

InterCon Travel Health Case Study

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Abstract

InterCon provides services to health insurers of foreign tourists who travel to the United States and Canada. After experiencing high growth, the company confronts several operational challenges. As a responsive measure, management considers developing an IT system. The system must go through the formal capital investment evaluation process, which requires estimation of costs and benefits and uses the NPV method. Subject to uncertainty, "soft" benefits are computed from probability distributions. All costs and benefits are treated as discounted cash flows. Employing a Monte Carlo simulation modeled in a common spreadsheet program, management must decide whether to fund the IT system.

Keywords: IT system development, soft benefits, Monte Carlo simulation, NPV analysis
Disciplines of Interest: Information Technology, Decision Support Systems, Finance

INTRODUCTION^{1,2,3}

This case study involves students in an IT planning exercise. Broadly defined here, IT planning involves activities related to the evaluation of a capital investment in a new computer-based application. The general objective is to decide whether the new application provides sufficient benefits to justify the costs. More specifically, the case study has these objectives.

- Identify typical costs and benefits that are associated with a new computer-based application.
- Apply discounted cash flows to cost and benefit estimates in order to account for realistic time considerations that occur in application development and use.
- Base benefit estimates on probability distributions to deal with the uncertainty that commonly arises when measuring them.
- Model the capital investment evaluation problem using a Monte Carlo simulation in a common spreadsheet program.
- Integrate terminology and concepts from information systems, finance and statistics into one practical

managerial decision-making context.

MOTIVATION

There is need for general analytic methods that facilitate reasonably complete and accurate evaluation of capital investments in computer-based applications for at least two reasons. First, there is some skepticism of and critical disposition towards investing in application development projects, because projects fall short of expectations by coming in over-budget or by lacking planned features.⁴ In the worst case, entire systems are scrapped causing large investments to be written off. Second, proposed applications compete for limited resources with capital investments in buildings, equipment and other assorted long-term assets.

THE AUDIENCE

Central features of our general analytic method are taken from finance and statistics principles. Finance principles include discounted cash flows (or the time-value of money) and capital investment evaluation methods (e.g., net present value). Statistics concepts include probability distributions as a means to deal with decision uncertainty. These concepts are generally taught in introductory (or core) finance and statistics courses. Thus, any course that generally occurs after introductory-level courses would offer suitable contexts, such as finance, statistics, data modeling and information systems electives. This case study may also be used in a “capstone” course, since it integrates concepts from three disciplines into one practical decision-making context.

INTERCON TRAVEL HEALTH: CASE⁵

Toronto-based InterCon Travel Health provides services to health insurers of foreign tourists who travel to the United States and Canada and experience injury or sickness while there. As an example, consider a Spanish tourist who falls on the steps of the Museum of Modern Art in New York City and breaks his hip. This tourist will obviously require surgery before returning to Spain. After the tourist contacts his health care insurer, the foreign entity may work with InterCon to facilitate the insurer’s obligations to the patient and provider. In short, InterCon will find a local health provider, and will handle all administrative and payment needs related to the surgery and hospitalization. InterCon is effectively a “middleman” between an American and Canadian health care provider network and foreign health insurance entities.⁶

Like any HMO, InterCon has a network of doctors who give discounted rates in return for a guaranteed customer base. The providers discount their rates in exchange for a commitment of relatively prompt payment from InterCon as well. Moreover, the customer base consists of sick or injured foreign tourists, a potentially profitable customer segment because *most* tourists require only minor treatment and rarely come back for follow-up visits. Consequently, InterCon can pass significant savings along to the foreign insurer, which may otherwise be forced to pay a higher claim to a provider not in InterCon’s network. In exchange for the lower claim fee, the foreign insurers pay a processing fee to InterCon. Another advantage from the insurers’ perspective is dealing with a single point-of-contact while administering claim payment. InterCon’s processing fee is currently set at 9.5% of the claim amount, which is divided evenly between the providers and insurers. InterCon will hold back 4.25% of the claim amount from the payment to the provider, and will add 4.25% above the claim amount to the foreign insurer’s charge.

The travel health care market has grown significantly during the past few years, and InterCon has grown with it. In 2001, InterCon had begun experiencing increasing difficulty with a claims processing procedure that was largely manual. With the annual number of claims having reached 20,000, the company realized that it must begin automating more of the business processes involving claims. This was particularly true provided the expected growth rate in the short term. Management was currently planning for an expected 3% annual growth rate in claim volume, and they were fairly certain that growth would hold in the 2-4% range in the short term.

In addition, the claims volume was highly cyclical, lagging about four to six weeks behind peak travel times. Thus, the bulk of claims came in from around mid-July to late-September, and the company routinely experienced a spike in late-January through early-February. Because substantial time and investment were needed to train claim administrators in this specialized area of medical claims administration, use of temporary workers was impractical. Therefore claims administration staff levels were held constant during peak processing times.

This resulted in an expanding claim backlog as the claims administration staff fell increasingly behind during the peak times. Eventually the staff could catch up as the peak travel times passed and claim volume fell. However, this situation potentially resulted in significant delay between the time that a claim came into InterCon from a provider and the time that the claim amount was collected from the foreign insurer—particularly for those claims that came in during the latter half of summer’s peak travel time. While the staff tried to identify and prioritize the larger claims, they were not always successful in accomplishing this. In general, those claims received from mid-August through mid-September usually did not get processed until after October 1.

Because of this delay, InterCon often missed the deadline for filing claims with the foreign insurers, resulting in a significant number of non-collectible claims. The filing deadline was typically six weeks, although there was some variation across countries. Despite the fact that InterCon could not obtain payment from the foreign insurers, the company was still responsible to reimburse the provider. These non-collectibles resulted in dollar for dollar lost claim income, and many claim administrators believed that the problem was getting worse.

