ALTERNATIVES
 BETTER QUALITY AND MORE INFORMED
 DECISION-MAKING PROCESS
 FASTER DECISION-MAKING

present
value

the decision-making process is quite difficult, but, based on the above assumption, must be attempted.

**technological
forecasts**

2. In most industries, some level of technological forecasting will be included in the cost-benefit analysis. Since the analysis primarily supports strategic planning, which is by definition long-range, technological change will almost surely occur. Writers on the subject hold mixed opinions about forecasting changes in technology as part of cost-benefit analysis. Although the majority of writers feel that this subject must be addressed in any analysis, Wolfe⁷ holds an opposing view, concluding that "... it is not clear whether it would be wise for cost-benefit analysis, in this early stage of its acceptance, to take upon itself the further difficulty of dealing with the imponderables of technological forecasting." He continues, "... the problem here is not so much the conceptualization of differing valuations as the development of reasonably unambiguous methods for eliciting the various values involved."

**discount
rates**

3. In much of the current literature, the formulation of the cost-benefit analysis is done through the maximization of the total present value benefits minus all costs subject to all specified constraints. But the value of money, whether applied to costs or to benefits, changes over time. Dewhurst⁸ writes that to do a correct analysis, there is a need to compare "... the worth of monies paid out for the investment to those (monetary) benefits from either profits or savings as a result of the investment."

Costs and benefits of a project do not usually occur within the same time frame. They occur unevenly over time, and to use the same monetary base (value of money) to compare one to the other can be misleading and may cast doubt upon the result of every facet of the analysis. The cost of money over varying time frames can be accommodated by a combination of discount rates and present value analysis. The establishment of the discount rate establishes the "time-value" of money invested in a project or enterprise. The discount rate is then applied to the project's projected costs and benefits via a present-value calculation, resulting in a long-range payoff derived from net time-adjusted benefits and net time-adjusted costs.

There are pitfalls to this technique when applied to long-term analysis. For instance, even though the discount rate used may accurately reflect the rate of inflation, inflation may affect costs and benefits differently, causing the analysis to be inaccurate. And inflation is not the only factor to be considered in establishing the discount rate. Because the costs of capital differ from business to business due to the nature of the individual business (assessment of the level of risk), slightly different base rates are generally appropriate from business to business. King and Schrems⁴ recommend that "... if there is great concern about

the choice of an appropriate discount rate, it may be wise to use a sensitivity analysis to evaluate the effect of the discount rate. By choosing a range of rates, say 6 percent, 10 percent, and 15 percent, and performing the analysis using each, it will become clearer as to just how important the discount rate is for the final decision. If the decision is only minimally sensitive to the rate, there is a wide margin for error in setting the rate." In the same vein, Baumol⁹ cautions, "It is generally recognized that the discount rate is a critical datum for the evaluation of any proposed government project. Even when there is little basic disagreement about the investment's prospective costs and benefits the choice of discount rate figure may make the difference between acceptance and rejection."

4. It is extremely difficult to place a dollar value on intangible costs and benefits, but the valuation must be addressed in order to assess alternatives in an equitable manner. Gregory and Van Horn¹⁰ contend that "Although intangibles are often used to reinforce a decision to adopt a new system, if they are treated as unvalued factors, the result may be a wrong decision. A change not warranted when the value of intangibles is omitted might be warranted if their value is counted." Dollar values may be estimated on the basis of such items as improved operational capability, increased product quality (resulting in fewer rejects or make-overs), and increased marketing potential. The dollar value estimates can then be included in cash-flow and pay-back analysis.¹¹ It is recommended that any analysis of this type (intangible) should be clearly labeled and that all assumptions about the cost or benefit be well-documented. If it is determined that no dollar value can be assigned (carrying with it a reasonable level of credibility), the intangible costs and benefits should, at a minimum, be documented and listed as plus, null, or minus factors to ensure that they are recognized and considered during the decision-making process. (Delphi is a strategic planning methodology whose techniques could be applied by the study team to the setting of monetary ranges and occurrence probabilities.¹²)

