FINANCIAL ARRANGEMENT SELECTION FOR ENERGY MANAGEMENT PROJECTS

By

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I. INTRODUCTION

1.1 CHAPTER OUTLINE

1.2 BACKGROUND

In today's market-driven economy, facility managers are seeking technologies and methods to reduce expenses and become more cost-competitive. Energy Management Projects (EMPs) are investments that can help the facility manager achieve these goals. Most EMPs are discretionary capital improvements that reduce expenses and environmental impact. Frequently, productivity and/or quality can be improved when a facility (host) implements an EMP.

EMPs are useful wherever energy is consumed. Many EMPs are actually equipment replacement projects, which Pohlman, Santiago and Markel [1988] found to have more predictable cash flows (less risk) than many other types of capital investments, especially new product lines or joint ventures. Zobler [1995] found that the risk from most EMPs is so low there are many third party lenders who are eager to locate and finance EMPs. Wingender and Woodroof [1997] found that EMPs are recognized by shareholders as good investments that boost stock prices. In addition to applications within the private sector, EMPs have also been successful within government facilities. Archibald [1996] claimed that for every $1 invested in EMPs within government facilities, $4 is saved.

Despite all these benefits, many cost-effective EMPs are not implemented due to (1) financial constraints, (2) perceived risk and (3) conflict with strategic company objectives (such as process or facility changes). *For example, consider a boiler retrofit that has a first cost of $100,000 and saves $65,000 every year for ten years. Even though the project is profitable, it might not be implemented because of the reason(s) below.*

1. *The host does not have access to the $100,000 to implement the project.*

2. *The host wants in-house personnel to focus on core business competencies, not managing EMPs.*
3. *The host is moving to a new location within one year, and will not be able to capture the full benefits of long-term operational savings.*

A study of manufacturing facilities revealed that first-cost and capital constraints represented over 35% (the largest percent) of the reasons why cost-effective EMPs were not implemented [U.S. Department of Energy, 1996]. Thus, additional energy savings can be reaped, if the facility manager's fear of "first costs" could be reduced. Often, this can be accomplished through alternative financing arrangements.

Alternative finance arrangements can overcome the "initial cost" obstacle, allowing firms to implement more EMPs. However, many facility managers are either unaware of, or have difficulty understanding the variety of financial arrangements available to them. Sullivan and Smith [1993] found that most facility managers use simple payback analyses to evaluate projects, which do not reveal the added value of unique financial arrangements and after-tax benefits. Fretty [1996] found that sometimes facility managers do not implement an EMP because financial terminology and contractual details intimidate them.

To meet the growing demand, there has been a dramatic increase in the number of finance companies specializing in EMPs. At the 1996 World Energy Engineering Congress, finance companies represented the most common exhibitor type. These financiers are introducing new payment arrangements to implement EMPs. Often, the financier's innovation will satisfy the unique customer needs of a large facility. This is a great service; however, most financiers are not attracted to small facilities with EMPs requiring less than $100,000 [Burke, 1997; Duca, 1998]. Thus, many facility managers remain unaware of, or confused about the common financial arrangements that could help them implement EMPs.

At a recent conference, Marsha Quinn, Director of the Office of Technology Access (Department of Energy) stated, "There is a definite need to improve financing tools to increase implementation rates of cost-effective and innovative EMPs." [Quinn, 1997a] In an attempt to realize greater implementation rates in federal facilities, several financial-assistance guidebooks and computer programs were created. The Pennsylvania Energy Office [1987] created the

Pennsylvania Life Cycle Costing Manual. The U.S. Environmental Protection Agency [1994] created Project Kalc, and the Tellus Institute [1996] created P2/Finance. These books and programs show how to do economic evaluations for projects, but don't indicate which financial arrangement is best. In addition, these programs don't incorporate qualitative factors such as strategic company objectives, or the impact on a facility's in-house resources. In a personal interview, Ms. Quinn also stated, "What is needed is a package that incorporates all the relevant factors and helps the facility manager determine which financial arrangement is best" [Quinn, 1997b].

Numerous papers have described the basic financial arrangements available for EMPs, and have shown how to use quantitative analysis to evaluate financial arrangements. *Quantitative analysis includes computing the Net Present Value (NPV), Internal Rate of Return (IRR), etc.* However, to this author's knowledge, no one has developed a procedure to help the facility manager identify the optimal financial arrangement for an EMP within a particular facility. Such an interactive selection procedure would need to incorporate quantitative and qualitative criteria from the facility, project and financial arrangement.

1.3 THE PROBLEM STATEMENT

There is a need for a standard methodology that incorporates quantitative and qualitative criteria in order to identify the optimal financial arrangement for an EMP within a particular facility.

1.4 THE PURPOSE OF THE STUDY

The purpose of this dissertation is to create a decision system (E-FUND) that will help the facility manager identify the most appropriate financial arrangement for an EMP within a particular facility. E-FUND will incorporate quantitative and qualitative characteristics of the EMP, the facility, and various financial arrangements. Based on these characteristics, E-FUND will help the facility manager (or whoever makes the investment decisions) thoroughly evaluate the alternatives and select the optimal financial arrangement. E-FUND will be applied to EMPs that a company's management would like to implement, yet have not decided how to implement.

1.5 THE OBJECTIVES OF THE STUDY

The objectives of this study are listed below.

1. The first objective is to introduce and explain the primary financial arrangements available for EMPs.

2. The second objective is to develop a list of common decision criteria (quantitative and qualitative) for EMPs, so a facility manager knows what to evaluate when considering a financial arrangement for a particular EMP.
3. The third objective is to develop a decision support system (E-FUND) that helps the facility manager select a financial arrangement for a particular EMP within a particular facility. E-FUND will be applicable to any facility. The development of E-FUND will have its own set of achievements, which are listed below.
   - E-FUND will extend existing EMP government financing programs, because it will help the facility manager pick the optimal financial arrangement, rather than simply explaining how to apply and evaluate different financial arrangements. In addition, E-FUND will incorporate qualitative and quantitative criteria into the decision process.
   - E-FUND will expand the typical lease/buy decision models because E-FUND allows all the primary financial arrangements available for EMPs to serve as alternatives.
   - E-FUND will use the Analytic Hierarchy Process (AHP) with criteria common to EMPs. The facility manager will then weight the importance of each criterion.

This is appropriate because he/she best understands the EMP, and what is best for that particular facility.

- E-FUND will expand the applications of the AHP into financing decisions for EMPs.

4. A final objective of this research is to survey professionals in the field and identify the degree to which criteria are perceived as "important".

1.6 EXPECTED OUTCOMES

This dissertation will develop a decision support system that will help the facility manager select the optimal financial arrangement for a particular EMP within a particular facility. Hopefully, (via this dissertation and its related publications) facility managers will be more comfortable with financial arrangements for EMPs, and be able to increase EMP implementation and "cash in" on untapped energy savings.

1.7 LIMITATIONS

E-FUND is designed for EMPs; thus it will have criteria that apply only to EMPs. However, a similar AHP model could be developed to function for almost any mutually exclusive, discretionary capital investment decision. Such a model would need to have its own set of criteria, priority weights (relationships) and alternatives.

1.8 IMPORTANCE OF THE STUDY

Conducting pre-investment analysis for projects can consume a considerable amount of human and financial resources. In order to be efficient in the utilization of these resources, facilities should focus on a small number of arrangements that have a high likelihood of realization. With E-FUND, the facility manager will be able to quickly and systematically eliminate infeasible arrangements and determine which financial arrangement is best.

By developing a systematic decision process for financing EMPs, facility managers may become less intimidated by initial costs and feel more comfortable with financial arrangements. It is also hoped that (via understanding the characteristics that make EMPs successful) lenders that are unfamiliar with EMPs will become more willing to finance EMPs. With a greater number of lenders participating in this market, competitive forces could reduce finance costs.

If any of the aforementioned goals are achieved, the implementation rate of EMPs may increase, which would improve cost-competitiveness while reducing environmental impacts caused by energy consumption.

1.9 CONTRIBUTIONS TO THE FIELD

This dissertation is a contribution to the energy management field because of the achievements listed below.

1. This dissertation presents a comprehensive description of financial arrangements commonly used for EMPs.
2. Within this dissertation, a list of common decision criteria for EMPs is developed, so the facility manager knows what to evaluate when considering a financial arrangement for a particular EMP.
3. E-FUND itself is a contribution. It is a comprehensive decision support system for financing EMPs, which incorporates quantitative and qualitative criteria specifically related to EMPs. E-FUND will be unique to the energy management field because the facility manager will indicate the importance of each criterion within a particular application. Thus, the facility manager will have the greatest influence on the decision outcome. This is appropriate because he/she best understands the EMP, and what is best for that particular facility.
4. During the development of E-FUND, responses will be collected from professionals within the energy management field. These professionals will be asked about the importance of criteria, as well as how well the arrangements satisfy each criterion. The variance in responses should provide some insight about how strongly

certain criteria are perceived as "important", and how well the arrangements satisfy each criterion.

5. E-FUND will extend existing EMP government financing programs, because it will indicate the optimal financial arrangement, rather than simply explaining how to use different financial arrangements. Further, E-FUND will incorporate qualitative and quantitative criteria into the decision process.
6. E-FUND will expand the typical lease/buy decision models because E-FUND allows all the primary financial arrangements available for EMPs to serve as alternatives.
7. E-Fund will also expand the applications of the AHP to include financing decisions for EMPs.

II. FINANCIAL ARRANGEMENTS FOR ENERGY MANAGEMENT PROJECTS

2.1 CHAPTER OUTLINE

2.2 FOREWORD TO CHAPTER II

Chapter II itself is a contribution to the energy management field because it describes the primary financial arrangements used for EMPs. (This author could not find such a comprehensive description in the literature). These arrangements need to be introduced and described here because these concepts are applied in subsequent chapters.

This chapter is divided into several parts. First, a simple example will introduce the basic financial arrangements. Then, financial terminology is defined and each arrangement is explained in greater detail. To show how to evaluate each arrangement, they are applied to a case study. *For readers that understand the financial arrangements, the section "Pros & Cons of each Financial Arrangement" may be useful.* In this chapter, footnotes (labeled "a, b, c…") are used to provide supporting information.

2.3 A SIMPLE EXAMPLE

Consider a small company "PizzaCo" that makes frozen pizzas, and distributes them regionally. PizzaCo uses an old delivery truck that breaks down frequently and is inefficient. Assume the old truck has no salvage value and is fully depreciated. PizzaCo's management would like to obtain a new and more efficient truck to reduce expenses and improve reliability. However, they do not have the cash on hand to purchase the truck. Thus, they consider their financing options.

2.3.1 Purchase the Truck with a Loan or Bond

Just like most car purchases, PizzaCo borrows money from a lender (a bank) and agrees to a monthly re-payment plan. Figure II-1 shows PizzaCo's annual cash flows for a loan. The *solid arrows* represent the financing cash flows between PizzaCo and the bank. Thus, at time zero when PizzaCo borrows the money, they receive a large sum of money from the bank, which is a positive cash flow. Each year, PizzaCo makes payments (on the principal, plus interest based on the unpaid balance), until the balance owed is zero. The payments are the negative cash flows.

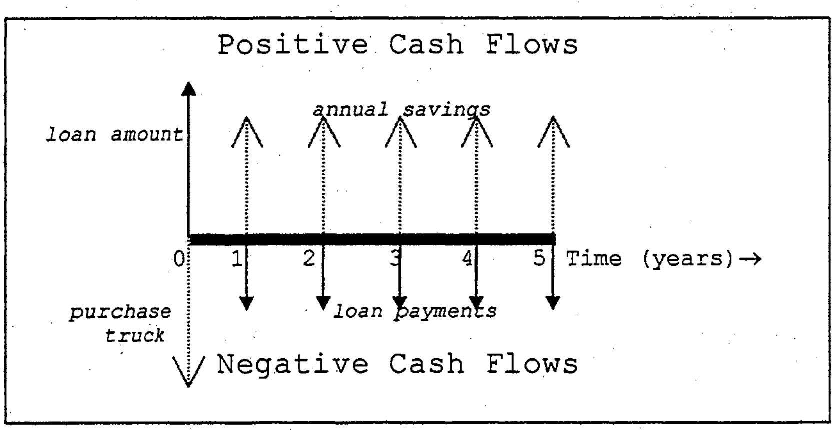

Figure II-1 PizzaCo's Cash Flows for a Loan

The *dashed arrows* represent the truck purchase as well as savings cash flows. Thus, at time zero, PizzaCo purchases the truck (a negative cash flow) with the money from the bank. Due to the new truck's greater efficiency, PizzaCo's annual expenses are reduced (which is a savings). The annual savings are the positive cash flows. The remaining cash flow diagrams in this paper utilize the same format.

