Using Cost Benefit Analysis for Enterprise Resource Planning Project Evaluation: A Case for Including Intangibles

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Abstract

This paper demonstrates how cost benefit analysis can be applied to large-scale ERP projects, and that these methods can incorporate intangible benefits, e.g., user satisfaction. Detailed information on the business case utilized by a large computer manufacturer in the decision to implement the SAP system R/3 is presented. Techniques that demonstrate how intangibles may be included in the standard cost benefit analyses follow. The paper concludes with a discussion on the state of valuing ERP projects and questions to be answered in the future.

1. Introduction

In 1998, expenditures for information technology (IT) accounted for more than 50% of corporations' annual capital investment in developed economies, and these outlays will average 5% of total corporate revenues by 2010 (Graeser, Willcocks, & Pisanias 1998). Given the staggering amount of resources devoted to IT, $530 billion worldwide in 1995, one would expect managers to have a firm grasp of the anticipated contribution of their IT investments to the organization's profit margin. However, quantitative measurements of an IT project's expected return are not often used, primarily because they are unable to capture many of the qualitative and intangible benefits that are expected (Farbey, Land, and Targett 1992). Still, managers must justify system investments "cost benefit analysis has assumed a pivotal position in the information systems revolution" (Sassone 1988).

Information system project evaluation is challenging not because the projects cannot be justified but because they cannot be justified in terms which accountants and some senior managers are prepared to accept (Gunton 1988). According to Mahmood and Szewczak (1999 pg. v.) the issue of measuring investments in IT is critical, these "measures may be quantitative in nature, but they must also be qualitative as well." The problem has grown as IS departments have advanced beyond implementing transaction processing systems with returns that are relatively easily to quantify to the implementation of management information systems and decision support systems. Systems in the latter category produce measurable benefits that are fuzzy at best, and defy conventional methods for quantifying the benefits. The failure of traditional measures to adequately capture the true value of the information technology systems was observed in the early days of MIS as an academic discipline (McRea 1970). This measurement dilemma has grown worse as IT becomes part of the organization's nervous system or infrastructure and is a critical part of its structures and processes where all elements are integrated assessing returns on individual assets is impractical. In addition to the factors listed above there is still a widespread lack of understanding of IT and information systems as a major capital asset (Willcocks and Lester 1999).

In today's dynamic and competitive environment, senior managers are demanding figures that derive an IT project's return before the project is undertaken. Therefore, CIO's and their IT staffs are beginning to rely on both tangible and intangible measures to determine a system's contribution to an organization's bottom line. This procedure is a new endeavor for many IT staffs especially as they struggle to convert intangible measures such as user satisfaction to a tangible quantity suitable for inclusion in cost benefit calculations. This study examines Consolidated Computer Company's (CCC)[1] efforts to determine the contribution of a proposed enterprise resource planning (ERP) system they are seeking approval to implement.

2. ERP Systems

Enterprise Resource Planning is a term used to describe business software that is 1) multifunctional in scope, 2) integrated in nature, and 3) modular in structure. An ERP software solution is appropriate when an organization is seeking the benefits of business process integration and contemporary best practices in its information system,

[1] The name is fictional, the company and case study are real.

looking for a full range of functionality throughout its organization, and seeking to limit its implementation and ongoing support costs (Norris et al 1998). Historically, the market for ERP solutions has been large multinational manufacturing companies (revenues over $1 billion) which operate in a discreet manufacturing environment. Today, however, the market is expanding to mid- ($250 million to $1 billion) and small- (under $250 million) companies across a wide range of industry sectors.

ERP systems have their origins in Manufacturing Resource Planning (MRP) software with installations traditionally in large scale manufacturing facilities, although recently the trend is to extend installations to industry sectors including telecommunications, public sector, insurance, gas & oil, and high tech manufacturing. Firms using the software generally seek process-oriented increases in productivity, up-to-the-minute access to timely information, and cost saving efficiencies. The systems are known for their process orientation rather than traditional functional orientation that may enhance an organization's move toward breaking down departmental boundaries and thinking. The ultimate goal of organizations implementing these packages is to carefully reengineer their processes, which in turn will hopefully benefit the bottom line.