intangible costs and benefits

5. "Risk is defined as situations in which the outcome is not certain but where the range of possible outcomes is known and the probabilities associated with these outcomes are known or can be estimated with some accuracy. Uncertainty relates to those situations when the range of outturns is known, but where probabilities cannot be estimated accurately, or where even the range of possible outcomes is not known."¹³ Elements that contribute to both risk and uncertainty are technology, competition, governmental action, differential inflation, unexpected strikes, technological "bugs," and the like. In addition, time can have an accumulating effect on some of these uncertainties.

risk and uncertainty

Efforts to cope with uncertainty include more accurate forecasts of cash flows, subjective adjustments to some of the factors influencing the outcome of a decision, the establishment of a high rate-of-return standard for a potentially risky project, and the application of a sensitivity analysis to the factors influencing the outcome of a decision by the assessment of range forecasts of the factors, i.e., high, likely, low. Thomas¹⁴ cautions that none of these approaches is completely satisfactory. In a manner similar to the recommendation to allow for a range of discount rates, Corti, in "Risk, Uncertainty, and Cost Benefit,"¹³ recommends the process of attaching "... probabilities and expected values, as far as possible, to likely paths for cash flows for the assessment." He continues, "... it is necessary to be as clear as possible about what are the objective and subjective elements entering into assumptions, projections, and weighting. Although analysis and decision-making judgment are frequently inter-related, the two must not be confused and the judgment element faced on its own." He concludes by saying that top management must define its attitude toward risk and communicate this position to lower-level managers, because "... some risks will affect the whole economic well-being of an organization and yet lie outside the purview of most of its managers. Top management should instruct or guide all of its managers on how to treat these risks. These are in the main risks and uncertainties affecting or determining overall strategy."

**application to
computer-based
systems**

6. Cost-benefit analyses, when applied to the justification and measurement of computer-based systems, have potential problem areas. In an introduction to "On Cost/Benefit of Computer-based Systems,"¹⁵ Nolan writes that conventional cost-benefit analysis contains two fallacies: (1) at the point "where an opportunity for a computer-based system is identified, all the costs and benefits are assumed to be known and susceptible to quantification" and (2) such techniques inherently bias priorities of computer-based projects toward clerically oriented systems.

The objective of a cost-benefit analysis is to reduce the number of variables to a reasonable level so that those who make decisions can more readily comprehend the effects, costs, benefits, and values.¹⁶ A cost-benefit analysis should provide the following: (1) a rationale for the recommendation, (2) a list of clearly defined assumptions, (3) an accounting for all of the costs and benefits affecting all people concerned, and (4) a demonstration of a common monetary base for all assumptions. If intangible costs and benefits cannot have a credible dollar value assigned, they should be documented and listed as plus, null, or minus factors, so that the assumptions associated with intangible costs and benefits are recognized and considered during the decision-making process (Figure 1). General limitations of the cost-benefit analysis technique are that the analysis is only as good as

the forecast assumptions that were used as the input and that, in some cases, the analysis can be prohibitively expensive.¹⁷ Specific limitations are those of "difficulties of assigning costs and benefits, failure to identify all alternatives, failure to specify the critical characteristics demanded of the system, and social and political realities. An analyst must be well-informed about these problems. A user of an analysis must be aware of the analytic shortcomings."⁴

Cost-benefit analysis has never been easy, and its difficulty has taken a quantum leap as the industry moves into an increasing number of fully integrated data-base-oriented, data-managed systems. As a data base (data-managed) system grows and supports multiple functional areas, it is increasingly difficult to cost-justify it using only tangible costs and benefits. No longer is the justification based on cost savings (i.e., fewer employees doing the same amount of work) or cost avoidance (i.e., the same number of employees doing more work). As the system grows and supports the complete management structure, it provides increasing intangible benefits and is perhaps best treated as a long-term capital investment, since it can no longer be readily expensed (accounting term meaning to assign) to products or product lines because of its sphere of influence over the (potentially) total management structure of the enterprise.