Finally, while the company’s management believed that they had been effective at keeping processing costs to a minimum, they did realize that procedures wholly reliant on manual effort left room for improvement. The procedures could never be entirely automated due to the complex nature of the claim administration task in this highly specialized area of medical claim administration. Nevertheless, management was interested in assessing what impact a new system might have on claim administration costs.

IT application project evaluation and prioritization

“With the company growing so quickly, each business project has to be successful in raising revenue, cutting costs, or providing a strategic advantage with customers,” says CEO Carmen Rodriguez. Recently the company developed a relatively straightforward process that is used to evaluate every project. The

process is performed by six senior executives, who make up the project evaluation committee.

The committee splits into two groups. One group includes the CIO Richard Nettleson and the heads of operations and research and development, and it analyzes the *costs* of every project. The other group consists of the two chief marketing officers and the head of business development, and it analyzes the expected *benefits*. With regard to benefits, the group typically focuses on expected impacts related to revenues and client retention. Each group has several staff members who assist with some of the more complex problems related to estimating a project's costs and benefits. In general, the groups do not discuss a project until both sides have evaluated it in order to stay objective. Each group's analysis is recorded in a spreadsheet, and these are merged to facilitate subsequent conversations and meetings. For any project, the decision outcomes are approve, pass over, or table for future consideration.

Rodriguez says the process works reasonably well. The two groups focus on their immediate task, and they stay honest with respect to not leaking information to the other group. This avoids the potential problem of an evaluation process that may not fully look at benefits after realizing that costs will be quite high for instance. This might cause the evaluation team to prematurely decide to pass over the project, thereby overlooking some potentially high-payoff projects. So there is always a full vetting of costs and benefits for each project. Rodriguez says, "We see all the options, get a thorough assessment of costs and benefits, and then find the winners."

The claim automation project proposal

In early 2001, one of the marketing teams proposed a project to begin automation of the claims processing system. The proposal came out of an important observation—most of the company's revenue comes from claims for in-patient hospital stays, which average around \$10,000, and the company was not collecting on these in some instances. Referred to as Class A, these claims represent 20 percent of InterCon's claims and over 80 percent of its claim income. The remaining 80 percent of claims consists mostly of clinic and hospital emergency room visits. These claims are divided into two classes referred to as Class B (30% of claims) and C (50% of claims). Class B claims involve a minor ailment that requires modest medical intervention. Class B claims averaged about \$1,000. Class C claims involve someone who believed he was sick or had been hurt, and sought medical attention only to learn that no medical treatment was necessary. Class C claims averaged about \$100, which was the typical average minimum fee for a visit.

The cost associated with processing these medical claims was generally high. The staff had to frequently follow up with the foreign insurers in order to pursue payment. The foreign insurers frequently contacted InterCon with questions concerning the claim. These questions typically focused on one of two points of clarification: (i) explanation of procedure codes and (ii) explanation of the meaning of English, and to a lesser extent French, medical terms. In addition, the medical providers were frequently contacting InterCon seeking explanation for why they had not been paid. The volume of contacts was increasing along with the volume of claims. In general, the staff tried to spend the most time on Class A claims, since there was more claim income involved, and the least time on Class C claims. A recent study estimated that the cost of processing Class A, B and C claims at \$300, \$125 and \$50 per claim, respectively. Both management and staff were surprised that the study showed the cost of processing Class B and C claims to be higher than their contribution to revenue in terms of the processing fees generated.

The project's benefits

Anticipating features of the new automated system, the benefits group identified at least two clear benefits. First, they believed that a claim processing cost savings should occur. For example, one new feature included an online form that providers could use to submit claims. A second form would be used to allow providers to track the status of a claim, and a third form provided similar capability for insurers. These features would offload some of the data entry work and reduce the number of provider and insurer contacts, thereby decreasing the demand on claim administrators' time. Unfortunately, despite the general agreement that a claims processing cost savings would occur, the members disagreed on the amount of savings.

In order to solve the problem, they decided to conduct a survey that would ask respondents to estimate the average decrease in claims processing costs due to the new features. The committee included themselves as individual respondents, in addition to others whose informed opinion might yield reasonably reliable estimates, such as some mid-level managers who had substantial experience with the company and all current claim administrators. Considering that current claims processing costs were \$2,450,000, each respondent estimated the annual savings. While most respondents contemplated the reduction in terms of percentage figure, they were asked to respond with a nominal dollar figure. These estimates averaged out at an annual savings of \$400,000, and they had a standard deviation of \$30,000. These figures related to all claim classes.

A second benefit related to the potential impact on lost claim income. It was believed that the system's new features would free up enough time such that the claim administration staff could be more effective in pursuing payment by the foreign insurers. Moreover, since the data were being submitted online, the system could reliably identify all Class A claims based on claim amount. In the past, some Class A claims eluded detection and sat unprocessed, thereby missing the deadline. This had substantial adverse financial impact that was simply unnecessary and could easily be avoided. In addition, it was considered that claims could be prioritized by country, with claims to foreign insurers of countries with shorter filing deadlines prioritized over those with longer filing deadlines.

Currently, 4% of Class A claims are non-collectible. 12% and 25% of Class B and C claims end up being non-collectible, respectively. The benefits group decided to focus on Class A claims, because these were obviously more important due to their higher average value. If necessary, the group could come back and consider the other classes. As it turned out, the benefits group also had difficulty agreeing on the amount of potential impact on lost claim income, so they also included this on the survey as well.

Considering that current annual lost claim income for class A claims was four percent or 1.6 million, each respondent estimated the annual savings. Most respondents believed that the new system could bring the non-collectible rate down from four to one percent, however others had slightly higher and lower estimates. In terms of dollar amounts, these estimates averaged out at an annual benefit of \$1,200,000 *reduction* in lost claim income. The standard deviation was \$40,000. These figures related to class A claims only.