The cost of implementing an ERP system varies. Implementations in smaller companies are approximately $10 million and take 23 months with the total cost of ownership estimated at $15.6 million (Meta Group 1999). In large companies, e.g. Fortune 1000, implementations can exceed several hundred million dollars and may take five years to accomplish. Yet, despite the considerable investment in time, capital, and resources the return on system investment is not clear. A survey of 63 companies with ERP systems discovered an average negative value of $1.5 million when quantifiable cost savings and revenue gains were balanced against spending on hardware, software, consulting, and support (Meta Group 1999). Additionally, anecdotal evidence suggests that ERP failures have contributed to the bankruptcy of companies, e.g., Fox-Meyer Drugs (Bulkely 1996). Yet despite negative reports such as the Meta Group's, ERP implementations are proceeding at a record pace with an abundance of success stories such as Cara Airport Services that saved 7% on production costs after their implementation of J. D. Edwards' application (Stedman 1999).

The process of quantifying the value of IT projects becomes much more difficult as the scope and magnitude of projects grow. ERP system implementations generally require large capital investments and, because of their integrated nature, possess a wide and complex scope. Early business information systems were transaction processing systems (TPSs) designed to replace workers who performed repetitive tasks, e.g. payroll clerks. The determination of the costs and the benefits for these systems was relatively easy. The salary of workers to be replaced was compared against the cost of the system and hence the project's value was estimated. As systems became more complex and began to support other types of activities, e.g., decision making, the ability to quantify their payback became more difficult. It was clear that more and better information improved decision making, but it was very challenging to quantify the value of a better decision. Better decisions represent one form of intangible benefit derived from the IT system.

This process has become ever more complicated with the advent of large-scale projects such as ERP systems and other infrastructure technologies. In the case of infrastructure projects the benefits in part found in the services that they support and enhance. For instance, upgrading the telecommunication infrastructure could be measured in increased bandwidth or even how much faster files/information is transferred. While the improvements in these metrics are tangible, it is challenging to link their relationship to the monetary benefits resulting from increased market share as a result of a customer's repeat visits to an electronic commerce site. One of the ERP system's greatest benefits is its ability to integrate, standardize and provide real time visibility to an organization's data. This benefit has been attributed to increasing productivity and improving management decision making. Yet given the task of quantifying this benefit most organizations state that it is beyond their ability to measure and hence list it as an intangible.

3. Evaluation Techniques for Technology Investments

This section briefly presents a variety of techniques for measurement of technology investments and argue why a family of methodologies known as cost benefit analysis (CBA) is often the methodology utilized in practice. To determine the benefits of IT projects Wehrs (1999) differentiates between *ex ante* and *ex post* evaluation. In ex ante evaluation the focus is on justifying the IT investment before it is made, and in ex post evaluation the goal is to justify costs that have been incurred so as to guide future IT expenditures. In this paper the *ex ante* view of the IT investment, that is, our goal is to focus on the investment decision and not the justification of costs

already incurred from an IT project. Wehrs partitions ex ante analysis into three major sets of techniques: decision theory, user information satisfaction, and CBA.

Decision theoretic approaches include information economics (Parker and Benson 1988) and multi-criteria approaches (Keeny & Raiffa 1976, and Land 1976). In this class of approaches the decision-maker whom attempts to maximize the organization's utility or value function by taking the preferred action over the set of choices for the firm. Information economics sets out to rank or measure the financial impact of changes brought about by implementing the new information system. The multi-criteria approach measures the value of an IT project, perhaps in terms other than economic, and allows for appraisal of the relative value of different project outcomes. Both approaches allow for the advent of uncertainty and for the fact that different stakeholders may have different views on the benefits of the project. Implementation of this class of models is complex requiring the specification of outcomes for the firm, the organizational utility or value derived from each outcome, and the potential actions available to the organization. In information economics one must also define the transition matrix describing likelihood of the moving from one outcome state to another given the action taken. While both approaches have deep theoretical roots, they have been criticized by Kleijnen (1980) and Treacy (1981) for the extent of knowledge required by the decision maker to build the model, the assumed rationality of the decision maker and the simplicity of the model.

User information satisfaction has two major schools user satisfaction and system use (Melone 1990). Ives, Olson and Baroudi (1983) introduce the concept of User Information Systems (UIS) as a method to evaluate IT investments by measuring the extent to which users believe the information system available to them meets their information requirements. UIS is accepted as a surrogate measure for changes in organizational effectiveness-the real goal of information system implementation. However, authors have criticized the UIS measure because of its lack of theoretical basis and because of a lack of empirical work validating the relationship between subjective assessment outcomes and economic performance (Wehrs, 1999). According to Melone (1990), the literature on UIS indicates that, on its own, UIS cannot be a surrogate for effectiveness of an information system. Swanson (1988), on the other hand, argues that the user attitudes are measured because information systems exist for the purpose of serving client interest, and hence, individual assessments of information systems are held to matter.