PizzaCo could also purchase the truck by selling a bond. This arrangement is similar to a loan, except investors (not a bank) give PizzaCo a large sum of money (called the bond's "par value"). Periodically, PizzaCo would pay the investors *only* the interest accumulated. As Figure II-2 shows, when the bond reaches maturity, PizzaCo returns the par value to the investors. The equipment purchase and savings cash flows are the same as with the loan.

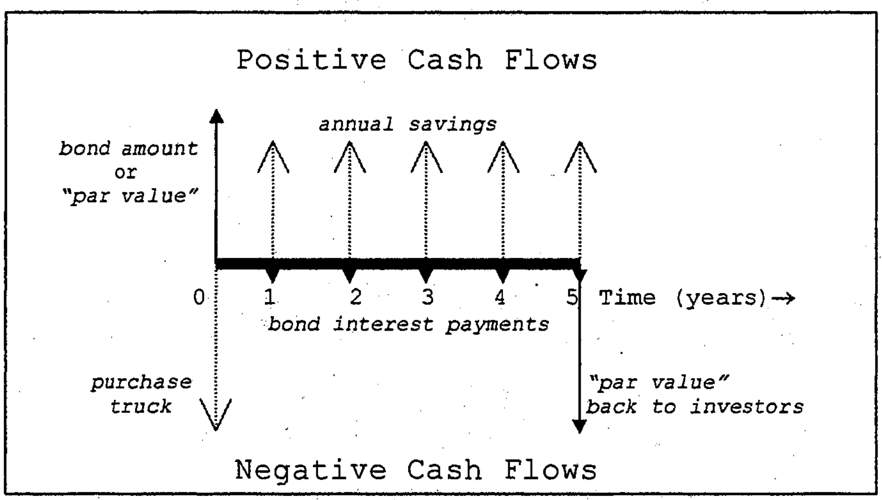

Figure II-2 PizzaCo's Cash Flows for a Bond

2.3.2 Sell Stock to Purchase the Truck

In this arrangement, PizzaCo sells its stock to raise money to purchase the truck. In return, PizzaCo is expected to pay dividends back to shareholders. Selling stock has a similar cash flow pattern as a bond, with a few subtle differences. Instead of interest payments to bondholders, PizzaCo would pay dividends to shareholders until some future date when PizzaCo could buy the stock back. However, these dividend payments are not mandatory, and if PizzaCo is experiencing financial strain, it does not need to distribute dividends. On the other hand, if PizzaCo's profits increase, this wealth will be shared with the new stockholders, because they now own a part of the company.

2.3.3 Rent the Truck

Just like renting a car, PizzaCo could rent a truck for an annual fee. This would be equivalent to a true lease. The rental company (lessor) owns and maintains the truck for PizzaCo (the lessee). PizzaCo pays the rental fees (lease payments) which are considered tax-deductible business expenses.

Figure II-3 shows that the lease payments (solid arrows) start as soon as the equipment is leased (year zero) to account for lease payments paid in advance.[a] Notice that the savings cash flows are essentially the same as the

[a] Lease payments "in arrears" (starting at the end of the first year) could also be arranged. However, the leasing company may require a security deposit as collateral.

previous arrangements, except there is no equipment purchase, which is a large negative cash flow at year zero.

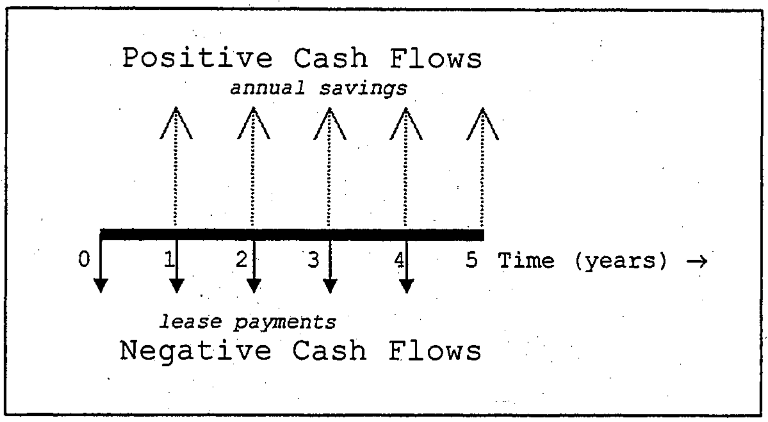

Figure II-3 PizzaCo's Cash Flows for a True Lease

In a true lease, the contract period should be shorter than the equipment's useful life. The lease is cancelable because the truck can be leased easily to someone else. At the end of the lease, PizzaCo can either return the truck or renew the lease. In a separate transaction, PizzaCo could also negotiate to buy the truck at the fair market value.

If PizzaCo wanted to secure the option to buy the truck (for a bargain price) at the end of the lease, then they would use a capital lease. A capital lease can be structured like an installment loan, however ownership is not transferred until the end of the lease. The lessor retains ownership as security in case the lessee (PizzaCo) defaults on payments. Because the entire cost of the truck is eventually paid, the lease payments are larger than the payments in a true lease, (assuming similar lease periods). Figure II-4 shows the cash flows for a capital lease with advance payments and a bargain purchase option at the end of year five.

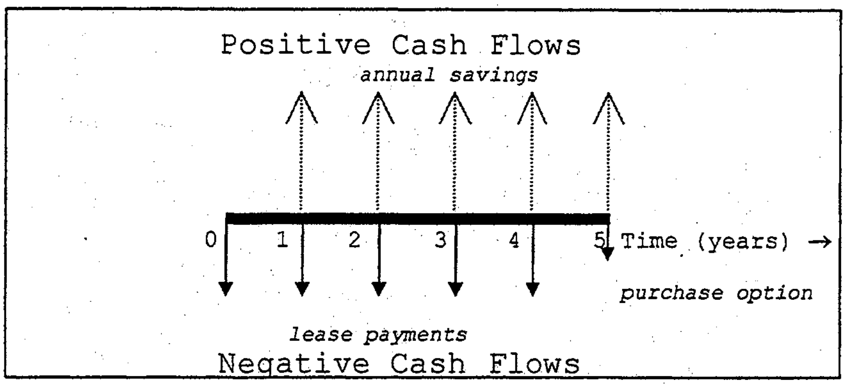

Figure II-4 PizzaCo's Cash Flows for a Capital Lease

There are some additional scenarios for lease arrangements. A "vendor-financed" agreement is when the lessor (or lender) is the equipment manufacturer. Alternatively, a third party could serve as a financing source. With "third party financing", a finance company would purchase a new truck and lease it to PizzaCo. In either case, there are two primary ways to repay the lessor.

1. With a "fixed payment plan"; where payments are due whether or not the new truck actually saves money.
2. With a "flexible payment plan"; where the savings from the new truck are shared with the third party, until the truck's purchase cost is recouped with interest. This is basically a "shared savings" arrangement.

2.3.4 Subcontract Pizza Delivery to a Third Party

Since PizzaCo's primary business is not delivery, it could subcontract that responsibility to another company. Let's say that a delivery service company would provide a truck and deliver the pizzas at a reduced cost. Each month, PizzaCo would pay the delivery service company a fee. However, this fee is guaranteed to be less than what PizzaCo would have spent on delivery. Thus, PizzaCo would obtain savings without investing any money or risk in a new truck. This arrangement is analogous to a performance contract.

This arrangement is very similar to a third-party lease and a shared savings agreement. However with a performance contract, the contractor assumes most of the risk, (because he supplies the equipment, with little or no investment from PizzaCo). The contractor also is responsible for ensuring that the delivery fee is less than what PizzaCo would have spent. For the PizzaCo example, the arrangement would designed under the conditions below.

- The delivery company owns and maintains the truck. It also is responsible for all operations related to delivering the pizzas.
- The monthly fee is related to the number of pizzas delivered. This is the *performance* aspect of the contract; if PizzaCo doesn't sell many pizzas, the fee is

reduced.[b] Thus, the delivery company assumes these risks:

1. PizzaCo will remain solvent, and
2. PizzaCo will sell enough pizzas to cover costs, and
3. the new truck will operate as expected and will actually reduce expenses per pizza, and
4. the external financial risk, such as inflation and interest rate changes, are acceptable.

- Because the delivery company is financially strong and experienced, it can usually obtain loans at low interest rates.
- The delivery company is an expert in delivery; it has specially skilled personnel and uses efficient equipment. Thus, the delivery company can deliver the pizzas at a lower cost (even after adding a profit) than PizzaCo.

Figure II-5 shows the net cash flows according to PizzaCo. Since the delivery company simply reduces PizzaCo's operational expenses, there is only a net savings. There are no negative financing cash flows.

Unlike the other arrangements, the delivery company's fee is a less expensive <u>substitute</u> for PizzaCo's in-house delivery expenses. With the other arrangements, PizzaCo had to pay a

[b] A minimum amount of pizzas may be required by the delivery company (performance contractor) to cover costs.

specific financing cost (loan, bond or lease payments, or dividends) associated with the truck, whether or not the truck actually saved money. With a performance contract, the delivery company is paid from the operational savings it generates. Because the savings are greater than the fee, there is a net savings. Often, the contractor guarantees the savings.

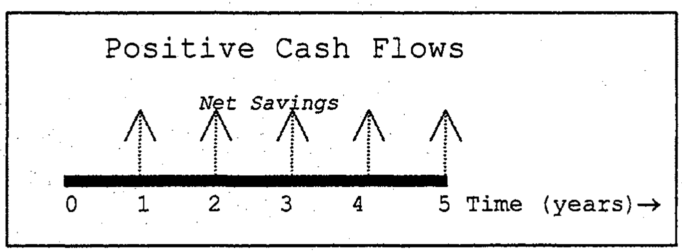

Figure II-5 PizzaCo's Cash Flows for a Performance Contract

Supplementary Note: Combinations of the basic finance arrangements are possible. For example, a shared savings arrangement can be structured within a performance contract. Also, performance contracts are often designed so that the host facility (PizzaCo) would own the asset at the end of the contract.

2.4 FINANCIAL ARRANGEMENTS IN DETAIL

To explain the basic financial arrangements in more detail, each one is applied to an energy management-related case study. To understand the economics behind each arrangement, some finance terminology is presented below.

2.4.1 Finance Terminology

Equipment can be purchased with cash on-hand (officially labeled "retained earnings"), a loan, a bond, a capital lease or by selling stock. Alternatively, equipment can be utilized with a true lease or with a performance contract.

Note that with performance contracting, the building owner is not paying for the equipment itself, but the benefits provided by the equipment. *In the Simple Example, the benefit was the pizza delivery. PizzaCo was not concerned with what type of truck was used.*

The decision to purchase or utilize equipment is partly dependent on the company's strategic focus. Cooke and Bonmeli [1967] found that if the company wants to delegate some or all of the responsibility of managing a project, it should use a true lease, or a performance contact. However, if the company wants to be intricately involved with the

EMP, purchasing and self-managing the equipment could yield the greatest profits. When the building owner purchases equipment, he/she usually maintains the equipment, and lists it as an asset on the balance sheet so it can be depreciated.

Financing for purchases has two categories:

1. Debt Financing, which is borrowing money from someone else, or another firm.
   (using loans, bonds and capital leases)

2. Equity Financing, which is using money from your company, or your stockholders.
   (using retained earnings, or issuing common stock)

In all cases, the borrower will pay an interest charge to borrow money. The interest rate is called the "cost of capital". The cost of capital is essentially dependent on three factors: (1) the borrower's credit rating, (2) project risk and (3) external risk. External risk can include energy price volatility, industry-specific economic performance as well as global economic conditions and trends. The cost of capital (or "cost of borrowing") influences the return on investment. If the cost of capital increases, then the return on investment decreases.

The "minimum attractive rate of return" (MARR) is a company's "hurdle rate" for projects. Only projects with a return on investment greater than the MARR should be accepted. The MARR is also used as the discount rate to determine the "net present value" (NPV).

The NPV converts the worth of future cash flows into their equivalent worth today, so all cash flows can be compared at the same point in time. NPV converts future cash flows by using a specific discount rate. *For example, at 10%, $1,000 dollars received one year from now is worth only $909.09 dollars today. In other words, if $909.09 dollars is invested today (at 10% interest per year), in one year it would be worth $1,000.* NPV is useful because future cash flows can be converted back to "time zero" (present). Then, the project's initial cost is subtracted from the converted cash flows to determine the NPV. If the NPV is positive, the investment is acceptable.

2.4.2 Explanation of Figures and Tables

Throughout this chapter's case study, figures are presented to illustrate the transactions of each arrangement. Tables are also presented to show how to perform the economic analyses of the different arrangements. The NPV is calculated for each arrangement.

It is important to note that the NPV of a particular arrangement can change significantly if the cost of capital, MARR, equipment residual value, or project life is adjusted. Thus, the examples within this paper are provided only to illustrate how to perform the analyses. The cash flows and interest rates are estimates, which can vary from project to project. To keep the calculations simple, end-of-year cash flows are used throughout this paper.