The discussion on non-collectibles created awareness among the benefit group members that, to the extent

the data are in electronic form, the overall potential for improving managerial decision-making and customer service quality should be significantly enhanced. With regards to customer service quality for example, information would be more accessible thereby reducing the time needed to respond to insurers' and providers' standard questions and requests. This would increase general responsiveness, which should translate into improvement in perceived customer service quality. In the long run, higher customer service quality would likely attract more insurers and providers, thereby generating more processing fees. The committee believed that they had identified only a few of the potential improvements in customer service quality.

In any event, the benefits group found that agreeing on the *degree* of potential impact on customer service quality—particularly how this impact might translate into dollar figures, was particularly contentious. There was wide disagreement among the benefit group members on this. Having included this on the survey as well, the benefits group found that respondents' independent estimates also varied widely. The respondents' estimates yielded an average annual *increase* in processing fees of \$1 million with a \$750,000 standard deviation.

The project's costs

The costs group determined that the project consisted of two modules—an online claims entry module and an automated claims processing module. Each one would have to be built, and then the two would have to be integrated. The group knew that *any* integration project would likely be complex and lengthy, however they were at a complete loss as to how to estimate the costs associated with integrating two modules that did not yet exist. In the end, the costs group decided that the modules would be built, and then integrated at a later time. They reasoned that collecting the data online and *semi-automating* claims processing—i.e., automating some steps of claim processing after the claim data are checked out by the claims staff, was a substantial improvement over the current system. “It's not real-time, but it's still fast,” commented one member of the costs group.

As a next step, the costs group determined that building the modules would require about two years of development effort. While the company had little experience in developing web-based applications, some members of the costs group consulted with development managers of other insurance companies. Although many advised using an application service provider (ASP), InterCon's management knew that no ASP existed that would provide the needed modules due to the relatively unusual nature of the business context. They realized early on that they would have to custom build the modules.

The effort would require a variety of skill sets from IS personnel. After preliminary discussions, they planned for five systems analysts, eleven programmers, two security and networking specialists and one project manager. The salaries for these positions varied widely, but the group was knowledgeable about average salary levels for the Toronto area. A systems analyst earned \$70,000 per year on average, a programmer \$55,000, a security and network specialist \$85,000 and a project manager \$125,000. They estimated that two years of development effort would be required to design, program, test and implement the customized modules. Based on past experience, they also knew that the development costs would be greater in the second year, so they planned for a 40% increase in the development staff during the second year. Finally, as one last precautionary measure, the costs group set up a contingency fund for hiring consultants in the event that the firm could not complete the project using in-house expertise. They set aside a \$500,000 contingency fund for consultants for each year.

Having invested in technology during the previous five years, the firm currently had excess computing capacity. Thus, the costs group estimated that no additional hardware or software would be needed. Nonetheless, ongoing operations and maintenance costs to support the modules would be incurred. Operational costs included overhead charges stemming from operation of the data center where the computers are housed. Other operational costs resulted from various tasks like generating and distributing routine and ad hoc reports, backing up the system, monitoring system performance, and guarding against potential virus and hacker attacks and the like. Maintenance costs covered efforts to keep the operating system, networking and security programs current with patches and upgrades. Maintenance costs also included efforts to modify the application software to deal with changes in the business environment that invariably occur.

The costs group estimated the modules' operational costs to be \$110,000 during the second year of development. Starting the operational costs at this point was prudent, because it was expected that the development group would have a working prototype on which they would iterate a program-test-program-test procedure in order to refine the modules' features, and until they had adequate operating reliability. A test environment that would mimic the operational environment was essential to enhance testing validity. The costs group planned for a 5% increase in operating costs per year.

After two years of development effort, the modules would be implemented and maintenance costs would begin to incur. The group estimated the maintenance costs to begin at \$150,000 and to increase at 10% per year. Normally they planned for 5% per year increase, however the nature of web-based technology and on-going security developments suggested that the pace of patches and upgrades would be relatively rapid. Other maintenance tasks were expected to occur with greater frequency as well.

The project's lag

With regards to IT development projects, the management team knew that benefits always lag behind much of the costs. There are usually unanticipated problems that come up during and shortly after implementation. Additionally there is usually a learning curve for affected groups, so it takes time for groups to use the system in an optimal way. Based on past experience and the nature of the considered system, management estimated a lag in benefit realization of about six months after implementation. Thus, only about one-half of the estimated benefits would be realized in the first year after implementation.

A green light?

Being very rational in its approach, InterCon considers one factor when determining whether to undertake a project—how much money will a project return? InterCon has traditionally used the 5-year NPV to assess return. The company currently assumes a 10% cost of capital in arriving at a NPV figure. The project planning process concludes with the calculation of a 5-year net present value (NPV) figure based on the costs and benefits previously identified.

While the company's management team recognized that any capital investment yielding a positive NPV made sense to fund from a rational perspective, the fact that many projects competed for funding significantly limited the number of projects that could be funded in any given year. After prioritizing projects based on 5-year NPV and allocating the investment capital accordingly, the company had been able to fund projects that had about a \$3,000,000 5-year NPV or greater from year to year. Therefore from a *practical* perspective, the company generally used a \$3,000,000 5-year NPV as the cut-off on which to base funding decisions. Thus, projects that yield \$3 million or higher are approved. For projects that come in just under this cut-off, they may be tabled for future consideration. Projects that are well under the cut-off are passed over. Both groups were anxious to know what decision outcome would result from their analyses.