Cost Benefit Analysis (CBA) has been widely utilized to compare the costs and benefits of all types of capital investment projects (Prest and Turvey 1965). CBA is a family of techniques most often utilized in calculating the economic value of IT projects (Farbey, Land, and Targett 1992, Bacon 1992). In all CBA approaches the future stream of economic benefits and costs is estimated and the value of each project option is calculated. One major benefit of the family of CBA approaches to managers is that the results are relatively easy to interpret, while the greatest challenge involves the adequate measurement of project costs and benefits (Brynjolfsson 1993). Detailed lists of the set of methodologies that fall under the CBA umbrella can be found in King and Schrems (1978), Sassone and Schaffer (1978) and Sassone (1988). Because of the challenges associated with providing economic value for the costs and benefits in IT projects, Dos Santos (1991) has proposed a more complex IT project valuation models based on the idea that subsequent project investments are optional. The subsequent decisions can be made better when more information concerning project success has been revealed.

It is generally accepted that all CBA activities require estimates of costs and benefits in future time periods. These estimates should account for the relevant costs at each stage of the project or system's life cycle. Most authors (Sassone & Schaffer 1978, Hares & Royle 1994) make strong arguments for the inclusion of discount factors in CBA analysis. Additionally it is the consensus that proper implementation of CBA includes the use of marginal versus average value analysis and that sensitivity analysis should always be part of the process. The challenge of effective assessment of costs and benefits is at the heart of any CBA activity, and Sassone (1988) lists seven generic methods for accomplishing this task. Following the assessment of costs and benefits, one of a number of outcome measures is calculated. The most common measures include net present value (NPV), internal rate of return (IRR) and payback period.

The formula for computing net present value, NPV (Sassone & Schaffer 1978) is

$$NPV = \sum_{i=0}^{T} \frac{B_i - C_i}{(1+d)^i}$$

In this formula B_i and C_i are the values of the benefit and cost for the i^{th} period in the future and d is the discount factor. In this formula the NPV is calculated from the current period (time 0) until period T. A greater value for NPV is assumed to be an indication of a more desirable project. One principal criticism of the use of NPV as a

criterion to judge a project is the choice of the discount factor, d. However, sensitivity analysis performed on this parameter will allow for examination of how the decision factor may affect the decision. In many cases, management will set a value of d, for which the project must a have a positive NPV which is known as the hurdle-rate.

A second criterion that is often used is payback period. The payback period is simply the earliest period in which the project's cost is recovered. In using this criterion, it is assumed that the project with the earliest payback period is the best. However, this may not be reasonable logic if a competing project has large anticipated benefits further in the future. A third method for evaluating projects is the internal rate of return, IRR, i.e, the annual rate at which project is estimated to pay off. The quantity IRR is found by solving the following equation:

$$C_0 - B_0 = \sum_{i=1}^{T} \frac{B_i - C_i}{(1 + IRR)^i}$$

As mentioned previously CBA has been criticized on a number of fronts. Keen (1975) was the first to note that the many of the costs and benefits of information systems are challenging to measure. This is becoming increasingly true as the use of information systems moves from transactional towards strategic. Keeny & Raiffa (1975) and others have criticized CBA on the basis that it does not include a method of coping with uncertainty that is usually present in information systems projects, e.g., many IT projects may be subject to user acceptance uncertainties. These criticisms make CBA challenging to utilize, however other authors have argued that this not evidence that CBA should be abandoned. Kaplan (1986) argues that one should choose a comparator, like missed strategic opportunity or declining cash flows to compare information systems projects. Dos Santos (1991) argues that since IT investments are made over time, some decisions can be foregone until more information about project success becomes available. In either case, a project may then appear to be more valuable than it otherwise would have been had these factors not been accounted for.