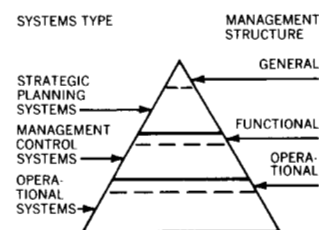
Differing approaches imposed by management structures

In 1965, Anthony¹⁸ presented the concept of a management structure for a typical enterprise using a pyramid figure and defined the (management) structure levels as operational, functional, and general. These categories, or levels, are defined so that "operational" encompasses management of the day-to-day activities, "functional" encompasses management of a business unit, and "general" encompasses the management of an entire enterprise.

A pyramid is used in Figure 2 to illustrate the grouping of systems that support the management levels into operational systems, management control systems, and strategic planning systems. For example, in support of the operational function of marketing would be such applications as order entry and order processing. Moving upward to the next level of the pyramid, the functional (management) level for marketing, would suggest supportive management control systems such as sales forecasting and sales management. Finally, the general management function could be supported by strategic planning systems such as economic forecasting (using econometric models and scenarios) and resource planning.

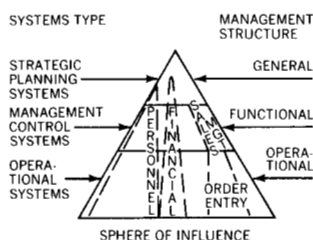
During the first generation of computers, and well into the second generation, the power of the data processing system was applied to

Figure 2 Management structure with supporting systems type



solving the problems of operational management and was implemented in a batch environment. Second-generation systems provided an on-line capability for operational systems and were compatible with the requirements of management control systems in support of functional management. And the third generation of computers allowed a gradual growth of general management applications in support of strategic planning, with the systems design evolving to the point of being data-managed. (Data-managed systems are defined by Walker and Catalano as systems that recognize that "data" are a resource and are controlled and managed by a set of organization-wide conventions providing for consolidated acquisition of the source data, reference control for the basic data banks, and parallel distribution for the data.¹⁹⁾

Figure 3 Systems type, management structure, and sphere of influence



Using the pyramid form, Figure 3 illustrates systems type, management structure, and sphere of influence. Sphere of influence is far more problematical than the other two dimensions and clearly overlaps their boundaries.

Based on work by Catalano and Walker,²⁰ the order entry and order processing applications as shown in Figure 3 could illustrate a stand-alone (batch or on-line) operational system. The major characteristics are multiple acquisition of data and serial distribution of that data. The personnel and financial systems illustrate a management control system design which is data-managed. The characteristics of this type of system are the consolidated acquisition of source data, the control of access to the data banks, and the parallel distribution of the data. These characteristics, reflected in the systems design and (potentially) in the total management support, are the very essence of the problem of financial justification for the data-managed system.

Impact of data-managed systems on financial justification

An important task of the enterprise information analysis study team is that of defining cost-benefit criteria that will allow priorities to be set for resource dedication for systems implementation. Walker and Catalano¹⁹ suggest that the "assessment should include some measures of user values, management values, and values as they pertain to the overall information systems objectives." A brief (less than two pages) guideline for a "risk-potential benefit analysis" is found in the Information Systems Planning Guide for BSP²¹ using a potential benefits matrix in combination with probability prediction. This approach, based on the "traditional" way in which a batch or on-line stand-alone system was cost-justified, is acceptable for a first cut. However, this format does not address the underlying issue of how a data-managed system will require different justification, because, by its very nature, it is accounted for in a different manner.