Discussion questions

1. Comment on the way InterCon has structured its project evaluation committee. Do you think it is wise to have a benefits and a costs group that focus only on the respective area? What might be the advantages and disadvantages of structuring the decision-making group in this way?
2. What are the specific costs and benefits that are associated with these modules?
3. Should the company fund the project based on the funding criteria and information presented in the case?
4. Are there other *costs* or *benefits* that are not considered in the case, but may in fact come into play? In considering these costs and benefits, should the company fund the project?
5. Finance theory suggests that any project with a positive NPV should be funded. The proposed project may have a positive NPV, but management will not fund it unless it meets the approximate 3 million 5-year NPV criterion. How would you reconcile the company's policy and practice with theory?
6. Consider the assumption of 10% cost of capital. Is this an appropriate rate for a capital investment of this nature? If not, would you argue for a higher or lower rate? Why? What rate would *you* choose? May we generalize about any factors that may systematically influence the assumed rate?
7. What cost of capital rate would you assume for an investment in an Internet start-up firm versus a restaurant franchise outlet? Is the rate that you chose for the project in question 6 closer to the Internet or restaurant option? Explain this.
8. What are the risks of *not* funding the project, especially in light of the expected growth rate? Are there adverse consequences for claims processing costs, lost claim income, processing fees or for some other cost or revenue figure that could be anticipated and measured?

SESSION PLAN

Setting the stage

Begin by explaining that any application development project will generate some set of costs and benefits. In considering illustrative examples, the instructor may usefully select one that most students can relate to.

- A bank's network of ATM systems: A bank invests in a network of ATM machines (costs) in order to provide more convenience to customers and to reduce the average time to conduct a demand account transaction (benefits).
- A company's Internet site: A company designs and deploys an Internet site (costs) in order to reduce the number of customer inquiries about products and follow on support and to establish a global presence (benefits).
- A university's classroom management system: A university invests in a classroom management system (costs) in order to improve the variety and speed of information accessibility and to provide alternative ways to communicate and to conduct collaborative assignments (benefits).

Identifying common costs and benefits

While delaying focus on the InterCon facts for the time being, ask the students to identify some specific costs and benefits that are typical of most applications. The presentation file shows some examples. We find that starting with costs works best because they tend to be more obvious than benefits. It may be useful to lay out the benefits in a pattern similar to that shown in Figure 2. This will set the stage for later discussion on hard and soft benefits. (re: IT-Planning.ppt; slides 4-9).

Understanding the typical pattern of costs and benefits

An application development project will incur substantial costs before generating any benefits, which is a typical pattern. This pattern is illustrated in Figure 1. Moreover, the costs differ in terms of how frequently they occur, consequently costs can be distinguished by one time (up-front) costs and recurring (ongoing) costs. On the other hand, while some benefits may occur only once, most are recurring in nature and will be treated as such in the case. In summary, a typical application development project will incur costs and generate benefits in a usual pattern that is characterized by large one time costs, followed by recurring costs along with assorted benefits. (re: IT-Planning.ppt; slides 10-12).

Place Figure 1 about here

After the life-cycle phases are introduced, it may be useful to summarize these key points: (i) one-time costs are incurred during development phase, (ii) recurring costs are incurred during use phase, (iii) most benefits are realized during use phase, and (iv) unexpected problems and an adaptation period will cause a lag in benefit realization after implementation.

Assumptions

We assume that a typical application development project is lengthy--lasting years rather than months or weeks. We also assume that a project will incur costs and generate benefits in a usual pattern described above. In light of this, the planning horizon should be set several years into the future in order to adequately capture the recurring costs and benefits. This argues for applying discounted cash flows to costs and benefits in order to arrive at a truer current (or present-day) value.

Any application will generate some set of benefits. In practice, we find that the ability to quantify any benefit will vary on a continuum that is characterized by lesser to greater degrees of difficulty. Thus, there is a natural tendency to focus on those benefits that are relatively easy to quantify, and to avoid or disregard the ones that present difficulty. In this case study, we assume that any benefit may be quantified under conditions of uncertainty. One means to deal with uncertainty that may present in assorted decision-making contexts is to use probability distributions.⁷ In this case study, we will use probability distributions to quantify a set of expected benefits under conditions of uncertainty.

Discounted cash flows and capital investment evaluation methods

As indicated earlier, application development projects incur one time costs in addition to recurring costs and benefits. In order to evaluate investments in new applications, any associated costs and benefits must be quantified. One may define quantification as estimating the value of any cost or benefit in some nominal currency. Any simple example may make the point that spending resources as an investment (costs) may be done for the purposes of reducing annual expenses (benefits) or generating additional revenues (benefits). This will facilitate thinking about costs and benefits in terms of cash flows. Also, because we assume that applications are used for long periods, the cash flows must be forecast several years into the future. Under these conditions, discounting expected cash flows accounts for the time-value of money, which derives a *more* accurate measure of the application's current or present-day value.⁸

There are several methods that may be used to evaluate capital investments. These include payback (PBK), net present value (NPV) and internal rate of return (IRR). While each method has its strengths and weaknesses, NPV is the preferred method for use in long-term capital budgeting analyses such as those presented in this case study. NPV has a number of advantages over the other two methods as it both considers the time value of money and provides the value of the project in today's dollars.⁹

Cost estimation

On a practical level, costs may be classified as development, maintenance and operations costs. Development costs consist mostly of the one time costs, and maintenance and operations costs are generally the recurring costs. Maintenance and operation costs are often a considerable portion of total

costs incurred during an application's life. In estimating costs, managers confront several challenges.

First, there is temptation to set the planning horizon too short. This may occur because the estimates become less accurate as they are projected farther into the future, which argues for shortening the planning horizon. On the other hand many applications' life expectancy is 15-25 or more years, which argues for extending the planning horizon. In short, there are several forces at work to create tension in setting an appropriate planning horizon. To the extent that managers are aware of this tension, they will be more effective in balancing it and negotiating toward a satisfactory planning horizon.

Second, there is temptation to short-cut planning efforts. This may occur because some costs may be difficult to quantify, thereby requiring considerable time commitment to come up with reliable estimates. Additionally, time pressures may create an imperative to move the capital investment decision toward resolution. The combined quantification difficulty and time pressure may cause managers to short-cut their planning efforts by ignoring some costs or by providing biased estimates. In response to the time pressure issue, one may legitimately argue that capital investments have long-term implications therefore thorough evaluation and attendant time is critical. There are various techniques for mitigating the quantification difficulty, and the case study offers one that deals with uncertainty reduction through probabilities.