Practically speaking, when financial analysis is called for, CBA is often utilized to analyze IT investment. Using CBA, Boehm (1993) found that the investment in software technology at the Department of Defense is paid back $5 for every $1 invested. The Glomark Group (1996) with over 300 client companies uses an ROI approach to assess the value of IT investments. Still, the issue of quantifiability seems to provide the major excuse for many organizations not to use CBA at all. Hogue and Watson (1983) found that in the case of DSS systems that a great majority (83%) of the organizations investigated did not bother to even try and quantify the benefits either in an ex post or ex ante setting. Farbey, Land and Targett (1992) found that only 4 of 16 firms surveyed used any kind of quantitative analysis in estimating the value of their IT projects. Bacon (1992) found that approximately 52% of companies used CBA approaches, but it was only applied to 56% of the projects within those organizations.

Sassone and Schaffer (1978) explicitly admit that costs and benefits of IT projects lie along a "spectrum of quantifiability" which makes the use of this procedure challenging. Hares & Royle (1994) agree and argue for the use of a broader methodology, "investment appraisal" which extends CBA to include discounting, the effects of over projects, project risk and flexibility and the inclusion of intangible assets. In the next section, we define and discuss classes of intangible assets that organizations may want to include in their CBA activities.

4. Intangibles and Technology Evaluation

The new International Accounting Standard IAS 38 defines an intangible as an identifiable non-monetary asset without physical substance held for use in the production or supply of goods or services, for rental to others, or for administrative purposes. In many areas, investments result in economically valuable, legally recognized intangible assets, including copyrights ("Titanic" and Windows2000), patents (Viagra), changes in processes for making existing goods, and other assets such as brand names and trademarks. If companies fail to include intangible assets or their marketplace results, then corporate profits are vastly understated (price/earnings ratios are overstated) which in turn impacts national income, savings, and investment.[2] Intangibles can result in any combination of (1) a higher price for a premium product or service, (2) more sales from existing product or service, (3) cost savings from an existing or new product or service, and (4) new business/ new sales from a new product/service (Hares and Royle 1994).

Not every business goal or benefit from a project can be quantitatively measured. A recent Ernst & Young (1999) study found that information not quantified on a company's balance sheet is increasingly becoming an important criterion for potential investors. Non-financial

[2] For instance, Titanic sold $1 billion in theater tickets and Viagra sales exceeded $700 million in its first month.

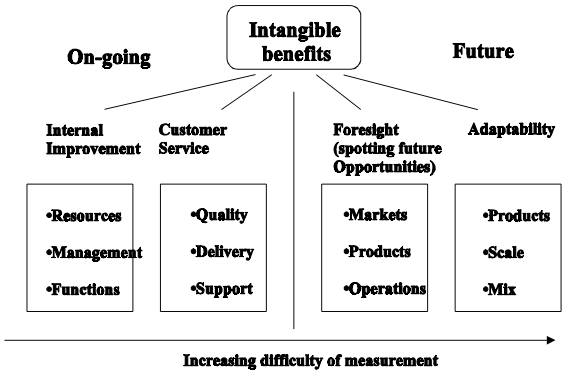
criteria, such as quality and credibility of management, market share, quality of investor relations, and customer satisfaction, accounted for 35% of the investor's decision. Davidow (1996) indicates that in the information age four-fifths of a firm's assets are intangible and that double-entry bookkeeping and measures of return on investment which do not consider intangibles are understating corporate value and profitability. Lev (1997) also indicates that conventional accounting performs poorly with internally generated intangibles, e.g. R&D, brand names, and talent, which are considered the engines of modern economic growth. Hares and Royle (1994) suggest that none of the methods for CBA are able to show how to measure and value the intangible benefits in financial terms.

Historically, the different treatment of tangibles and intangibles can be traced to the distinction between goods and services. As far back as Adam Smith, goods were material and could be stored while services were immaterial and transitory. This transitory nature meant services could not be counted as assets, but goods could. Logically, then, things counted as investment must be tangible. This led to a definition of wealth as "material objects owned by human beings." Therefore, what is material is tangible, and can constitute wealth which underlies the national income accounting conventions used to determine asset value, profit, saving, and investment. This logic fails to consider that more investment in today's economy are intangible and these investments yield higher profits which equal greater output and savings. One estimate suggests that an adjustment for R&D alone would raise U.S. GDP roughly 1.5%. Extending this argument to project evaluation, the payback period would be reduced and the return to the business would become proportionally greater.