Four major differences in the financial justification of traditional, stand-alone systems and data-managed systems are described below:

1. *Small versus large up-front costs.* While batch and on-line stand-alone systems can be (comparatively) implemented with small, incremental up-front costs, a data-managed system generally requires a large up-front investment.
2. *Expensed versus investment dollars.* From an accounting perspective, the stand-alone system most often directly supports operational and functional activities of the enterprise, and is therefore treated as a direct expense to a product, product line, etc. Conversely, the data-managed system, with its inherent support of the enterprise as a whole, would be more appropriately classified as a long-term capital investment and treated as an indirect expense. It is interesting to note that although it may be considered a long-term capital investment, the software system, unlike most other capital expenditures: (1) does not depreciate and, in fact, should appreciate as the number of applications is increased, (2) most probably cannot be sold as can other assets because of its unique implementation, but (3) can be copied with ease and provided to another function in the enterprise, with no development cost incurred by the recipient.
3. *Large versus small future integration costs.* Potentially large costs can be incurred in the future if functions in stand-alone systems require integration. In contrast, the data-managed system would normally be expected to require a relatively small incremental cost for each new function added.
4. *Tangible versus intangible benefits.* The financial justification of the traditional batch and on-line system is based largely on easily measured tangible costs and benefits because of its inherent small sphere of influence (generally, operational and/or functional levels of activity). The data-managed system will require justification based largely on difficult-to-measure, intangible benefits—for example, better/more-informed management.

Figure 4 illustrates the interrelationships of management structure, type of costs and benefits, and type of expense accounting. It is evident from this figure that a different mix of cost-benefit criteria is required for the data-managed system than is required for the more traditional batch and on-line stand-alone systems with their (comparatively) smaller sphere of influence.

An approach to quantifying intangible benefits

Each enterprise information analysis will contain some element of value analysis, explicit or implicit, in the recommendations included in the study report. The suggested format included in the BSP manual²¹ is a first step toward a cost-benefit analysis structure in

Figure 4 Management structure and method of accounting for expenditures associated with type of costs and benefits

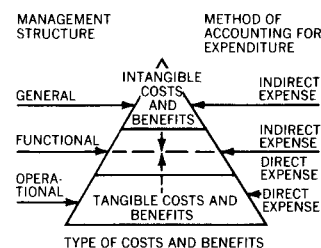


Figure 5 Expanded taxonomy for intangible benefits

BENEFITS	(\$ or + or 0)	1*	2*	3*
MANDATORY INFORMATION NEEDS				
INFORMATION PROCESSING EFFICIENCY				
IMPROVED ASSET UTILIZATION				
IMPROVED RESOURCE CONTROL				
IMPROVED ORGANIZATIONAL PLANNING				
INCREASED ORGANIZATIONAL FLEXIBILITY				
PROMOTION OF ORGANIZATIONAL LEARNING AND UNDERSTANDING				
INCREASED ACCURACY IN CLERICAL OPERATIONS				
MORE TIMELY INFORMATION AVAILABLE				
AVAILABILITY OF NEW/BETTER/MORE INFORMATION				
ABILITY TO INVESTIGATE INCREASED NUMBER OF ALTERNATIVES				
BETTER QUALITY AND MORE INFORMED DECISION-MAKING PROCESS				
FASTER DECISION-MAKING				

*1 = most likely, 2 = likely, and 3 = least likely to occur

support of data-managed systems that have been defined through the use of enterprise information analysis. Figure 5 introduces an expanded taxonomy of intangible benefits that can be applied during cost-benefit analyses.

This expanded taxonomy was developed from the checklist of intangible benefits suggested in Figure 1. At a minimum, the applicable elements could be quite simply listed in the cost benefit or value analysis. They could be noted as to whether there would be a positive or null effect, and ranked to reflect the probability of occurrence, using the numbers 1, 2, or 3 to reflect a judgment of most likely, likely, and least likely to occur. If dollars can be estimated and probability ranges can be agreed on, analytical models can be used to do sensitivity analysis for ranges of intangible benefits. (For information regarding current tools that can be of assistance to the study team during an enterprise information analysis, see Reference 22.) Since most enterprises have their own set of guidelines and criteria for expenditures and asset acquisition, the expanded taxonomy would probably require some modification by the study team prior to its application.