For these and other reasons, there is a common tendency for a significant share of actual costs to remain unaccounted for during capital investment assessment. On a conceptual level, these costs may be called hidden costs. Hidden costs contrast to apparent costs, which are accounted for. One broad management objective is to effectively deal with the cost planning challenges such that a greater share of actual costs end up being apparent rather than hidden. (re: IT-Planning.ppt; slides 19-21).

Benefit estimation

One management challenge relates to the potentially significant delay between when costs are incurred and benefits are realized. This occurs partly because the development phase is often lengthy, perhaps lasting 1-2 years or more. Thus, there is significant expenditure outlay as the majority of one time costs are incurred before any benefits are realized. Additionally, there is a lag in benefit realization as unforeseen problems arise and affected groups learn and adapt to the new system after implementation. Thus, many IT managers find themselves in a position of defending the worthiness or value of a new application as the development phase draws on and perhaps into the use phase as well if the lag is severe. In some cases, applications have been abandoned during this period.

In response, one may take advantage of applications' modular nature and follow an incremental implementation strategy. Under an incremental implementation strategy, management may introduce parts of the application's capabilities (or modules) in successive stages. This will allow for shorter and staggered development phases for different parts of the application, thereby reducing the time until some benefits are realized. While these benefits are only partial ones, it provides project advocates with some short-term "wins" to fend off potential criticisms concerning the project's value. With regards to the learning curve effect on benefit delay, one solution is for management to assure ample planning and adequate funding for training programs and support staff in order to minimize the learning curve's duration. (re: IT-Planning.ppt; slide 23).

A second management challenge relates to quantifying some benefits. Where benefit quantification is more or less difficult, we may call these hard or soft benefits, respectively. (Refer to Figure 2.) For example, hard benefits may include reduced costs in the form of labor cost savings where the application automates a manual task. Alternatively, an application may be introduced into facilities in order to provide monitoring and control capabilities that reduce fire and theft risk. This may reduce costs through lower insurance premiums. In these cases, there is a relatively obvious cost savings that can be estimated through reduced wages or insurance premiums.

Place Figure 2 about here

Soft benefits present a more challenging effort because they are, by definition, comparatively difficult to quantify. Soft benefits may occur where applications provide for “richer” data sources, such as more expansive electronic databases that offer data of higher granularity, of current and historical nature, or of internal and external sources. In general, richer data sources are argued to lead to more effective managerial decision-making, which should logically lead to improved firm performance. Alternatively, applications that support workers’ communication, coordination and collaboration efforts through electronic mediated means allow these efforts to proceed at a faster pace and expand the range of communication modalities that may be used. Therefore employees should be able to work more efficiently, which should logically lead to improved firm performance. However, there is significant challenge in quantifying the value of “...more effective managerial decision making” or “...improved communication, coordination and collaboration efforts.” Quantification difficulties present in other ways. Most applications simultaneously produce hard and soft benefits. While managers may have an intuition or gut-feel that an application will lead to certain soft benefits, they often fail to include them in any formal analysis because of the quantification difficulty. But this does not provide for a complete assessment of all benefits.

We argue that the conceptual distinction presented in Figure 2 identifies a *continuum* that reflects *varying* degrees of quantifiability. In this sense, the hard versus soft benefit distinction is relative in nature, and is intended to highlight that the benefits that present in practice will likely vary the full range of quantifiability. Moreover, there may be disagreement on whether a benefit is appropriately classified as hard or soft.

In summary, there is a common tendency for the soft benefits to be ignored, because management assumes they cannot be quantified at all or only after considerable time. Thus, one broad management objective is to counteract this tendency by keeping soft benefits in the capital investment evaluation. Our general analytic technique can be applied to both soft and hard benefits (and costs) if desired. Therefore we derive a more complete evaluation of the application, and thereby yield a less biased comparison in relation to other capital investment options. (re: IT-Planning.ppt; slides 24-28).

The Monte Carlo simulation model

The specific benefits from the case include claims processing cost reduction, lost claim income reduction

and service quality enhancement. The estimates of these benefits are subject to uncertainty. Uncertain outcomes are often modeled using probability distributions that incorporate a manager's view of possible scenarios.¹⁰ The most widely used probability distribution is the normal distribution. It is shaped like a bell, which means that numbers in the middle are more likely to happen than numbers away from the middle. It is also entirely characterized by its *mean* (also called *expected value*, or *average*) and *standard deviation*. If they are known, the distribution is uniquely defined and all probabilities can be computed. This makes the normal distribution particularly useful in practice. For example, if the goal of a manager is to incorporate risk in the estimate of future benefits, she can model future benefits as a normal distribution. The mean of this distribution will be a value representative of the benefits the manager expects on average, and the standard deviation will be an estimate of the volatility in these benefits. The actual numbers for the mean and the standard deviation can be obtained from expert opinions, or from data on the distribution of benefits of similar projects in the company or the industry.