Annie Brooking suggests that IT cannot be measured in isolation. In her book, Intellectual Capital, she indicates that there is a shift in the make-up of the net value of a company. In 1977, 1% of the net value of a UK company was based on intangible assets. In 1986 the make up shifted to 44% and it is growing rapidly. She decomposes intangibles into four areas: market assets, items which yield market power, e.g. brand names; intellectual property - copyrights; human-centered assets like knowledge; and infrastructure assets. IT falls into the last category. It is not the value of computers and software in the business, but their impact on the business' performance. Brooking examines Barclay's bank, whose computer and software assets equal approximately £100million. If those assets suddenly disappeared, the bank would not open, so clearly the value of the assets is much greater than the cost of the assets themselves. The difference is their intangible benefit or worth. The knowledge and expertise of an information technology department is an intangible asset in and of itself, but so is the way IT applies that knowledge to make other departments function more smoothly (Schwartz 2000).

Computer systems are increasingly being developed for what are at first sight non-price factors and hence intangible. Hares and Royle (1994) indicate there are two main intangible benefits in IT investment. The first is internal improvement or infrastructure investment and the second related to customers. The latter, customer viewed intangible benefits are overwhelmingly those that the customer sees now and wants in the future - particularly related to customer service and user satisfaction (See Figure 1). These qualities posse an intrinsic value potentially greater than the immediate and calculable financial returns. They categorize intangible benefits as on-going and future oriented.

Figure 1
What are Intangibles?



The on-going intangible benefits are those concerned with internal improvement of company operations or output performance. These are perhaps the most tangible of intangible benefits and can include 1) changes in production processes, 2) methods of management operations, and 3) changes to production value and process chains with resulting benefits as increased output or lower production costs. The second group of intangible benefits is more difficult to measure with their effectiveness being decided by external forces. This grouping involves services to customers that increase the utility (value added) of products or services. The benefits are converted into retained sales/customers, increased sales, customer satisfaction, and increased prices and include 1) quality of product or service as a market differentiator, 2) improved delivery of a product or service, and 3) improved service provided with products

and services.

The next two groups of intangibles relate to future benefits and include the ability to identify new business opportunities leading to competitive advantage. The first of these benefits embody spotting market trends. If new trends can be ascertained then a business is able to convert products or services to gain new sales and market position. Another example of this intangible benefit is the development of process through which to conduct business operations. This method provides the opportunity to cut prices and gain market dominance as was the case with Dell Computers. The final group of intangible benefits is the ability to adapt to change. As with the identification of market trends the benefits derived include adapting products and services to market trends and the modification of production processes. This ability is critical for firms in rapidly changing industries and can potentially converted into increased sales and higher margins.

IT projects deliver intangible benefits that cannot be quantified using mathematical equations like NPV, such as better information access, improved workflow, and increased customer satisfaction which are listed among the key attributes of ERP systems. One key function of IS departments has been the support of high quality decision making. This has been difficult to quantify especially at the higher levels of the organization where results are deferred. In the IS literature, Emery (1971), and Keen and Scott-Morgan (1978) point out the importance of intangible benefits. Litecky (1981) indicates that despite the perceived importance of intangibles, there has been little if any guidance in the quantification of derived benefits. He proposes several assumptions as a precondition to quantifying benefits. First, tangible costs and benefits are relatively easy to estimate whereas intangible benefits are quite difficult to estimate. Second, tangible costs are ordinarily much greater than tangible benefits and intangible costs are insignificant.

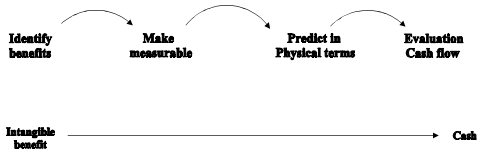
Parker and Benson (1988) explain that in order for enterprises to gain competitive advantage, the way IT is financially justified must change. Cost-benefit analysis is not adequate for evaluation of IT applications, except when dealing with cost-avoidance issues. If CBA is to be expanded additional measures such as the perceived value to the business, increased customer satisfaction, or the utility of IT in supporting decision making must be considered (Katz 1993). Clark (1992) found little guidance on IT's contribution to corporate profits in the literature but found firms focused on reliability of service, technical performance, and business plan support all items difficult to accurately quantify. Other studies found varying measures of IT assessment including productivity (increases of), user utility, impact on value chain, business alignmen, system quality, information quality, use, and user satisfaction (DeLone and McLean 1992). Accampo (1989) contends that CBA can be hard to apply to activities where information is the key commodity. Given that many of the measures found in the IS literature and listed above to evaluate system success are intangible, traditional methods of project evaluation fall short. This problem becomes even more difficult when analysis encompasses changes to business processes and information flows which impact productivity and decision support.