Within the tables, the following abbreviations and equations are used:

EOY	= End of Year
Savings	= Pre-Tax Cash Flow
Depr.	= Depreciation
Taxable Income	= Savings - Depreciation - Interest Payment
Tax	= (Taxable Income)*(Tax Rate)
ATCF	= After Tax Cash Flow = Savings - Total Payments - Taxes

Table II-1 shows the basic equations that are used to calculate the values under each column heading within the economic analysis tables.

Table II-1 Table of Sample Equations used in Economic Analyses

A	B	C	D	E	F	G	H	I	J
EOY	Savings	Depreciation	Payments			Principal Outstanding	Taxable Income	Tax	ATCF
			Principal	Interest	Total				
n n+1 n+2		= (MACRS %)*(Purchase Price)			=(D)+(E)	=(G at year n)-(D at year n+1)	=(B)-(C)-(E)	=(H)*(tax rate)	=(B)-(F)-(I)

Regarding depreciation, the "modified accelerated cost recovery system" (MACRS) is used in the economic analyses. This system indicates the percent depreciation claimable year-by-year after the equipment is purchased. Table II-2 shows the MACRS percentages for seven-year property. *For example, after the first year, an owner could depreciate 14.29% of an equipment's value. The equipment's "book value" equals the remaining unrecovered depreciation. Thus, after the first year, the book value would be 100%-14.29%, which equals 85.71% of the original value. If the owner sells the property before it has been fully depreciated, he/she can claim the book value as a tax-deduction.* [c]

[c] To be precise, the IRS uses a "half-year convention" for equipment that is sold before it has been completely depreciated. In the tax year that the equipment is sold, (say year "x") the owner claims only ½ of the MACRS depreciation percent for that year. (This is because the owner has only used the equipment for a fraction of the final year.) Then on a separate line entry, (in the year "x*"), the remaining unclaimed depreciation is claimed as "book value". The x* year is presented as a separate line item to show the book value treatment, however x* entries occur in the same tax year as "x".

Table II-2 MACRS Depreciation Percentages

EOY	MACRS Depreciation Percentages for 7-Year Property
0	0
1	14.29%
2	24.49%
3	17.49%
4	12.49%
5	8.93%
6	8.92%
7	8.93%
8	4.46%

2.5 THE CASE STUDY

Suppose PizzaCo (*the host*) needs a new chilled water system for a specific process in its manufacturing plant. The installed cost of the new system is $2.5 million. The expected equipment life is 15 years, however the process will only be needed for 5 years, after which the chilled water system will be sold at an estimated market value of $1,200,000 (book value at year five = $669,375). The chilled water system should save PizzaCo about $1 million/year in energy savings. PizzaCo's tax rate is 34%. The equipment's annual maintenance and insurance cost is $50,000. PizzaCo's MARR is 18%.

Since at the end of year 5, PizzaCo expects to sell the asset for an amount greater than its book value, the additional revenues are called a "capital gain", (which equals the market value - book value) and are taxed. If PizzaCo sells the asset for less than its book value, PizzaCo incurs a "capital loss".

PizzaCo does not have $2.5 million to pay for the new system, thus it considers its finance options. PizzaCo is a small company with an average credit rating, which means that it will pay a higher cost of capital than a larger company with an excellent credit rating. As with any borrowing arrangement, if investors believe that an investment is risky, they will demand a higher interest rate.

2.5.1 Purchase Equipment with Retained Earnings

If PizzaCo did have enough retained earnings (cash on-hand) available, it could purchase the equipment without external financing. Although external finance expenses would be zero, any cash used to purchase the equipment would carry an "opportunity cost", because that cash could have been used to earn a return somewhere else. This opportunity cost rate is usually set equal to the MARR.

Of all the arrangements described in this paper, purchasing equipment with retained earnings is probably the simplest to understand. For this reason, it will serve as a brief example and introduction to the economic analysis tables that are used throughout this paper.

Application to the Case Study

Figure II-6 illustrates the resource flows between the parties. In this arrangement, PizzaCo purchases the chilled water system directly from the equipment manufacturer.

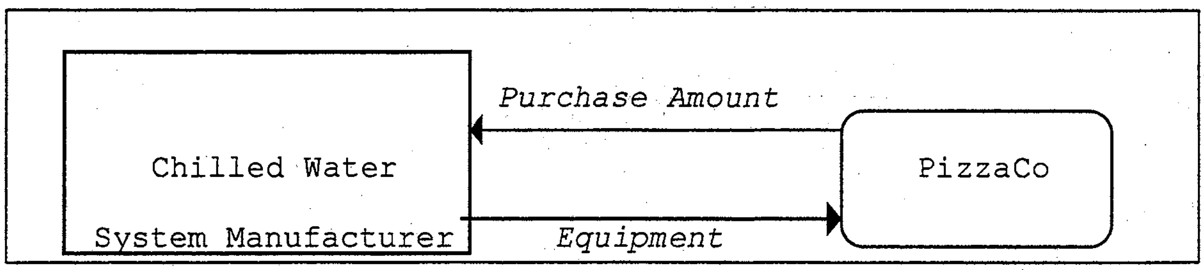

Figure II-6 Resource Flows for Using Retained Earnings

Once the equipment is installed, PizzaCo recovers the full $1 million/year in savings for the entire five years, but must spend $50,000/year on maintenance and insurance. At the end of the five-year project, PizzaCo expects to sell the equipment for its market value of $1,200,000. Assume MARR is 18%, and the equipment is classified as 7-year property for MACRS depreciation. Table II-3 shows the economic analysis for purchasing the equipment with retained earnings.

Table II-3 Economic Analysis for Using Retained Earnings

EOY	Savings	Depr.	Payments Principal	Payments Interest	Payments Total	Principal Outstanding	Taxable Income	Tax	ATCF
0					2,500,000				-2,500,000
1	950,000	357,250					592,750	201,535	748,465
2	950,000	612,250					337,750	114,835	835,165
3	950,000	437,250					512,750	174,335	775,665
4	950,000	312,250					637,750	216,835	733,165
5	950,000	111,625					838,375	285,048	664,953
5*	1,200,000	669,375					530,625	180,413	1,019,588
		2,500,000							
						Net Present Value at 18%:			$320,675

Notes:	Loan Amount:	0		
	Loan Finance Rate:	0%	MARR =	18%
			Tax Rate	34%
	MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5			
	Accounting Book Value at end of year 5:	669,375		
	Estimated Market Value at end of year 5:	1,200,000		
	EOY 5 illustrates the Equipment Sale and Book Value*			
	Taxable Income:	=(Market Value - Book Value)		
		=(1,200,000 - 669,375) = $530,625		

Reading Table II-3 from left to right, and top to bottom, at EOY 0, the single payment is entered into the table. Each year thereafter, the savings as well as the depreciation (which equals the equipment purchase price multiplied by the appropriate MACRS % for each year) are entered into the table. Year by year, the taxable income = savings - depreciation. The taxable income is then taxed at 34% to obtain the tax for each year. The after-tax cash flow = savings - tax for each year.

At EOY 5, the equipment is sold before the entire value was depreciated. EOY 5* shows how the equipment sale and book value are claimed. In summary, the NPV of all the ATCFs would be $320,675.

2.5.2 Loans

Loans have been the traditional financial arrangement for many types of equipment purchases. Kastantin [1986] claimed that a bank's willingness to loan depends on the borrower's financial health, experience in energy management and number of years in business.

Morgan [1991] pointed out that obtaining a bank loan can be difficult if the loan officer is unfamiliar with EMPs. Loan officers and financiers may not understand energy-related terminology (demand charges, kVAR, etc.). In addition, facility managers may not be comfortable with the financier's language. Thus, to save time, a bank that can understand EMPs should be chosen.

Most banks will require a down payment and collateral to secure a loan. However, securing assets can be difficult with EMPs because the equipment often becomes part of the real estate of the plant. *For example, it would be very difficult for a bank to repossess lighting fixtures from a retrofit.* In these scenarios, lenders may be willing to secure other assets as collateral.

Application to the Case Study

Figure II-7 illustrates the resource flows between the parties. In this arrangement, PizzaCo purchases the chilled water system with a loan from a bank. PizzaCo makes equal payments (principal + interest) to the bank for five years to retire the debt. Due to PizzaCo's small size, credibility, and inexperience in managing chilled water systems, PizzaCo is likely to pay a relatively high cost of capital. For example, let's assume 15%.

PizzaCo recovers the full $1 million/year in savings for the entire five years, but must spend $50,000/year on maintenance and insurance. At the end of the five-year project, PizzaCo expects to sell the equipment for its market value of $1,200,000. Tables II-4 and II-5 show the economic analysis for loans with a zero down payment and a 20% down payment, respectively. Assume that the bank reduces the interest rate to 14% for the loan with the 20% down payment. Since the asset is listed on PizzaCo's balance sheet, PizzaCo can use depreciation benefits to reduce the after-tax cost. In addition, all loan interest expenses are tax-deductible.

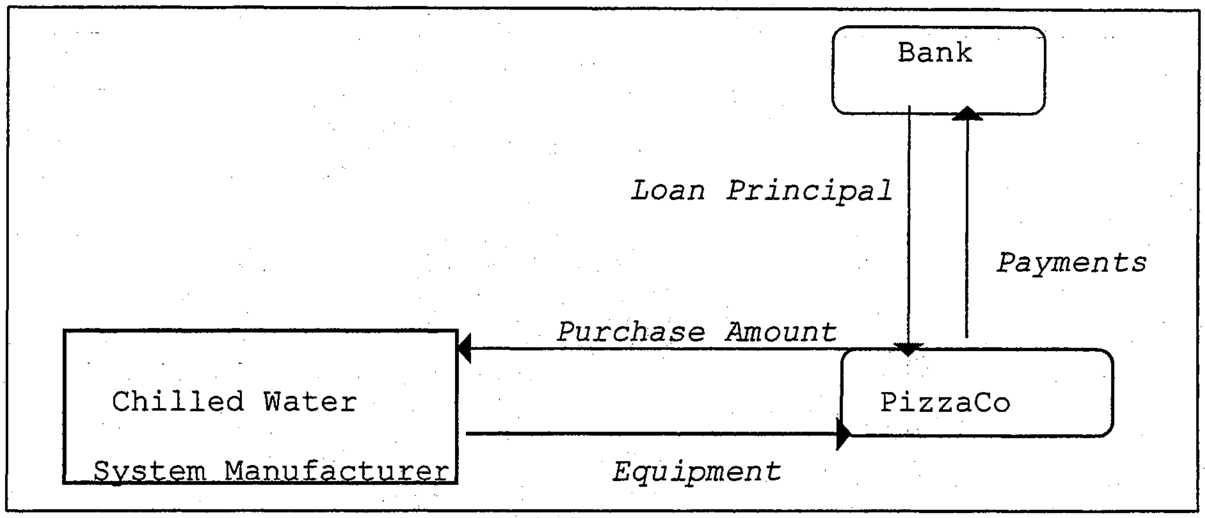

Figure II-7 Resource Flow Diagram for a Loan

Table II-4 Economic Analysis for a Loan with No Down Payment

EOY	Savings	Depr.	Payments			Principal	Taxable	Tax	ATCF
			Principal	Interest	Total	Outstanding	Income		
0						2,500,000			
1	950,000	357,250	370,789	375,000	745,789	2,129,211	217,750	74,035	130,176
2	950,000	612,250	426,407	319,382	745,789	1,702,804	18,368	6,245	197,966
3	950,000	437,250	490,368	255,421	745,789	1,212,435	257,329	87,492	116,719
4	950,000	312,250	563,924	181,865	745,789	648,511	455,885	155,001	49,210
5	950,000	111,625	648,511	97,277	745,789	0	741,098	251,973	-47,761
5*	1,200,000	669,375					530,625	180,413	1,019,588
		2,500,000							

Net Present Value at 18%: $757,121

Notes: Loan Amount: 2,500,000 (used to purchase equipment at year 0)
Loan Finance Rate: 15% MARR = 18%
Tax Rate 34%
MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5
Accounting Book Value at end of year 5: 669,375
Estimated Market Value at end of year 5: 1,200,000
EOY 5 illustrates the Equipment Sale and Book Value*
Taxable Income: =(Market Value - Book Value)
=(1,200,000 - 669,375) = $530,625

Table II-5 Economic Analysis for a Loan with a 20% Down-Payment

EOY		Depr.	Payments			Principal	Taxable	Tax	ATCF
			Principal	Interest	Total	Outstanding	Income		
0					500,000	2,000,000			-500,000
1	950,000	357,250	302,567	280,000	582,567	1,697,433	312,750	106,335	261,098
2	950,000	612,250	344,926	237,641	582,567	1,352,507	100,109	34,037	333,396
3	950,000	437,250	393,216	189,351	582,567	959,291	323,399	109,956	257,477
4	950,000	312,250	448,266	134,301	582,567	511,024	503,449	171,173	196,260
5	950,000	111,625	511,024	71,543	582,567	0	766,832	260,723	106,710
5*	1,200,000	669,375					530,625	180,413	1,019,588
		2,500,000							
						Net Present Value at 18%:			$710,962

Notes: Loan Amount: 2,000,000 (used to purchase equipment at year 0)
Loan Finance Rate: 14% MARR = 18%
Down-payment: 500,000 Tax Rate 34%
MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5
Accounting Book Value at end of year 5: 669,375
Estimated Market Value at end of year 5: 1,200,000
EOY 5 illustrates the Equipment Sale and Book Value*
Taxable Income: =(Market Value - Book Value)
=(1,200,000 - 669,375) = $530,625

2.5.3 Bonds

Bonds are very similar to loans; a sum of money is borrowed and repaid with interest over a period of time. The primary difference is that with a bond, the issuer (PizzaCo) periodically pays the investors *only* the interest earned. This periodic payment is called the "coupon interest payment". *For example, a $1,000 bond with a 10% coupon will pay $100 per year. When the bond matures, the issuer returns the face value ($1,000) to the investors.*

Bonds are issued by corporations and government entities. Government bonds generate tax-free income for investors, thus these bonds can be issued at lower rates than corporate bonds. This benefit provides government facilities an economic advantage to use bonds to finance projects.