In spreadsheet Intercon.xls, we use the normal distribution to model the uncertainty in benefits, and run a Monte Carlo simulation in a common spreadsheet program (Excel) to study the effect of the assumed uncertainty on the NPV of the project. Excel's random number generating capabilities are limited – it can only generate a number between 0 and 1 using the command '=RAND()'. However, if one can generate a random number between 0 and 1, one can generate a random number from any probability distribution. This is because of the fact that the total area under a probability distribution curve is always 1. Suppose that the number generated by RAND() is 0.975. The number 0.975 can be thought of as the cumulative area under the bell-shaped curve up to some number on the x-axis. Therefore, to generate a random number from the normal distribution, one can simply calculate the value on the x-axis of a normal distribution so that the area under the curve to the left of that number is 0.975. The Excel function NORMINV(probability, mean, standard deviation) helps “invert” the area (probability) under the normal curve to obtain the actual random number on the x-axis. Thus, the formula '=NORMINV(RAND(), mean, standard deviation)' can be used to generate random numbers from a normal distribution with the specified mean and standard deviation. (re: IT-Planning.ppt; slides 29-31)

Pressing the CALC/F9 key makes Excel recalculate all random numbers. Pressing F9 several times can help illustrate to students the volatility in the possible values for the benefits and, respectively, the volatility in the NPV. However, it cannot give them a clear idea of the actual range of possible values for the benefits, because Excel does not keep track of random values that have occurred previously. To build a distribution for the possible values for the benefits and the NPV, we create a spreadsheet with 100 columns, each corresponding to a different realization of a random number. (Refer to the Appendix; ProbOut worksheet). Each of these 100 columns can be thought of as a *trial*, or a *scenario*. There is no need to use the F9 key, unless we want to illustrate that every time we press the CALC/F9, we generate a different set of 100 scenarios. The values of the NPV for the 100 possible scenarios can be used to create summary data, such as the NPV's expected (average) value, standard deviation, probability that it is less than zero, probability that it is over 3 million and so on. Some of these summary data examples are shown. (Refer to the Appendix; ProbOut worksheet). For example, the probability that the NPV will end up negative can be estimated by counting the number of scenarios out of the 100 that end up negative in the simulation, and dividing by the total number of simulated scenarios. The exact Excel formula in our model is in ProbOut!B52: =COUNTIF(\$B\$48:\$C\$48,"<0")/COUNT(\$B\$48:\$C\$48).

Remark. 100 scenarios is a relatively small number. The higher the number of scenarios, the more accurate the estimates of the costs and the NPV will be. However, if there are more scenarios, Excel slows down significantly, because it recalculates the spreadsheet after every entry. This is a limitation of Excel as a simulation tool. In order to avoid this limitation altogether, consider using Excel simulation

add-ins such as Crystal Ball and @RISK. These add-ins handle hundreds of thousands of scenarios, keep track of the descriptive statistics of the simulations, and enable the user to simulate a number of different distributions in addition to the normal distribution. Alternatively, one may disable Excel's automatic recalculation, and press F9 when recalculations are necessary. To disable automatic recalculation, go to TOOLS | OPTIONS | Calculation Tab and set calculation to manual.

Remark. More advanced students may notice that the average value for the NPV they obtain from the simulation is (approximately) the same as the value they obtain if they plug in the average estimates for benefits in the formula for the NPV. This is the exception rather than the rule. The NPV is a simple linear combination of costs and benefits, and its exact mean value can be computed from the mean values for the uncertain benefits. However, in many real-life situations the quantity a manager wants to estimate is a more complicated expression of uncertain inputs. Simulation is particularly helpful in such cases. In the case of InterCon, simulation can still help a manager gain important insights not only about the average and the standard deviation of the NPV, but also about the distribution of the NPV as a whole, and the impact of different factors on the variability in this distribution.

Remark. The case states that the management team expects about a six-month lag in benefit realization after implementation. This would affect benefit levels the first year after implementation or year 2 in the model. The lag duration may be entered in ProbOut!B2 as number of months. The model is built on the assumption that the lag will range between 0 - 12 months, therefore any potential lag will affect benefit levels in year 2 only.

Remark. The case suggests that the company will continue to experience growth. We assume that overall growth in claims will result in corresponding growth in benefits, because claim volume directly impacts the cited benefits. However, while our current assumption models a linear relationship, the functional form is probably more complex in reality. In an effort to hold the complexity of the model to a manageable level, we model a linear relationship between claim volume and impact on cited benefits. More specifically, the monetary value of each benefit will increase at 3% per annum (cells B3, B4 and B5 in worksheet ProbOut). The values in B3, B4 and B5 can be changed to model different growth rate assumptions, and will have an effect on the NPV results from the simulation, e.g., on the probability that the NPV will be negative. The instructor may want to discuss why one would make different assumptions on the growth rates, and how the different results from the simulation will affect the decision a manager would make. The growth rates are currently modeled as constant; however, it is easy to make them random variables. For example, if one believes that the growth rate for the benefits of claims processing cost reduction could be anywhere in the range 2% - 4%, one can enter the formula $=0.02+RAND()*(0.04-0.02)$ in cell ProbOut!B3. This formula will generate a random number between 2% and 4%.

The in-class exercise

The exercise's objective is to answer the question—should the company fund the project? Useful figures to examine at this point would be the average 5-year NPV, its volatility, the probability that the NPV is less than zero, and the probability that the NPV is over 3 million. If the students have modeled the problem correctly, the 5-year NPV will be in the general range of \$2.1 to 2.5 million under the assumption of 10% cost of capital. Moreover, the probability that the 5-year NPV is over 3 million is usually between 20-27%, or about one-in-four chance. Thus, the decision outcome should be to "...pass over the project," since the average 5-year NPV figure is more likely than not to be below the 3 million

criterion. (Refer to the Appendix; ProbOut!B50:B53.)

Some may argue that a 5-year planning horizon is not long enough, and in fact runs counter to an earlier view that "... many applications' life expectancy is 15-25 or more years, which argues for extending the planning horizon." (p.14) The instructor may advise that five years is used for pedagogical reasons. In practice, a longer planning horizon is advisable and the students may pursue this outside of class by modeling a 10, 15, 20 and 25-year horizon.

Some may respond that not all costs and benefits identified in discussion question 2 are accounted for however, such as the benefit associated with reducing the non-collectible rates on Class B and C claims. Additionally, discussion question 4 may identify other costs and benefits that could be included in the analyses. The instructor may make reasonable assumptions and incorporate these or other benefits into the model in order to show its robustness. In so doing, one may simulate the sampling method that is used to derive the average and standard deviation figures that are presented in the case. A three-step sampling method procedure is outlined here.