A survey conducted by Ernst & Young (1988) found that 60% of all UK companies concerned with the manufacturing of automobile components made no attempt to quantify the intangible benefits gained from the use of CAD/CAM systems, that only 20% quantified the benefits in physical terms, and only 20% quantified the intangible benefits in monetary terms. To accomplish the task of incorporating the intangible benefits into the financial analysis one must create multiattribute justification techniques which permit the inclusion of both monetary and non-monetary factors in the analysis (Badiru 1990). This method can lead to a single financial model but requires a technique that bridges the gap between the intangible and tangible factors. Illustrated in Figure 2, this quantification technique (Hares and Royle 1994) applies a set of steps to express intangibles monetary terms. The steps include 1) identify benefits, 2) make the benefits measurable, 3) predict the results in physical terms, and 4) evaluate the cash flow. Explained below, this technique strives to convert the intangible benefit into cash flow that can be incorporated into CBA.

The first step of quantification is the *identification* of the intangible benefits. Two useful sources of information to assist identification include 1) critical success factors (CSFs) and 2) a checklist of intangibles. Many CSFs include quantifiable items. For instance, improved customer service, a CSF, could be measured by a stated reduction in the number of customer complaints. A checklist of intangibles is generally easier to create but perhaps harder to quantify. The IS literature suggests a

number of factors for evaluating system success including customer satisfaction, product/service quality and reliability, speed of service, improved service, and reduction of errors. All of these intangibles can be converted into monetary terms through the ability to 1) maintain and increase sales, 2) increase prices, 3) reduce costs, and 4) create new business.

Figure 2
The Quantification Technique
"Bridging the Gap"



The second step is to make the intangible benefits *measurable*. This consists of re-expressing the benefits described above in more measurable terms. The third step is to *predict the benefit in physical terms*. This is generally the most difficult of the quantification steps with multiple methods to convert measures into actual numbers. The first method is the market survey. Market surveys are most attractive because 1) the perceptions of the company and customer can be aligned and an agreement of monetary equivalence can be agreed upon and 2) surveys can include a forward-looking component which could lead to proactive actions which potentially increase the value of the project. The second method is management estimates which is usually used when surveys are not possible. Senior management whose operations are supported by the project but who are removed from project responsibility generates these estimates. The problem with management estimates is that they are based on past evidence and therefore reactive. The third method is comparative case study of a similar business. The advantage of this method is that the firm gains from the lessons learned from the past exercise. The disadvantage is that past projects are conducted in a different business environment and the method uses backward looking methodology. The final step in the quantification technique is the *evaluation in cash flow terms*. This is a simple mathematical process with the volumes from the previous steps related to the monetary value of the benefit. It is at this point that the technique can be merged with CBA.

5. The Business Case for ERP at Consolidated Computer Company

Consolidated Computer Company is a global software and hardware manufacturing, distribution and consulting organization with a long and very successful history delivering and implementing a wide range of business solutions. In the early 1990s CCC faced very significant challenges that included high operating costs, a bloated workforce and many redundancies across the globe in manufacturing, research, and design. To revive its legacy, CCC set forth a number of strategic imperatives that included firm wide cost reduction, reduction of product development and deployment cycle, marketing as a single global organization and streamlining the relationship between CCC and its customers. One part of implementing the plan for accomplishing these objectives was to put in place the integrated supply chain in its Personal Computer Division (PCD) which would include procurement, production and fulfillment.

In examining the costs of operating the company, among other items CCC's corporate management found that IT expenditures were excessive. Like many other multinational organizations CCC had, over the years, implemented and now operated hundreds of non-integrated information systems to support their business throughout the world. Management felt that reduction of a number of legacy systems could be achieved through the use of an integrated software solution, i.e., an ERP system. To accomplish their goal of reducing costs and integrating the supply chain, corporate managers established a relationship with a major ERP solution provider. While corporate management moved ahead with the new initiatives, significant problems with customer satisfaction and inventory management at PCD continued.