Application to the Case Study

Although PizzaCo (a private company) would not be able to obtain the low rates of a government bond, they could issue bonds with coupon interest rates competitive with the loan interest rate of 15%.

In this arrangement, PizzaCo receives the investors' cash (bond par value) and purchases the equipment. PizzaCo uses part of the energy savings to pay the coupon interest payments to the investors. When the bond matures, PizzaCo must then return the par value to the investors. See Figure II-8.

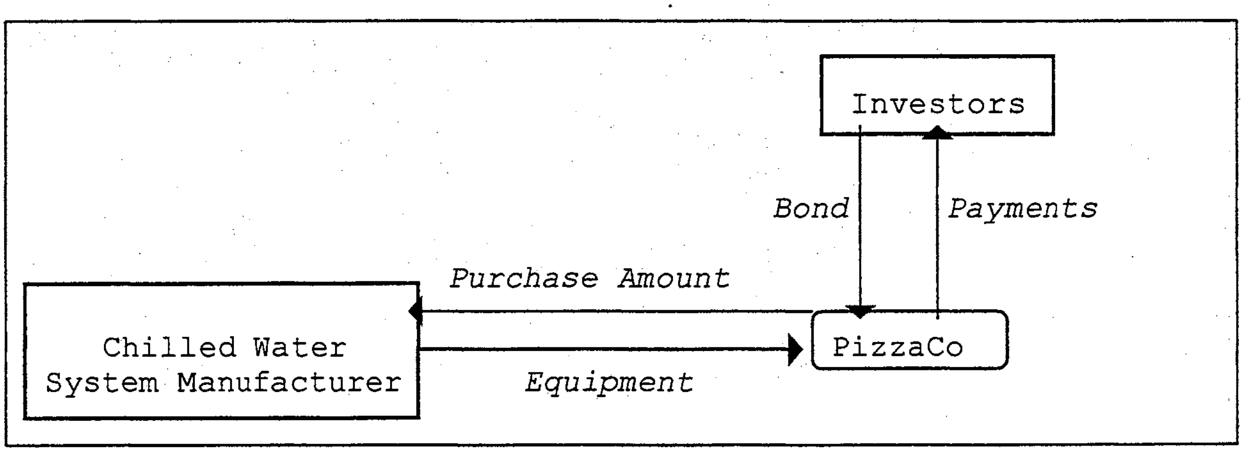

Figure II-8 Resource Flow Diagram for a Bond

As with a loan, PizzaCo owns, maintains and depreciates the equipment throughout the project's life. All coupon interest payments are tax-deductible. At the end of the five-year project, PizzaCo expects to sell the equipment for its market value of $1,200,000. Table II-6 shows the economic analysis of this finance arrangement.

Table II-6 Economic Analysis for a Bond

EOY	Savings	Depr.	Payments Principal	Payments Interest	Payments Total	Principal Outstanding	Taxable Income	Tax	ATCF
0						2,500,000			
1	950,000	357,250		375,000	375,000	2,500,000	217,750	74,035	500,965
2	950,000	612,250		375,000	375,000	2,500,000	-37,250	-12,665	587,665
3	950,000	437,250		375,000	375,000	2,500,000	137,750	46,835	528,165
4	950,000	312,250		375,000	375,000	2,500,000	262,750	89,335	485,665
5	950,000	111,625	2,500,000	375,000	2,875,000	0	463,375	157,548	-2,082,548
5*	1,200,000	669,375					530,625	180,413	1,019,588
		2,500,000							
						Net Present Value at 18%:			953,927

Notes:	Bond Amount:	2,500,000	(used to purchase equipment at year 0)	
	Coupon Interest Rate:	15%	MARR =	18%
			Tax Rate	34%
	MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5			
	Accounting Book Value at end of year 5:	669,375		
	Estimated Market Value at end of year 5:	1,200,000		
	EOY 5 illustrates the Equipment Sale and Book Value*			
	Taxable Income:		=(Market Value - Book Value)	
			=(1,200,000 - 669,375) = $530,625	

2.5.4 Selling Stock

Although less popular, selling company stock is an equity financing option which can raise capital for projects. For the host, selling stock offers a flexible repayment schedule, because dividend payments to shareholders aren't absolutely mandatory. Selling stock is also often used to help a company attain its desired capital structure.

However, selling new shares of stock dilutes the power of existing shares and may send an inaccurate "signal" to investors about the company's financial strength. If the company is selling stock, investors may think that it is desperate for cash and in a poor financial condition. Under this belief, the company's stock price could decrease. However, recent research by Wingender and Woodroof [1997] indicates that when a firm announces an EMP, investors react favorably. On average, stock prices were shown to increase abnormally by 21.33%.

The cost of capital for selling stock is essentially:

$$\text{cost of capital}_{\text{selling stock}} = D/P$$

where D = annual dividend payment

P = company stock price

In most cases, the after-tax cost of capital for selling stock is higher than the after-tax cost of debt capital (using loans, bonds and capital leases). This is because interest expenses (on debt) are tax deductible, but dividend payments to shareholders are not.

In addition to tax considerations, there are other reasons why the cost of debt capital is less than the cost of selling stock. Lenders and bond buyers (creditors) will accept a lower rate of return because they are in a less risky position due to the reasons below.

- Creditors have a contract to receive money at a certain time and future value (stockholders have no such guarantee with dividends).
- Creditors have first claim on earnings (interest is paid before shareholder dividends are allocated).
- Creditors usually have secured assets as collateral and have first claim on assets in the event of bankruptcy.

Despite the high cost of capital, selling stock does have some advantages. This arrangement does not bind the host to a rigid payment plan (like debt financing agreements) because dividend payments are not mandatory. The host has control over when it will pay dividends. Thus, when selling stock, the host receives greater payment flexibility, but at a higher cost of capital.

Application to the Case Study

As Figure II-9 shows, the financial arrangement is very similar to a bond, at year zero the firm receives $2.5 million, except the funds come from the sale of stock. Instead of coupon interest payments, the firm distributes dividends. At the end of year five, PizzaCo repurchases the stock. Alternatively, PizzaCo could capitalize the dividend payments, which means setting aside enough money so that the dividends could be paid with the interest generated.

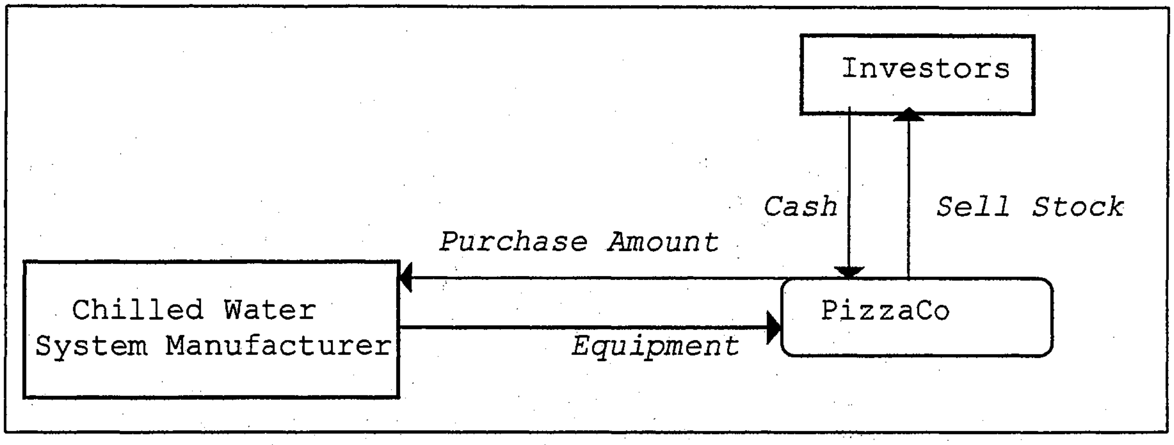

Figure II-9 Resource Flow Diagram for Selling Stock

Table II-7 shows the economic analysis for issuing stock at a 16% cost of equity capital, and repurchasing the stock at the end of year five. (For consistency of comparison to the other arrangements, the stock price does not change during the contract.) Like a loan or bond, PizzaCo owns and maintains the asset. Thus, the annual savings are only $950,000. PizzaCo pays annual dividends worth $400,000. At the end of year 5, PizzaCo expects to sell the asset for $1,200,000.

Table II-7 Economic Analysis of Selling Stock

EOY	Savings	Depr.	Stock Transactions: Sale of Stock	Stock Transactions: Repurchase	Stock Transactions: Dividend Payments	Taxable Income	Tax	ATCF
0			*$ 2,500,000 from Stock Sale is used to purchase equipment, thus*					*ATCF = 0*
1	950,000	357,250			400,000	592,750	201,535	348,465
2	950,000	612,250			400,000	337,750	114,835	435,165
3	950,000	437,250			400,000	512,750	174,335	375,665
4	950,000	312,250			400,000	637,750	216,835	333,165
5	950,000	111,625		2,500,000	400,000	838,375	285,048	-2,235,048
5*	1,200,000	669,375				530,625	180,413	1,019,588
		2,500,000						
					Net Present Value at 18%:			477,033

Notes:	Value of Stock Sold (which is repurchased after year	2,500,000	(used to purchase equipment at year 0)	
	Cost of Capital = Annual Dividend Rate:	16%	MARR =	18%
			Tax Rate	34%
	MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5			
	Accounting Book Value at end of year 5:	669,375		
	Estimated Market Value at end of year 5:	1,200,000		
	EOY 5 illustrates the Equipment Sale and Book Value*			
	Taxable Income:		=(Market Value - Book Value)	
			=(1,200,000 - 669,375) = $530,625	

Note that Table II-7 is slightly different from the other tables in this paper:

Taxable Income = Savings - Depreciation, and

ATCF = Savings - Stock Repurchases - Dividends - Tax

2.5.5 Leases

Firms generally own assets, however it is the *use* of these assets that is important, not the ownership. Leasing is one way of obtaining the use of assets. There are numerous types of leasing arrangements, ranging from basic rental agreements to extended payment plans for purchases. Sharp and Nguyen [1995] claim that leasing is used for nearly one-third of all equipment utilization. Leases can be structured and approved very quickly, even within 48 hours.

Table II-8 lists some additional reasons why leasing can be an attractive arrangement for the lessee.

Table II-8 Good Reasons to Lease

Financial Reasons
With some leases, the entire lease payment is tax-deductible.
Some leases allow "off-balance sheet" financing, preserving credit lines
Risk Sharing
Leasing is good for short-term asset use, and reduces the risk of getting stuck with obsolete equipment
Leasing offers less risk and responsibility

Basically, there are two types of leases; the "true lease" (a.k.a. "operating" or "guideline lease") and the "capital lease". One of the primary differences between a true lease and a capital lease is the tax treatment. In a true lease, the lessor owns the equipment and receives the depreciation benefits. However, the lessee can claim the entire lease payment as a tax-deductible business expense. In a capital lease, the lessee (PizzaCo) owns and depreciates the equipment. However, only the interest portion of the lease payment is tax-deductible. In general, a true lease is effective for a short-term project, where the company does not plan to use the equipment when the project ends. A capital lease is effective for long-term equipment.

<u>The True Lease</u>

Figure II-10 illustrates the legal differences between a true lease and a capital lease as described by Schallheim [1994]. A true lease (or operating lease) is strictly a rental agreement. The word "strict" is appropriate because the Internal Revenue Service will only recognize a true lease if it satisfies the following criteria:

1. the lease period must be less than 80% of the equipment's life, and
2. the equipment's estimated residual value must be ≥ 20% of its value at the beginning of the lease, and
3. there is no "bargain purchase option", and
4. there is no planned transfer of ownership, and
5. the equipment must not be custom-made and only useful in a particular facility.