A. Pick one benefit and ask each class member to quantify that benefit by recording an estimate on a piece of paper. While they can estimate in terms of percentage figures if that is conceptually simpler, they must provide their response using a monetary value.

B. Sample the class for their answers and compute the average and standard deviation. Make a judgment call as to how many students to query. About 10-15 responses are sufficient for this exercise.

C. Incorporate the new variable into the model. Most changes will occur on the NPV and ProbOut worksheets.

The larger IT planning context

As capital investment decisions relate to application development projects and at a broad level, the general steps involve (i) identifying, (ii) evaluating, (iii) prioritizing and (iv) selecting several projects. The NPV method can be used to not only evaluate but to prioritize and select projects as well. In general, projects yielding higher NPVs have higher priority, and projects yielding a positive NPV are selected. However, most firms operate with limited resources so selection criteria may be modified accordingly. For example there may not be enough resources to fund all projects with a positive NPV, so another (higher) threshold or criterion value must be used instead in order to bring the number of selected projects in line with available resources. Finally, while NPV and other capital investment evaluation methods provide for an objective or rational approach to project evaluation, prioritization and selection, capital investment decisions may be subjugated to competitive and political influences.

APPENDIX: THE MONTE CARLO SIMULATION IN EXCEL

ClaimAnalysis – A worksheet that models assorted data on key variables by claim class and totals. All figures show annual amounts.

Claim Class	# Claims by Class ... as % of Total	Average Claim Amount	Claim Income ... as % of Total
Class A	4,000 20%	\$ 10,000	\$ 40,000,000 85%
Class B	6,000 30%	\$ 1,000	\$ 6,000,000 13%
Class C	10,000 50%	\$ 100	\$ 1,000,000 2%
Total (Annual)	20,000		\$ 47,000,000

Claim Class	Processing Fee Rate	Processing Fees	Average Claim Processing	Claim Processing Cost	Non-collectible Rate	Lost Claim Income
Class A	9.5%	\$ 3,800,000	\$ 300	\$ 1,200,000	4%	\$ 1,800,000
Class B	9.5%	\$ 570,000	\$ 125	\$ 750,000	12%	\$ 720,000
Class C	9.5%	\$ 95,000	\$ 50	\$ 500,000	25%	\$ 250,000
Total (Annual)		\$ 4,465,000		\$ 2,450,000		\$ 2,570,000

ProbOut—A worksheet that models all benefits (blue background) and costs (yellow background). The benefits are subject to uncertainty, so probabilities are used to calculate estimates. These estimates are generated from the random number function (blue font) and the NORMINV() function, and they recalculate when the CALC/F9 key is pressed. The worksheet is setup to provide 100 trials. Fewer trials may be used, but the benefit estimates will become more unstable.

Variable	Mean	Std. Dev.
Claims Processing Cost Reduction	\$400,000	\$30,000
Lost Claim Income Reduction	\$1,200,000	\$40,000
Service Quality Enhancement	\$1,000,000	\$750,000

Year	Total Benefits	Total Costs
Year 2	\$1,579,566.84	\$1,733,261.63
Year 3	\$4,611,211.86	\$1,952,010.99
Year 4	\$3,419,987.41	\$3,482,484.78
Year 5	\$5,237,537.11	\$3,628,454.22
Total Benefits Year 0	\$1,750,000.00	\$1,750,000.00

ProbOut (continued)—Simple formulation renders the cost values, which are not subject to uncertainty. The costs are identical across all 100 trials. The costs and benefits are totaled and discounted at the bottom (green background). A difference shows a 5-year NPV for each trial. Summary data on the 5-year NPV figures are shown in brown font.

Trial No	1	2	3	4	5	6
27 Development Staff	\$1,250,000.00	\$1,250,000.00	\$1,250,000.00	\$1,250,000.00	\$1,250,000.00	\$1,250,000.00
28 Consulting Contingency	\$500,000.00	\$500,000.00	\$500,000.00	\$500,000.00	\$500,000.00	\$500,000.00
Total Costs Year 0	\$1,750,000.00	\$1,750,000.00	\$1,750,000.00	\$1,750,000.00	\$1,750,000.00	\$1,750,000.00
30 Development Staff	\$1,750,000.00	\$1,750,000.00	\$1,750,000.00	\$1,750,000.00	\$1,750,000.00	\$1,750,000.00
31 Consulting Contingency	\$500,000.00	\$500,000.00	\$500,000.00	\$500,000.00	\$500,000.00	\$500,000.00
32 Operations	\$110,000.00	\$110,000.00	\$110,000.00	\$110,000.00	\$110,000.00	\$110,000.00
Total Costs Year 1	\$2,360,000.00	\$2,360,000.00	\$2,360,000.00	\$2,360,000.00	\$2,360,000.00	\$2,360,000.00
34 Operations	\$115,500.00	\$115,500.00	\$115,500.00	\$115,500.00	\$115,500.00	\$115,500.00
35 Maintenance	\$150,000.00	\$150,000.00	\$150,000.00	\$150,000.00	\$150,000.00	\$150,000.00
Total Costs Year 2	\$265,500.00	\$265,500.00	\$265,500.00	\$265,500.00	\$265,500.00	\$265,500.00
37 Operations	\$121,275.00	\$121,275.00	\$121,275.00	\$121,275.00	\$121,275.00	\$121,275.00
38 Maintenance	\$165,000.00	\$165,000.00	\$165,000.00	\$165,000.00	\$165,000.00	\$165,000.00
Total Costs Year 3	\$286,275.00	\$286,275.00	\$286,275.00	\$286,275.00	\$286,275.00	\$286,275.00
40 Operations	\$127,338.75	\$127,338.75	\$127,338.75	\$127,338.75	\$127,338.75	\$127,338.75
41 Maintenance	\$181,500.00	\$181,500.00	\$181,500.00	\$181,500.00	\$181,500.00	\$181,500.00
Total Costs Year 4	\$308,838.75	\$308,838.75	\$308,838.75	\$308,838.75	\$308,838.75	\$308,838.75
43 Operations	\$133,705.69	\$133,705.69	\$133,705.69	\$133,705.69	\$133,705.69	\$133,705.69
44 Maintenance	\$199,650.00	\$199,650.00	\$199,650.00	\$199,650.00	\$199,650.00	\$199,650.00
Total Costs Year 5	\$333,355.69	\$333,355.69	\$333,355.69	\$333,355.69	\$333,355.69	\$333,355.69
46 Total Discounted Benefits	\$7,735,272.06	\$6,057,781.56	\$4,879,160.42	\$6,403,383.47	\$5,129,127.75	\$7,116,589.81
47 Total Discounted Costs	\$4,747,887.35	\$4,747,887.35	\$4,747,887.35	\$4,747,887.35	\$4,747,887.35	\$4,747,887.35
48 NPV(5Yr)	\$3,007,384.70	\$1,309,894.21	\$131,273.07	\$1,655,696.12	\$381,240.39	\$2,368,702.46
50 Average	\$2,238,765.11					
51 Standard Deviation	\$1,111,162.14					
52 Probability of Negative NPV	1%					
53 Probability of NPV > 3 Million	24%					