At the beginning of 1997, managers in charge of reengineering the supply chain in PCD were directed to justify the large expenditure that would be required to implement the ERP system. To cut costs in operations PCD's management believed that decreasing work in progress and increasing inventory turns in the production facility was necessary. One part of achieving these goals included the implementation of a just-in-time procurement system. Improvements to the order fulfillment and customer management processes would also be required to improve declining customer satisfaction indices. Furthermore, it was clear that the large number information systems used in operations did not offer the functionality required to attain these goals. To justify the substantial investment, the CBA methodology was utilized to build the business case for implementing the ERP solution.

The scope of the PCD systems implementation project was to bring the ERP solution to three major production facilities across the globe. In their analysis PCD management used NPV, IRR and payback period to assess

the project's return on investment. The business case was built assuming a 10-year time horizon utilized a 20% hurdle rate. To calculate benefits very conservative revenue growth and profit margin assumptions were made and no benefit was assumed to commence until one year following the implementation at each site. Productivity savings of between 5 and 20% were assumed for the production and order fulfillment processes. The new system would also enable a one-time inventory reduction of 10% that was assumed to occur one year after implementation. Cost savings resulting from the reduction in number and complexity of systems in operation were also included. Major capital expenditures were assumed to occur over three years and the high-end of development and deployment cost estimates were used for each site. The cost benefit estimates resulting from the above assumptions are shown in the Table 1.

Table 1: Cost Benefit Analysis (Tangibles Only) NPV($ millions)/IRR

Productivity	Inventory	IT Ops	Implementation Cost	Total*	IRR*
18.8	49.1	23.4	(73.4)	28.1	39.20%
* Additional factors are included in these figures					

5.1 Including Intangibles in the Business Case

Long before PCD embarked on their ERP evaluation project the company's managers knew there was serious problem with customer satisfaction. Their annual surveys with customers and suppliers indicated that levels of satisfaction where down 21% and 15% respectively with customers indicating significantly better relations with PCD's competition. Realizing that sagging satisfaction would soon translate into smaller market share and falling profit margins, senior management ranked satisfaction improvement as a key goal during system evaluation. Using a method very similar to the quantification technique (Hares and Royle 1994), the project managers identified improved customer/user satisfaction as a key system deliverable.

Satisfaction as a deliverable was critical to customers and suppliers, and existed as a metric within PCD with data collected on an annual basis. To convert satisfaction from an intangible to a measurable factor, PCD's IS department complied a list of customer reported system deficiencies from the last satisfaction survey. Upon completion of the deficiencies list, IS managers examined each item's performance in the current system and its expected result on the proposed ERP system (see Figure 3 for a sample of the items). This procedure established a baseline from which the managers could project the level of satisfaction improvement once the proposed system was in place. From the proposed improvements, managers throughout PCD, not just members of the project team and IS department, consulted customers and projected that once deployed the proposed ERP system could improve customer satisfaction by 5% initially and approximately 2% per year there after (assuming expectations were met).

The next major task in this analysis was to predict the economic value of an increase in customer satisfaction to CCC. This step was also accomplished through management interviews and surveys with CCC's key customers and suppliers.

Figure 3
Sample items for Customer Satisfaction Survey

Item	Current system	Proposed ERP system
Enter pricing data	5-80 days	5 minutes
Committed ship date	1 day	Realtime
Schedule orders	Overnight	Realtime
Credit check	15-20 minutes	Realtime
Enter order	30 minutes	5 minutes
Inquiry response	15-20 minutes	Realtime
Ship and build	Overnight	Realtime

The managers undertaking this project were those most familiar with customers, particularly those in the sales and marketing organizations. The results of several hundred interviews suggested that for each 5% improvement in customer satisfaction, CCC could expect a 1% gain in market share. The results, while nonscientific, indicated that market share increases would result in significant benefits for the company. The final step of this process was to evaluate the potential cash flow resulting from market share gains. Based on the cash flow resulting from the customer market share improvements the CBA was redone and the results appear in Table 2 below.