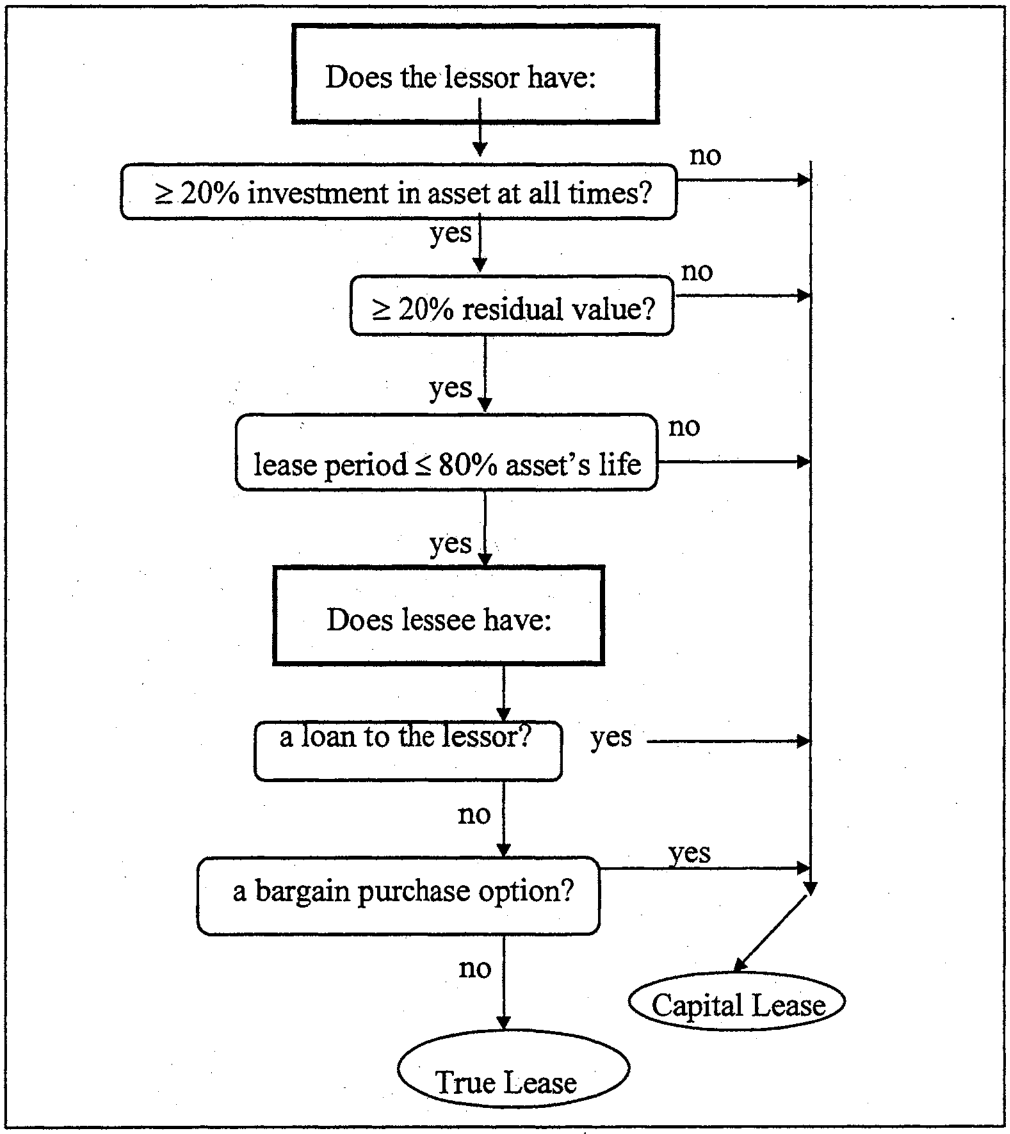

Figure II-10 Classification for a True Lease

Application to the Case Study

It is unlikely that PizzaCo could find a lessor that would be willing to lease a sophisticated chilled water system and after five years, move the system to another facility. Thus, obtaining a true lease would be unlikely. However, Figure II-11 shows the basic relationship between the lessor and lessee in a true lease. A third-party leasing company could also be involved by purchasing the equipment and leasing to PizzaCo. Such a resource flow diagram is shown for the capital lease.

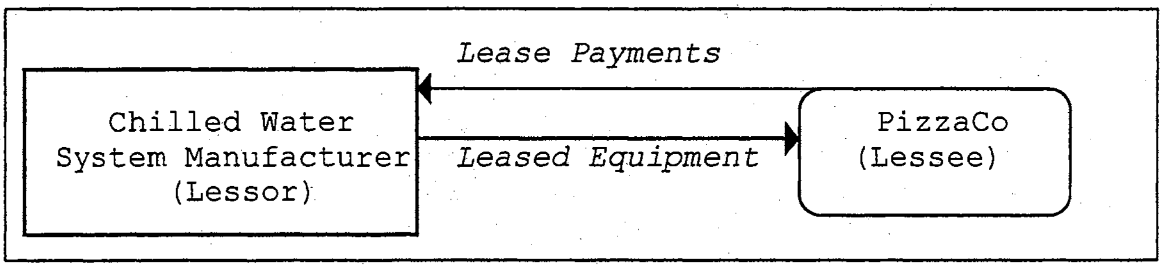

Figure II-11 Resource Flow Diagram for a True Lease

Table II-9 shows the economic analysis for a true lease. Notice that the lessor pays the maintenance and insurance costs, so PizzaCo saves the full $1 million per year. PizzaCo can deduct the entire lease payment of $400,000 as a business expense. However PizzaCo does not obtain ownership, so it can't depreciate the asset.

Table II-9 Economic Analysis for a True Lease

EOY	Savings	Depr.	Payments			Principal	Taxable	Tax	ATCF
			Principal	Interest	Total	Outstanding	Income		
0					400,000		-400,000		-400,000
1	1,000,000				400,000		600,000	204,000	396,000
2	1,000,000				400,000		600,000	204,000	396,000
3	1,000,000				400,000		600,000	204,000	396,000
4	1,000,000				400,000		600,000	204,000	396,000
5	1,000,000						1,000,000	340,000	660,000

Net Present Value at 18%: $953,757

Notes:	Annual Lease Payment:		400,000
	MARR =	18%	
	Tax Rate	34%	

The Capital Lease

The capital lease has a much broader definition than a true lease. A capital lease fulfills any one of the following criteria:

1. the lease term ≥ 75% of the equipment's life;
2. the present value of the lease payments ≥ 90% of the initial value of the equipment;
3. the lease transfers ownership;
4. the lease contains a "bargain purchase option", which is negotiated at the inception of the lease.

Most capital leases are basically extended payment plans, except ownership is usually not transferred until the end of the contract. This arrangement is common for large EMPs because the equipment (such as a chilled water system) is usually difficult to reuse at another facility. With this arrangement, the lessee eventually pays for the entire asset (plus interest). In most capital leases, the lessee pays the maintenance and insurance costs.

The capital lease has some interesting tax implications because the lessee must list the asset on its balance sheet from the *beginning* of the contract. Thus, like a loan, the lessee gets to depreciate the asset and only the interest portion of the lease payment is tax deductible.

Application to the Case Study

Figure II-12 shows the basic relationship between the equipment manufacturer, lessor and lessee in a capital lease. The finance company purchases the equipment and leases it to PizzaCo. The finance company (lessor) is shown as a third party, although it also could be a division of the equipment manufacturer. Because the finance company is involved, a lower cost of capital (12%) is possible due to reduced risk of payment default.

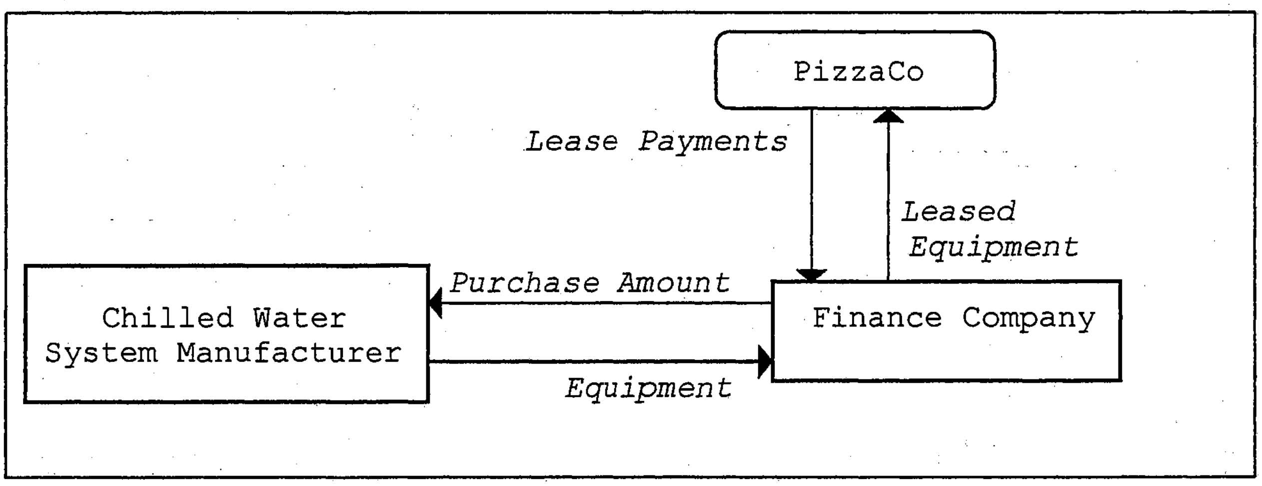

Figure II-12 Resource Flow Diagram for a Capital Lease

Like an installment loan, PizzaCo's lease payments cover the entire equipment cost. However, the lease payments are made in advance. Because PizzaCo is considered the owner, it pays the $50,000 annual maintenance expenses, which reduces the annual savings to $950,000. PizzaCo receives the benefits of depreciation and tax-deductible interest payments. To be consistent with the analyses of the other arrangements, PizzaCo would sell the equipment at the end of the lease for its market value. Table II-10 shows the economic analysis for a capital lease.

Table II-10 Economic Analysis for a Capital Lease

EOY	Savings	Depr.	Payments in Advance			Principal	Taxable	Tax	ATCF
			Principal	Interest	Total	Outstanding	Income		
0			619,218	0	619,218	1,880,782			-619,218
1	950,000	357,250	393,524	225,694	619,218	1,487,258	367,056	124,799	205,983
2	950,000	612,250	440,747	178,471	619,218	1,046,511	159,279	54,155	276,627
3	950,000	437,250	493,637	125,581	619,218	552,874	387,169	131,637	199,145
4	950,000	312,250	552,874	66,345	619,218	0	571,405	194,278	136,503
5	950,000	111,625					838,375	285,048	664,953
5*	1,200,000	669,375					530,625	180,413	1,019,588
		2,500,000							

Net Present Value at 18%: $681,953

Notes: Total Lease Amount: 2,500,000

However, Since the payments are in advance, the first payment is analogous to a Down-Payment

Thus the actual amount borrowed is only = 2,500,000 - 619,218 = 1,880,782

Lease Finance Rate: 12% MARR = 18%

Tax Rate 34%

MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5

Accounting Book Value at end of year 5: 669,375

Estimated Market Value at end of year 5: 1,200,000

EOY 5 illustrates the Equipment Sale and Book Value*

Taxable Income: =(Market Value - Book Value)

=(1,200,000 - 669,375) = $530,625

With most types of leases, loans and bonds the monthly payments are fixed, regardless of the equipment's utilization, or performance. However, shared savings agreements can be incorporated into certain types of leases. The following financial arrangements are performance-based.

2.5.6 Performance Contracting

Performance contracting is a unique arrangement that allows the building owner to make necessary improvements while investing very little money up-front. The contractor usually assumes responsibility for purchasing and installing the equipment, as well as maintenance throughout the contract. But the unique aspect of performance contracting is that the contractor is paid based on the performance of the installed equipment. Only after the installed equipment actually reduces expenses does the contractor get paid. Energy service companies (ESCOs) typically serve as contractors within this line of business.

Unlike most loans, leases and other fixed payment arrangements, the ESCO is paid based on the performance of the equipment. In other words, if the finished product doesn't save energy, the host doesn't pay. This aspect removes the incentive to "cut corners" on construction or other phases of the project, as with bid/spec contracting. In fact, often there is an incentive to exceed savings estimates. For this reason, performance contracting usually entails a more "facility-wide" scope of work (to find extra energy savings), than loans or leases on particular pieces of equipment.

With a facility-wide scope, many improvements can occur at the same time. For example, lighting and air conditioning systems can be upgraded at the same time. In addition, the indoor air quality can be improved. With a comprehensive facility management approach, a "domino-effect" on cost reduction is possible. For example, if facility improvements create a safer and higher quality environment for workers, productivity could increase. As a result of decreased employee absenteeism, the workman's compensation cost could also be reduced. These are additional benefits to the facility.