NPV—Summary of all benefit and costs data by year starting at year 0 (current year) through year 5. For the benefits data, each benefit-year figure is calculated as the mean of the 100 trials computed on the previous worksheet. For the costs data, they are entered as constants or simple formulas to account for expected annual increases.

	0	1	2	3	4	5
Cost of Capital	10%					
Benefits						
Hard Benefits						
Claim Processing Cost			\$ 207,234	\$ 424,164	\$ 433,764	\$ 453,474
Lost Claim Income			\$ 619,645	\$ 1,272,819	\$ 1,306,837	\$ 1,354,971
Soft Benefits						
Service Quality			\$ 545,840	\$ 1,056,004	\$ 1,009,559	\$ 1,207,265
Total Benefits			\$ 1,372,718	\$ 2,752,987	\$ 2,750,159	\$ 3,015,709
Costs						
Apparent Costs						
Development Staff	\$1,250,000	\$1,750,000				
Consulting Contingency	\$500,000	\$500,000				
Hidden Costs						
Operations		\$110,000	\$115,500	\$121,275	\$127,339	\$133,706
Maintenance			\$150,000	\$165,000	\$181,500	\$199,650
Total Costs	\$1,750,000	\$2,360,000	\$265,500	\$286,275	\$308,839	\$333,356
Summary						
Net Cashflows	(\$1,750,000)	(\$2,360,000)	\$1,107,218	\$2,466,712	\$2,441,321	\$2,682,353
Discount Factor	1.00	0.91	0.83	0.75	0.68	0.62
Discounted Cashflows	(\$1,750,000)	(\$2,145,455)	\$915,096	\$1,853,277	\$1,667,455	\$1,665,530
Discounted Cashflows (Cum.)	(\$1,750,000)	(\$3,895,455)	(\$2,980,398)	(\$1,127,121)	\$540,334	\$2,205,864
Net Present Value (5yr)	\$2,205,864					

ENDNOTES

1 Portions of this case are adapted from "Two Teams are Better than One," CIO Magazine, 15 July 2001, 74-77. Reprinted through the courtesy of CIO. 2002, CXO Media Inc. All rights reserved.

2 This case is intended as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

3 Any teaching material may be obtained from the authors upon request. These include a spreadsheet file (intercom.xls) and a presentation file (IT-planning.ppt).

⁴ See for example Information Technology for Management, 7th Edition, by Henry C. Lucas, Jr., chapter 3, or Foundations of Information Systems, by Vladimir Zwass, chapter 13. Other references include Enterprise Resource Planning, 2005, by Mary Summer, chapter 8, and When Too Much IT Knowledge is a Dangerous Thing, by Andrew McAfee, Sloan Management Review, Vol. 44:2, Winter 2003: p.83-89.

5 Most data that are referenced in the case may be found in intercon.xls.

6 Most home country health insurers are government agencies that administer national health care programs. A few countries have health payment systems similar to the American one, where companies run private health care plans that operate alongside the national Medicare and Medicaid payment systems.

7 There are numerous circumstances where managers make decisions under conditions of uncertainty. Some examples include estimating expected market demand at various price points, or estimating defect rates associated with discrete product production processes.

⁸ The presentation file shows two examples of a hypothetical decision where spending \$1,000 (cost) will reduce operating expenses by \$300 per year (benefit). The first example uses a 5-year planning horizon and yields a positive NPV, which we assume results in a favorable decision outcome. The second example uses a 4-year planning horizon and yields a negative NPV, which we assume results in an unfavorable decision outcome. Thus, the two examples illustrate different outcomes for the same decision by modifying the planning horizon. This will emphasize the critical role that the planning horizon plays in these decisions. (re: IT-Planning.ppt; slides 16-18).

⁹ Most major undergraduate and graduate corporate finance textbooks will have a good overview of the time value of money concept and the PBK, NPV, and IRR methods. See Corporate Finance by Ross, Westerfield, and Jaffe, McGraw-Hill/Irwin publisher, or Principles of Corporate Finance, by Brealey, Myers, and Allen, McGraw-Hill/Irwin publisher, for good expositions of these concepts, the methods, and the differences among the methods.

¹⁰ There is a number of different probability distributions. See D. Bertsimas and R. Freund, "Data, Models, and Decisions," *Dynamic Ideas*, 2005, or <http://www.itl.nist.gov/div898/handbook/eda/section3/eda36.htm> for a description of the most commonly used types.