Concluding remarks

A gradual evolution of systems design has occurred concurrently with the introduction of each new computer generation. The initial systems design was batch-oriented, largely a replacement of clerical functions supporting operational management, which lent itself well to a financial justification using classical cost-benefit analysis and which had virtually no intangible costs or benefits to consider. With the development of the facilities to support on-line systems came the development of "management information systems" and "management inquiry systems," providing information and data as input to

Table 1 Summary of systems design characteristics: Cause and effect

<i>Characteristics</i>	<i>Systems design</i>	
	<i>Traditional stand-alone</i>	<i>Data-managed</i>
<i>(Cause)</i>		
Management level support	*primarily operational and functional	*operational, functional, and general
Systems type	*operational and management control systems	*operational, management control, and strategic planning systems
Systems characteristics	*independent applications	*large integrated data base
	*probable duplication of data	*single-source/multiple-use data
<i>(Effect)</i>		
Financial aspects	*small, incremental up-front costs	*large up-front investment
	*direct expense to a product, product line, etc.	*long-term capital investment, indirect expense
	*potentially large cost incurred if functions need to be integrated in the future	*potentially small incremental cost for each new function added
	*financial justification based largely upon tangible costs and benefits that are easily measurable	*financial justification based largely on difficult-to-measure intangible costs and benefits

functional management for tactical planning. The intangible benefits of "better management decisions" were generally noted but not assigned a value in the cost-benefit analysis. The development of data-managed management information systems and decision support systems has extended information systems capabilities that provide the potential for integrated support of the strategic planning efforts of the enterprise. These systems cannot be cost-justified on the same basis as the "clerical function replacement" systems. From an accounting perspective, the costs (investments) should be treated differently. The benefits are intangible and, therefore, difficult to assess (1) in dollar terms and (2) in probability of occurrence; however, "hard" dollars will ultimately appear on the Profit and Loss Statement of the enterprise. (Table 1 provides a summary of the differences in the financial aspects of the systems.)

The "traditional" approach of cost-benefit analysis is very compatible with the bogeys, budgets, and quotas by which the performance of a business function is measured. The incentive at the functional level is to minimize cost (investment) and maximize the efficiency of the asset to support that product (i.e., maximize return on gross assets). When there is a rise within the organizational pyramid to general management, the large data-managed systems data base can be used in support of long-term strategy, serving the organization as a whole, making all levels of management more efficient, but making the traditional cost-benefit analysis ineffective as a means of financial justification. The cost-benefit analysis becomes more elusive (forecasting the economy; technological change; better, more informed management), moving from the traditional data processing justification base of tangible (measurable) costs and benefits to intangible (not so easily measurable) costs and benefits.

A taxonomy for intangible benefits for cost-benefit or value analysis has been presented (Figure 5) and can be used in the consideration of the valuation of intangible benefits for a data-managed information system. It is by no means exhaustive, but it is a place to start, and it can be used as an extension to the value analysis suggested by the Business Systems Planning methodology.

The lack of visible and successful effort in cost-benefit analysis codification for data-managed systems is attributable to the difficulty of the effort due to the movement of benefits from tangible to intangible and to the basic philosophical differences between multiple independent application programs versus a single data-resourced system. It must be recognized, however, that during the development of strategic and tactical plans, alternatives will be evaluated on the basis of the resources required, the implementation time schedule, the monetary value of the costs and benefits of each alternative, and that this process is an integral part of any decision mechanism.⁸ Not to address intangible benefits is to deny their existence and their value, which is the key to the financial justification of the data-managed system.

Information, now considered a "resource," will, in the future, be structured, produced, and measured in a manner similar to other enterprise products through the gradual formalization of information supply. Enterprise information analysis is perhaps the first step toward such a formalization, which carries with it a requirement for an associated formalization of financial justification and measurement of information supply, that provides (1) a structure for the communication and measurement of the strategic objectives of the enterprise and (2) a means of direction for tactical planning.

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