Performance contracting is a risk-sharing relationship between the host and the ESCO. Kane [1995] claims that risk-sharing agreements are optimized when each risk is allocated to the party in the best position to control that risk. Depending on the host's capability to manage the risks (equipment performance, financing, etc.) the host will delegate some of these responsibilities to the ESCO. In general, the amount of risk assigned to the ESCO is directly related to the percent savings that must be shared with the ESCO.

For facilities that are not in a good position to manage the risks of an energy project, performance contracting may be the only economically feasible implementation method. *For example, the US Federal Government used performance contracting to upgrade facilities when budgets were being dramatically cut. In essence, they "sold" some of their future energy savings to an ESCO.*

In general, performance contracting may be the best option for facilities that:

- are severely constrained by their cash flows;
- have a high cost of capital;
- don't have sufficient resources, such as a lack of in-house energy management expertise or an inadequate maintenance capacity[d];
- are seeking to reduce in-house responsibilities and focus more on their core business objectives; or
- are attempting a new type of project that has an uncertain reliability[e].

Performance contracting does have some drawbacks. In addition to sharing the savings with an ESCO, the tax benefits of depreciation and other economic benefits must be negotiated. Whenever large contracts are involved, there is reason for concern. Hines [1996] found that 11% of customers who were considering EMPs felt that dealing with an ESCO was too confusing or complicated. Another 23% said

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[d] Maintenance capacity represents the ability that the maintenance personnel will be able to maintain the new system. It has been shown that systems fail and are replaced when maintenance concerns are not incorporated into the planning process. See Woodroof, [1997b] "Lighting Retrofits: Don't Forget About Maintenance", Energy Engineering, 94(1) p. 59.

[e] For example, a lighting retrofit has a high probability of producing the expected cash flows, whereas a completely new process does not have the same "time-tested" reliability. If the in-house energy management

the deal wouldn't provide sufficient financial benefits. Coates and DelPonti [1996] claim, "with complex contracts, there may be more options and more room for error." Therefore, it is critical to choose an ESCO with a good reputation and experience within the types of facilities that are involved.

There are a few common types of contracts. The ESCO will usually offer the following options:

- guaranteed fixed dollar savings;
- guaranteed fixed energy (MMBTU) savings;
- a percent of energy savings; or
- a combination of the above.

Obviously, facility managers would prefer the options with "guaranteed savings". However this extra security (and risk to the ESCO) usually costs more. The primary difference between the two guaranteed options is that guaranteed fixed dollar savings contracts ensure dollar savings, even if energy prices fall. *For example, if energy prices drop and the equipment does not save as much money as predicted, the ESCO must pay (out of its own pocket) the contracted savings to the host.*

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team cannot manage this risk, performance contracting may be an attractive alternative.

Percent energy savings contracts are agreements that basically share energy savings between the host and the ESCO. The more energy saved, the higher the revenues to both parties. However, the host has less predictable savings and must also monitor the ESCO to ensure compliance to the contract. There are numerous hybrid contracts available that combine the positive aspects of the above options.

Application to the Case Study

PizzaCo would enter into a hybrid contract; *percent energy savings/guaranteed arrangement.* The ESCO would purchase, install and operate a highly efficient chilled water system. The ESCO would guarantee that PizzaCo would save the $1,000,000 per year, but PizzaCo would pay the ESCO 80% of the savings. In this way, PizzaCo would not need to invest any money, and would simply collect the net savings of $200,000 each year.

With this arrangement, there are no depreciation, interest payments or tax-benefits for PizzaCo. However, PizzaCo receives a positive cash flow with no investment and little risk. At the end of the contract, the ESCO removes the equipment. At the end of most performance contracts, the host usually acquires or purchases the equipment for fair market value. However, for this case study, the equipment was removed to make a consistent comparison with the other financial arrangements.

Figure II-13 illustrates the transactions between the parties. Table II-11 presents the economic analysis for performance contracting.

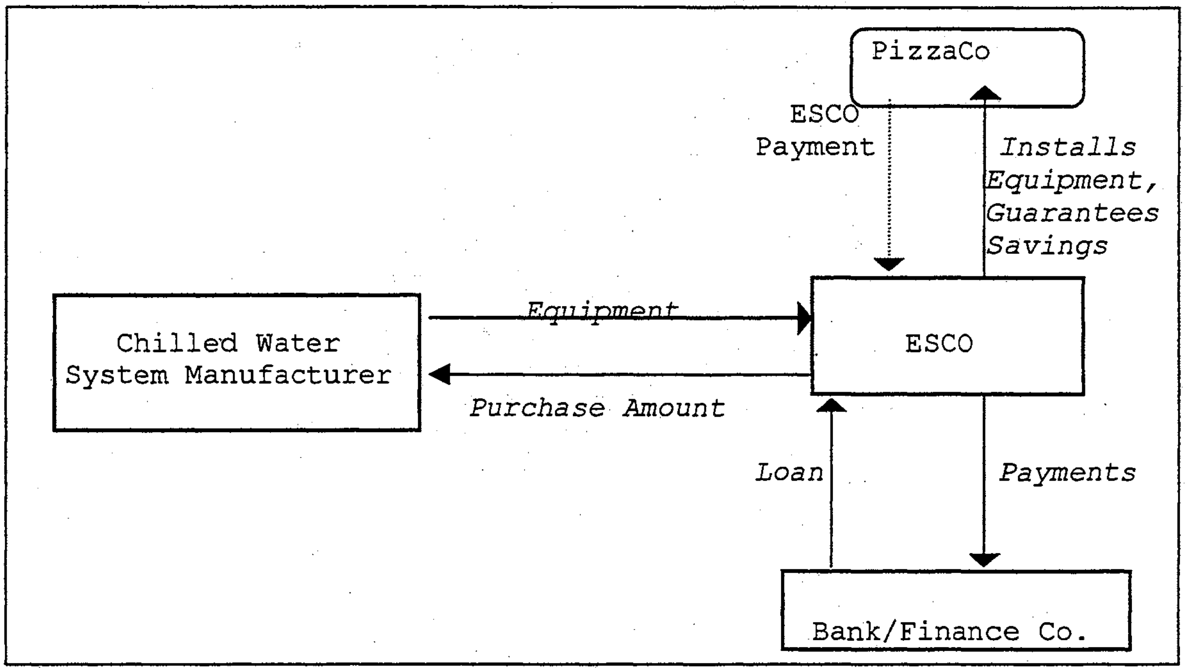

Figure II-13 Transactions for a Performance Contract

Table II-11 Economic Analysis of a Performance Contract

EOY	Savings	Depr.	ESCO Payments		Total	Principal Outstanding	Taxable Income	Tax	ATCF
0									
1	1,000,000				800,000		200,000	68,000	132,000
2	1,000,000				800,000		200,000	68,000	132,000
3	1,000,000				800,000		200,000	68,000	132,000
4	1,000,000				800,000		200,000	68,000	132,000
5	1,000,000				800,000		200,000	68,000	132,000

Net Present Value at 18%: $412,787

Notes: ESCO purchases/operates equipment. Host pays ESCO 80% of the savings = $800,000.
The contract could also be designed so that PizzaCo can buy the equipment at the end of year 5.

Note that Table II-11 is slightly different from the other tables in this paper: Taxable Income = Savings-Depreciation - ESCO Payments.

2.5.7 Summary Of Tax Benefits

Table II-12 summarizes the tax benefits of each financial arrangement presented in this paper.

Table II-12 Host's Tax Benefits for each Arrangement

ARRANGEMENT	Depreciation Benefits	Interest Payments are Tax-Deductible	Total Payments are Tax-Deductible
Retained Earnings	X		
Loan	X	X	
Bond	X	X	
Sell Stock	X		
Capital Lease	X	X	
True Lease			X
Performance Contract			X

2.5.8 Additional Options

Combinations of the basic financial arrangements can be created to enhance the value of a project. A sample of the possible combinations are described below.

- Third party financiers often cooperate with performance contracting firms to implement EMPs.
- Utility rebates and government programs may provide additional benefits for particular projects.
- Tax-exempt leases are available to government facilities.

- Insurance can be purchased to protect against risks relating to equipment performance, energy savings, etc.
- Some financial arrangements can be structured as *non-recourse* to the host. Thus, the ESCO or lessor would assume the risks of payment default. However, as mentioned before, profit sharing increases with risk sharing.

Attempting to identify the absolute best financial arrangement is a rewarding goal, unless it takes too long. As every minute passes, potential dollar savings are lost forever. Thus as Hansen [1993] claims, when considering special grant funds, rebate programs or other unique opportunities, it is important to consider the lost savings due to delay.

2.6 "PROS" & "CONS" OF EACH FINANCIAL ARRANGEMENT

This section presents a brief summary of the "Pros" and "Cons" of each financial arrangement from the host's perspective.

Loan

"Pros":

- host keeps all savings,
- depreciation & interest payments are tax-deductible,
- host owns the equipment, and
- the arrangement is good for long-term use of equipment

"Cons":

- host takes all the risk, and must install and manage project

Bond

Has the same Pros/Cons as loan, and

"Pro":

- good for government facilities, because they can offer a tax-free rate (that is lower, but considered favorable by investors)

Sell Stock

Has the same Pros/Cons as loan, and

"Pro":

- selling stock could help the host achieve its target capital structure

"Con":

- dividend payments (unlike interest payments) are not tax-deductible, and
- dilutes company control

Use Retained Earnings

Has the same Pros/Cons as loan, and

"Pro":

- host pays no external interest charges. However retained earnings do carry an opportunity cost, because such funds could be invested somewhere at the MARR.

"Con":

- host loses tax-deductible benefits of interest charges

Capital Lease

Has the same Pros/Cons as loan, and

"Pro":

- Greater flexibility in financing, possible lower cost of capital with third-party participation

True Lease

"Pros":

- allows use of equipment, without ownership risks,
- reduced risk of poor performance, service, equipment obsolescence, etc.,
- good for short-term use of equipment, and
- entire lease payment is tax-deductible

"Cons":

- no ownership at end of lease contract, and
- no depreciation tax benefits'

Performance Contract

"Pros":

- allows use of equipment, with reduced installment/operational risks, and
- reduced risk of poor performance, service, equipment obsolescence, etc., and
- allows host to focus on its core business objectives

"Cons":

- potentially binding contracts, legal expenses, and increased administrative costs, and
- host must share project savings

2.7 RULES OF THUMB

When investigating financing options, consider the following generalities:

loans, bonds and other host-managed arrangements should be used when a customer has the resources (experience, financial support, and time) to handle the risks.

Performance contracting (ESCO assumes most of the risk) is usually best when a customer doesn't have the resources to properly manage the project. Remember that with any arrangement where the host delegates risk to another firm, the host must also share the savings.

Leases are the "middle ground" between owning and delegating risks. Leases are very popular due to their tax benefits. True leases tend to be preferred when:

- the equipment is needed on a short-term basis;

- the equipment has unusual service problems that cannot be handled by the host;
- technological advances cause equipment to become obsolete quickly; or
- depreciation benefits are not useful to the lessee.

Capital Leases are preferred when:

- the installation and removal of equipment is costly;
- the equipment is needed for a long time; or
- the equipment user desires to secure a "bargain purchase option".

An Alternative Indicator of which Financial Arrangement may be Best

The decision to manage the project with in-house resources or use performance contracting may be indicated by the interest rate the host must pay. Most lenders specializing in energy projects are experts at assessing risks associated with a company and a potential project. Lenders will assign an interest rate based on three risks: (1) the host's credit risk, (2) project risk and (3) external risk.

If lenders assign a high interest rate (relative to prime rate), they believe the arrangement is risky. If lenders assign a low rate, they believe that all three risk areas can be managed.

Assuming that the cost of capital assigned by a lender represents the cumulative risk of a project within a specific company, a ballpark decision can be made using the following relationship: If the cost of capital is relatively:

High	>>>use performance contracting
Medium	>>>use leases
Low	>>>use loans, bonds and other host-managed arrangements

Thus if the cost of capital is relatively high, the host may want to pursue performance contracting, or another risk-shedding arrangement. However, if the lenders assign a low cost of capital, (the host is probably in good enough shape to handle the project) the project could be funded internally with loans or bonds.

2.8 CHAPTER SUMMARY

This chapter has introduced the primary financial arrangements available for EMPs. The positive and negative aspects of each arrangement were also presented. Hopefully, this information will be helpful to facility managers and decision-makers.

III. LITERATURE REVIEW OF DECISION SUPPORT SYSTEMS

3.1 CHAPTER OUTLINE

3.2 FOREWORD TO DECISION SUPPORT SYSTEMS

Decision support systems (DSS) *assist* decision-makers by providing a structured approach to making a selection among alternatives. The word "assist" is important, because these systems *support* rather than *replace* managerial judgement, (as with expert systems). Managers often need this support when dealing with decisions that involve multiple criteria. Keen and Scott-Morgan [1978] provide a classical definition of DSS:

> DSS couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of decisions. DSS can be computer-based support systems for management decision-makers who deal with semi-structured problems.