Table 2: Cost Benefit Analysis (Tangibles and Intangibles) NPV($ millions)/IRR

Productivity	Inventory	IT Ops	User Sat	Implementation Cost	Total*	IRR*
18.8	49.1	23.4	228.7	(73.4)	228.9	124.0%
*Additional factors are included in these figures						

6. Discussion and Conclusion

In the face of significant threats to market share and shareholder value the Consolidated Computer Company (CCC) embarked on a major organizational restructuring. As part of that effort, the personal computer division (PCD) was asked to justify in economic terms a large investment in an ERP solution. In the first cost benefit analysis (Table 1), PCD management used estimates of productivity savings, inventory savings and savings resulting from more effective information systems operations to calculate the net present value (NPV) and internal rate of return (IRR) for the project. The NPV of productivity improvements and inventory reductions resulting from new system implementation were estimated at $18.8 million and $49.1 million respectively over the 10 year time horizon utilized. The NPV for IT operations cost savings was estimated to be $23.4 million. The total NPV for the project was estimated to $28.1 million and all NPV calculations assumed a 20% hurdle rate. Table 1 shows that internal rate of return for this project was estimated to be 39.2%. Using these estimates the ERP implementation project meets the hurdle rate criteria set by CCC management.

In a subsequent CBA many of the same figures cost and benefit figures were utilized, however the intangible items of customer satisfaction was also included. The assumption made by PCD management was that implementing the ERP system would have a significant and positive impact on customer satisfaction and hence improve market share. This view had been justified by data gathered through customer interviews. The NPV resulting from increasing the customer satisfaction was estimated to be $228.7 million. This resulted in the new total NPV of the project when customer satisfaction was included in the project to be valued at $228.9 million with an IRR was 124%. Upon including the intangible of customer satisfaction the ERP implementation project was significantly more beneficial to improving organization bottom line.

As a result of the evaluation and analysis, CCC's IS department was given the approval to implement the Enterprise Resource Planning (ERP) package. The implementation of the new system, including replacement of legacy hardware and software, was conducted on time and on budget. During it's first year of operation the ERP system contributed over $225 million in savings and productivity improvements. The results of the CBA and intangible analysis were convincing factors that led CCC to the decision to implement the system. Without the numerical results senior management would not have agreed to move the project forward regardless of anticipated benefits. Even with the analysis of tangible factors and the quantification of intangibles, all benefits of a large scale IS project are not included in the overall equation.

The first and most important criteria when undertaking IS project evaluation is whether the system contributes to the strategic objectives of the organization. This initial criteria is more complex than "does the system help the organization achieve it's goal" or make the organization better at what it does. One benefit often sited upon installation of an ERP system is the improvement in information quality, access, and use. Benchmarking Partners (1999), a research and technology advisory firm, reported 88% of respondents in the banking and finance industries cited information quality and accessibility as a key benefit of their implementation. Janus Capital Management found that their finance group spent 65% of their time tracking down data so that analysis could be conducted. Their implementation cut storage costs, improved efficiency, and decreased time to provide clients with information. In addition to accessibility of information, quality and standardization of information rank high on the list of strategic benefits. Most ERP systems replace a number of legacy systems, each with their own databases and data formats. The ability for management throughout the organization to understand data while having it in a standard format, located in a single database, improves the quality of the information in turn leading to better decisions.

Movement to enterprise integration and process orientation was also cited as a key strategic benefit. This benefit is manifest in the breaking down of organization barriers, previously represented in departmental structures, and replacing them with integrated optimized processes. Standardization of an organization's technology platform is another benefit area. Similar to the situation for business processes, many organizations have found themselves with widely disparate IT platforms, systems, and data standards throughout their organizations. As a matter of fact, the Y2K problem prompted many organizations to replace old legacy systems. While there is no guarantee that replacing legacy systems is cheaper in the long run (there is actually some debate regarding total cost of ownership with ERP systems), in many situations new systems are easier and cheaper to maintain than their predecessors.

Most of the benefits discussed above can be grouped under the category of keeping the organization competitive. Some of the costs and benefits e.g. system

operations and maintenance, are easily measured. Others such as better access to information, information quality, and improved decision making are harder if not impossible to quantify. The managers at CCC made a conscious decision to measure some factors and omit others due to time and fiscal constraints. They also made all their assumptions based on the worst case scenario. All estimates and numerical justification were made using the most conservative estimates. This allowed them to report confidently to senior management knowing their results reflected the most realistic findings and expectations.

Information systems escalating expense and growing importance to organizations have made the justification of projects increasingly critical. This study demonstrated that traditional cost benefit analysis could be applied to large scale information systems projects such as infrastructure and enterprise resource planning. Extending the traditional methodology, the study illustrated how intangible measures can be used to augment CBA analysis and include what was once believed not considered measurable. This improved analysis provided CCC's managers with a more accurate and realistic look of the returns expected as a result of undertaking the ERP implementation.

7. References

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