There are many types of DSS available on the market today, and not all require a computer. However, this literature review will only discuss a small sub-set of DSS: systems that are designed for multiple-criteria decisions. In addition, this literature review will focus on systems where the manager needs to structure a "hierarchy of objectives". Structuring a hierarchy of objectives is different than setting up a decision tree, where managers form a set of contingency action plans, based on "if/then" actions.

An expert system makes decisions based on the opinions of experts, which are incorporated into a program. Expert systems are not discussed in this chapter because most of these systems do not allow for detailed input from the user (individual facility manager), which could have the greatest impact on the decision. For instance, a facility manager may have site-specific concerns that would render the experts' opinions obsolete. Most expert systems do not allow the flexibility for the facility manager to alter the knowledge base, (adding and deleting decision criteria), on which the expert system makes decisions. Further, one of the goals of this dissertation is to educate and get the facility manager more involved in the financial decision process. Because expert systems are not well suited for these tasks, they are not included in this chapter's discussion of DSS.

The following citation from Starr and Zeleny [1977] describes some of the contributions to the field of multiple-objective decision support.

> There were only scattered discussions of multiple objectives [decision support] during the fifties, appearing in mainly articles of Koopman [1953, 1956], Hitch [1953], Hoag [1956], Klahr [1958], Dorfman [1960], as well as in books by Miller and Starr [1969], Karlin [1959] and Hanssmann [1962].
>
> It is our personal opinion that in spite of the initiatory works we mentioned (and there were many we did not mention) the true foundation of serious and continuous study of MCDM were laid by Erik Johnsen [1968] in his monograph, *Studies in Multi-objective Decision Models*.

Based on the achievements of these professionals, several advanced multi-objective decision systems were developed.

These systems are introduced and discussed at the beginning of this chapter. Of these DSS, the Analytic Hierarchy Process (AHP) has become one of the most popular. Today, on the Internet alone, there are over 1,000 references of AHP applications. Thus, the majority of this literature review will focus on the AHP and its applications to the objectives of this dissertation.

3.3 MULTIPLE-CRITERIA DECISION SUPPORT SYSTEMS

There are several DSS that can assist a manager when making multiple-criteria decisions. Sullivan [1986] describes some of the fundamentals of decision support systems as applied to capital investments. Some nontraditional investment decision support systems include:

- Profile Charts;
- Linear Additive Model and Multi-Attribute Utility Theory;
- The Multiple-Attribute Decision Model (MADM); and
- The Analytic Hierarchy Process (AHP)

Each of these systems can be designed to utilize quantitative as well as qualitative criteria to evaluate investments. In some cases, it is advantageous to combine attributes of different decision support systems. However, the numerous combinations that are possible have not been as well tested and understood as the individual systems. The following sections describe each DSS in greater detail.

3.3.1 Profile Charts

Table III-1 below illustrates the simplicity of this technique as applied to a car selection example. By using a profile chart, the manager quickly judges how well an alternative satisfies each criterion ("low price", "low cost insurance", etc.). As Table III-1 shows, the score within each criterion can range from "-2" to "2", (a wider scoring range could also be used). The more positive the score, the better the alternative satisfies that particular criterion. The individual scores for each criterion are added together to determine the cumulative score. The alternative with the highest cumulative score is selected.

Table III-1 Judgements within a Profile Chart

	ALTERNATIVES	
	Mercedes	**Escort**
DECISION FACTOR	SCORE	SCORE
Low Price	-2	2
Low Cost Insurance	-1	1
Good Warrantee	1	1
Good Fuel Economy	-2	2
High Prestige	2	-2
High Comfort	2	-2
Strong Exterior	2	-2
Ergonomic Interior	2	-2
CUMULATIVE SCORE	**4**	**-2**

Although the profile chart is simple to understand and use, it should only be applied as a quick evaluation tool. Other DSS are much more comprehensive and offer the ability to weight the importance of each criterion. In addition, other DSS offer the ability to verify the logic of the comparisons. For these reasons, profile charts are not the most effective or comprehensive choice for making multiple objective decisions.

3.3.2 Linear Additive Model and Multi-Attribute Utility Theory

The Linear Additive Model (a.k.a. Multi-Attribute Utility Theory) allows criteria to be weighted according to their importance. The decision-maker then assigns percent weights to each criterion, so that the total allocation from one node to its immediate descendants equals 100%. Although this is a quick assignment process, French [1989] found that the lack of comparisons between criteria inhibits the ability to verify the logic of the criteria weights.

3.3.3 The Multiple-Attribute Decision Model (MADM)

The MADM is a management tool for project selection that allows the decision-maker to set priorities for projects and to rank them while considering the critical factors for a project's success. Like other models, it is important to define the problem clearly, identify and classify the critical factors. With MADM, critical factors are classified into three groups: "quantitative-financial", "quantitative-non financial" and "qualitative factors".

For each critical factor, the decision-maker assigns a relative weight of importance (in points). If a critical factor has many weight points, it is relatively important. Similar to the Linear Additive Model, the cumulative weight points (across all critical factors) assigned must equal 100.

In addition to weight points, scalar values ("0" to "5") are assigned to each critical factor. The scalar values indicate the frequency that the critical factor has an impact. For example, the scale for a process yield might be defined as follows:

- A scalar of "0" indicates that process yield is less than 90%.
- A scalar of "1" indicates that process yield is at least 80%, but less than 85%.
- A scalar of "2" indicates that process yield is at least 85%, but less than 90%.
- A scalar of "3" indicates that process yield is at least 90%, but less than 95%.
- A scalar of "4" indicates that process yield is at least 95%, but less than 99%.
- A scalar of "5" indicates that process yield is greater than 99%.

MADM incorporates a risk adjustment by assigning a confidence level (confidence level of "0" implies maximum risk; confidence of "1" means no risk) per factor for each alternative.

The priority scores for the alternative projects are then computed by summing the products of the weight, scalar value and confidence level over all critical factors. The decision-maker has only to select the project that has the highest priority score, since this is the alternative that presumably maximizes the values of the critical factors while minimizing risk.

Although the MADM processes are more technically advanced than many other models, MADM has similar deficiencies because the logic of the decision-maker's judgements cannot be assessed. In addition, the combination of scalar values and risk adjustment may not be appropriate for all decisions. Including these extra factors when unneeded may confuse the decision-maker.

3.3.4 The Analytic Hierarchy Process (AHP)

Unlike the previous DSS, the AHP allows the decision-maker to weight the importance of criteria as well as verify the logic of his/her judgements. Along with being highly applicable and customizable, the AHP has numerous additional benefits, which require some background information to appreciate. The following sections of this chapter provide a detailed discussion of the AHP.

3.4 BACKGROUND OF THE ANALYTIC HIERARCHY PROCESS

Dr. Thomas Saaty developed the Analytic Hierarchy Process (AHP) in the 1970s. The AHP is a tool to help facilitate decision-making for problems with multiple objectives, or multiple criteria. When these types of decisions need to be made, it is difficult for the decision-maker to visualize all the "pros" and "cons" in order to identify the alternative that will best satisfy the primary goal. The AHP provides a systematic process to incorporate the important criteria into a mathematical model, which estimates the appropriateness of each alternative. The model produces a "score" of each alternative's ability to satisfy the primary goal.

The AHP has been successfully used internationally in numerous fields such as risk assessment [Mustafa and Al-Bahar, 1991], electric power allocation [Saaty and Mariano, 1979], selecting portfolio investments [Saaty, Rogers, and Pell, 1980], multi-attribute performance evaluation [Chan and Lynn, 1991], lease or buy decisions [Vargas and Saaty, 1981] and many others. For additional background, Shim

[1989] and Zahedi [1986] provide a comprehensive survey of AHP applications.

One reason AHP is popular is because the decision-maker must *visually* structure and organize the decision criteria. As a result of using this visual representation of the problem, the decision-maker becomes more aware of the relationships between the criteria and the primary goal. Liberatore [1987] claims the enlightened decision-maker is more likely to make decisions that are consistent with the firm's mission. Among multi-criteria decision-making methodologies used in industry, Schoemaker and Waid [1982] found that the AHP was the easiest to use, and produced the most trustworthy results.

3.5 EFFECTIVE QUALITIES OF THE AHP

Several authors have claimed that AHP is successful in capital budgeting decisions because it expands traditional discounted cash flow (DCF) economic analyses to incorporate qualitative criteria (such as flexibility, quality and productivity) [Jensen, 1987; Boucher and MacStravic, 1991; Liberatore, Monahan, and Stout, 1992]. Before AHP, several authors questioned the exclusive use of DCF analysis to justify capital investments [Mensah and Miranti, 1989; Shank and Govindarajan, 1989; Noble, 1990; Polakoff, 1990;

Bromwich and Bhirani, 1991]. Several attempts were made to refine DCF techniques in order to make the "best" capital investment decisions [Miltenberg and Krinsky, 1987; Kwan and Yuan, 1988; Meyer, Besley and Longstreet, 1988; Weaver, Peters, Cason and Daleiden, 1989]. Although there are many opinions on what a new capital budgeting process should include, many authors stated that such a new process would need to:

1. incorporate quantitative as well as qualitative criteria to the decision process; and
2. formalize the decision process with a systematic approach.

AHP has been popular because it can accommodate these requirements, while remaining flexible and highly applicable. The following sections describe the importance of the aforementioned requirements.

3.5.1 Incorporating Quantitative and Qualitative Decision Criteria

Qualitative criteria can have a significant impact on a manager's decision process. Saaty and Desai, [1979] found that intangible factors (such as: flexibility, safety, comfort, ego and company image) accounted for 52% of the priorities assigned to a decision on vehicle choice. Cost and maintenance accounted for 40% and 8% respectively. Although the above study demonstrated the importance of qualitative criteria within a decision, additional publications have presented a wide variety of conclusions regarding the relative importance of quantitative and qualitative criteria.

- Petty, Scott and Bird [1975] found that 77% of respondents prefer quantitative criteria (such as NPV, IRR) over qualitative criteria.
- Wheelwright [1981] found that the U.S. Auto Industry was losing its market to Japan partly because Japanese managers did a better job incorporating strategic planning issues (quality, flexibility, etc.) into investment decisions.
- Rosenthal [1986] found that qualitative and quantitative criteria were equally important.

Due to the variety of professional opinions, the relative importance of quantitative and qualitative criteria should be adjustable, so that each facility's particular preferences can influence the decision. To meet this need, the AHP was designed to incorporate all types of criteria, and allow the decision-maker to influence the relative importance of each criterion.

3.5.2 Formalizing the Decision Process

A formalized decision process allows the decision-maker to view the problem with greater awareness and objectivity. With the AHP, complex decision problems are arranged in a manageable structure of criteria called a hierarchy. This arrangement makes it possible for decision-makers to focus on each and every part of a complex problem, and identify which criteria are most important to the primary goal. By systematically prioritizing criteria as well as measuring how well each alternative satisfies these criteria, the AHP generates an overall ranking of the alternatives. In other words, the AHP will "score" each alternative's ability to accomplish the primary goal.

To confirm the results, AHP's consistency ratio test can indicate whether the decision hierarchy and priorities are logical. Sensitivity analyses can also provide useful information about the alternatives and the impact of variance in a criterion's weight.

3.6 STANDARD AHP PROCEDURES

This section will describe the AHP in detail. A sample application of purchasing a car is used to demonstrate some of the AHP procedures. In general, AHP has four steps.

1. First, the decision hierarchy is structured, (the "Structuring Phase").
2. The second step is to determine the relative importance of each decision criterion, (the "Assessment Phase").
3. The third step consists of using the decision-maker's judgements on the importance of each criterion to determine local normalized priority weights from each criterion to its sub-criteria. Then, aggregating the local priority weights to determine an overall ranking of decision alternatives, (the "Synthesis Phase").
4. Finally, the logic of the decision-maker is verified through consistency ratio tests and by performing sensitivity analyses.

3.6.1 The Structuring Phase

The decision-maker structures the problem into a hierarchy where each level consists of a set of decision elements (nodes). Figure III-1 illustrates the terminology for a sample hierarchy. The top level has only one node: the primary goal of the decision problem. Lower levels contain the criteria (or objectives) and sub-criteria. The bottom level in the hierarchy is composed of the alternatives. Although the local normalized priority weights are not calculated until the "Synthesis" phase, their relation is also shown in Figure III-1.

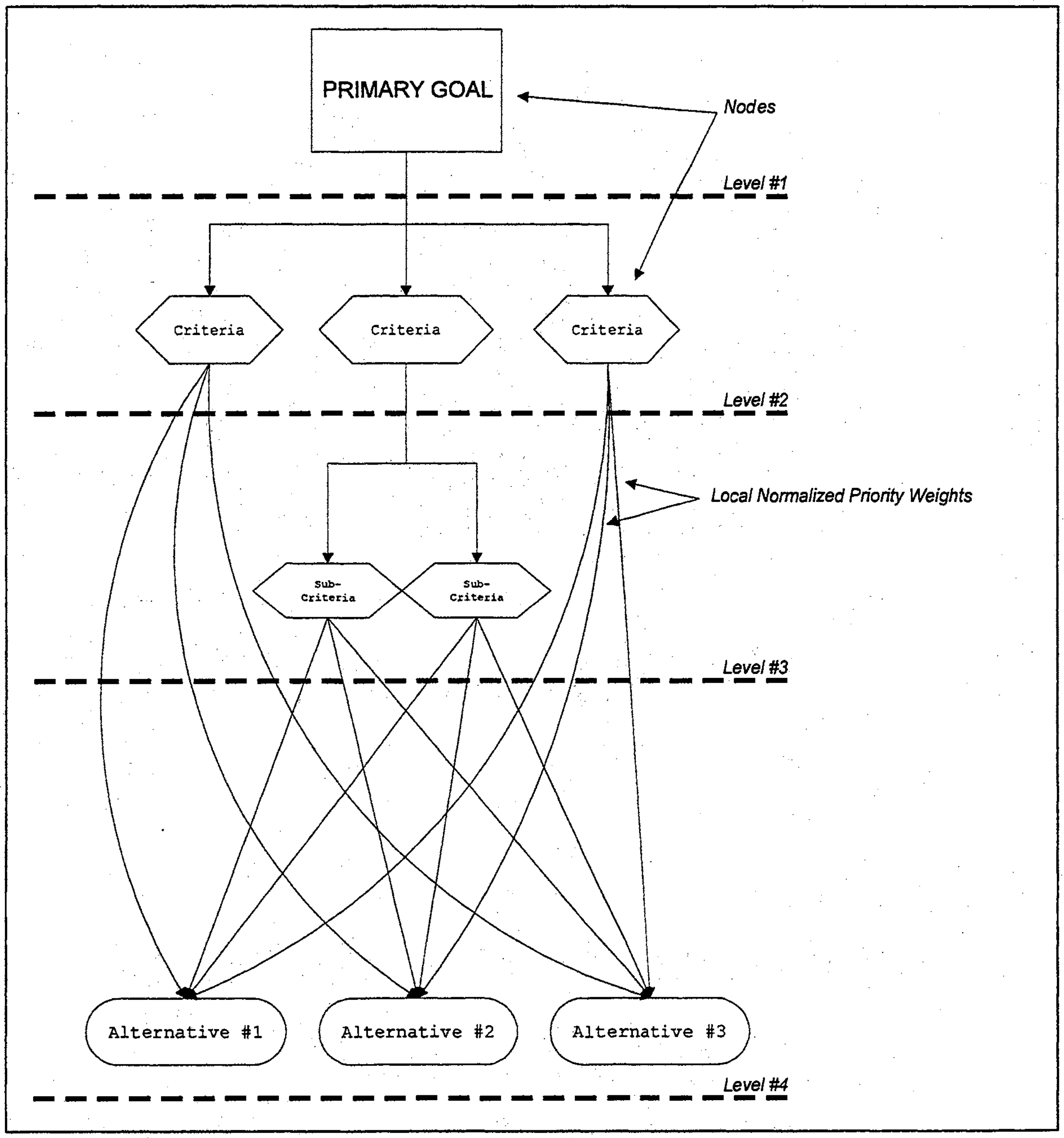

Figure III-1 Terminology in an AHP Hierarchy

Figure III-2 shows a sample hierarchy for selecting car. The first level of the hierarchy contains the primary goal: "pick the best car". The level beneath the primary goal contains four decision criteria (objectives): "low price", "low operation & maintenance costs", "high prestige" and "high quality". Each criterion may have its own sub-criteria. The bottom level of the hierarchy is composed of the three alternatives: "Mercedes", "Maxima" and "Escort". This completes the "Structuring Phase" of the AHP.

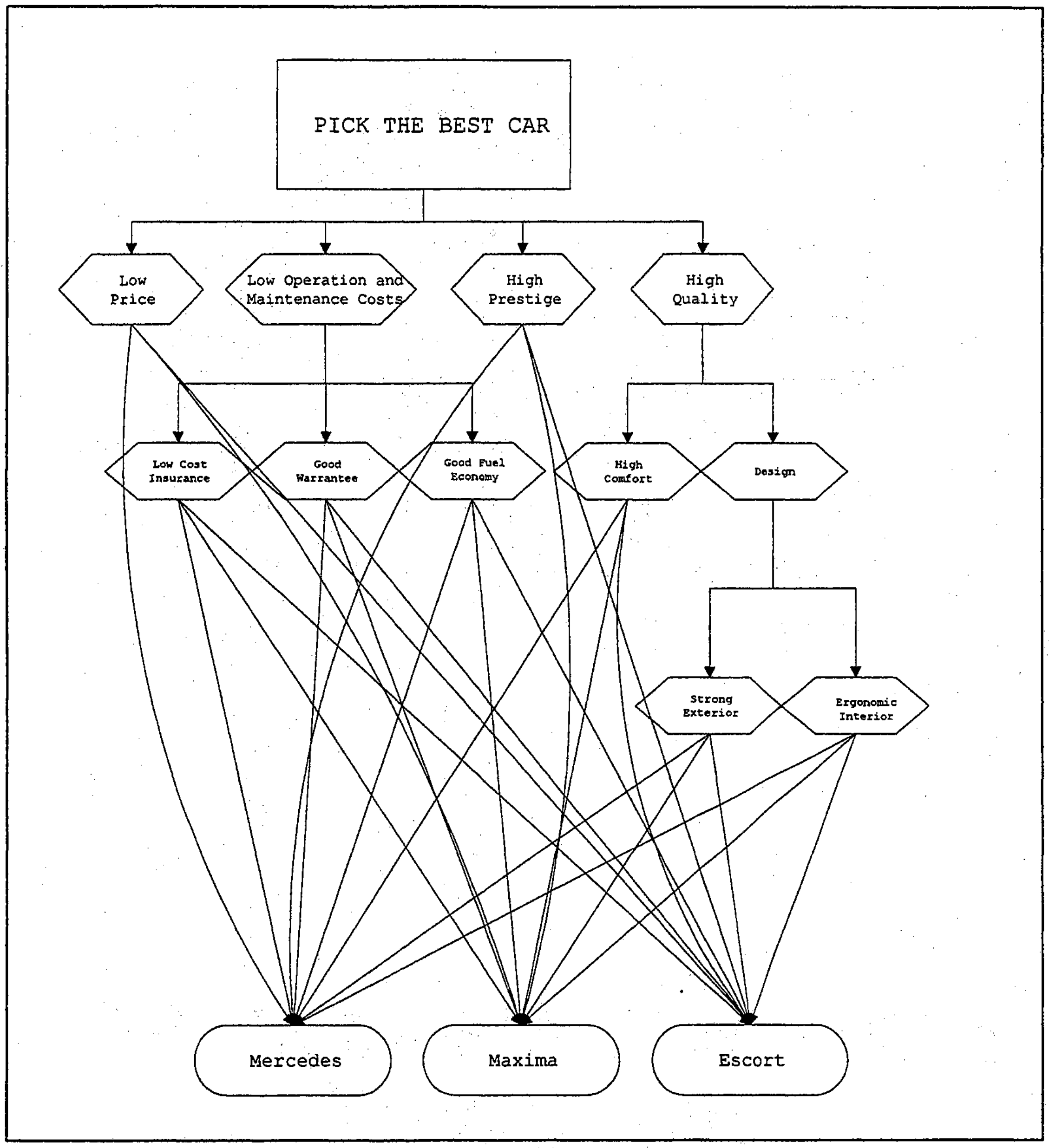

Figure III-2 Sample Hierarchy for Selecting a Car

3.6.2 The Assessment Phase

Once the hierarchy is developed, the decision-maker makes judgements to indicate each criterion's relative importance to the node from which it originates, (which is one level higher). The judgements can be determined through the different assessment techniques presented below.

- With "ratings", criteria are judged based on a scale. Obtaining judgements via ratings can be effective for ranking hundreds of criteria, as long as the standards used for grading are clearly understood by the evaluators. *For example, within Figure III-2, the cars could be rated as to how they satisfy the "high comfort" criterion. The judgements could be "outstanding", "good", average, "below average", or "poor". Alternatively, a "1" to "9" scale could be used, where "1" implies "poor" and "9" implies "outstanding".*

- Via "direct data entry", actual numbers representing the different descendants of a node are used. *For example, price estimates are available for different cars. Thus, when comparing how well each car satisfies the "low price" criterion, actual car prices can be entered into the model. The lower the price, the better. In this case, the decision-maker simply enters the inverse of the actual prices as the judgements. For example, the Mercedes would have a judgement of (1/$80,000), while the Maxima might have a judgement of (1/$40,000). Thus, the Maxima would receive a higher judgement.*

- With "pair-wise comparisons" between criteria, nodes can be distinguished based on importance, preference or likelihood of one criterion over another. *For example within Figure III-2, "low price", "low operating and maintenance costs", "high prestige" and "high quality" are pair-wise compared to determine which is the most important to the node: "pick the best car". Judgements would take the following format: "price is twice as important as maintenance cost".* A more detailed description of the pair-wise comparison process is presented later in this section.

AHP allows combinations of assessment techniques. In other words, pair-wise, ratings and direct data entry can all be used to assess different criteria under a single hierarchy.

In general, when assessing criteria where quantitative data is available, the decision-maker is likely to use direct data (or some manipulation thereof) as the judgements. In contrast, when assessing qualitative criteria, the decision-maker is likely to use the ratings method or pair-wise comparison process to determine judgements. *In the car selection example, actual data is inserted for the quantitative criteria: ("low price", "fuel economy", etc.). However for the qualitative criteria, ("high comfort", "high* *prestige", etc.) pair-wise comparisons, or ratings are used to determine how well each alternative satisfies the criteria.*

The pair-wise comparison process can be easily illustrated in a matrix format. Table III-2 presents the judgements between the main criteria to satisfy the "pick the best car" node.

Table III-2 Matrix of Criteria Judgements

	Low Price	Low Operation and Maintenance Costs	High Prestige	High Quality
Low Price	1	2	4	2
Low Operation and Maintenance Costs	1/2	1	2	1
High Prestige	1/4	1/2	1	1/2
High Quality	1/2	1	2	1

Note that Table III-2 is a reciprocal matrix, and $a_{ij} = 1/a_{ji}$. Thus, it would be redundant to describe the shaded areas. Reading the matrix's non-shaded entries (rows first, then columns), the results are interpreted in Table III-3.

Table III-3 Meanings for each entry in Matrix of Criteria Judgements

Pair-wise Comparison	Judgement	Ratio
"Low Price" compared to "Low Operation and Maintenance Costs"	Obtaining a car with a low price is 2 times more important than obtaining a car with low operation & maintenance costs *or* *"Maintenance" is 1/2 as important as "Price"*	2
"Low Price" compared to "High Prestige"	Obtaining a car with a low price is 4 times more important than obtaining a car with high prestige	4
"Low Price" compared to "High Quality"	Obtaining a car with a low price is 2 times more important than obtaining a car with high quality	2
"Low Operation & Maintenance Costs" compared to "High Prestige"	Obtaining a car with low operation & maintenance costs is 2 times more important than obtaining a car with high prestige	2
"Low Operation & Maintenance Costs" compared to "High Quality"	Obtaining a car with low operation & maintenance costs is as important as obtaining a car with high quality	1
"High Prestige" compared to High "Quality"	Obtaining a car with high prestige is only 1/2 as important as obtaining a car with high quality	0.5

Whether via pair-wise comparison, ratings or actual data insertion, the judgement process continues, level by level throughout the hierarchy. *For example, "low cost insurance", "good warrantee" and "good fuel economy" are judged as to how well they contribute to a car with "low operation & maintenance costs".* Finally, judgements are entered about how well each alternative satisfies each of the lowest-level criteria for each branch. This last step completes the Assessment Phase of AHP.

3.6.3 The Synthesis Phase

3.6.3.1 *Conceptual Explanation of Synthesis Phase*

The third process of the AHP is to synthesize all the criteria judgements into "local normalized priority weights", then "route weights", and eventually an overall "score" for each alternative.

Local normalized priority weights are determined by normalizing each node's judgements of its immediate descendant criteria, (such that the sum of the priority weights from one node to its immediate descendants equals one). After local normalized priority weights have been determined for all nodes in one level, the next level's nodes should be normalized. This process can be completed either "top-down" or "bottom-up" within the hierarchy, until all nodes are normalized.

Figure III-3 shows what the car selection hierarchy should look like with local normalized priority weights inserted.

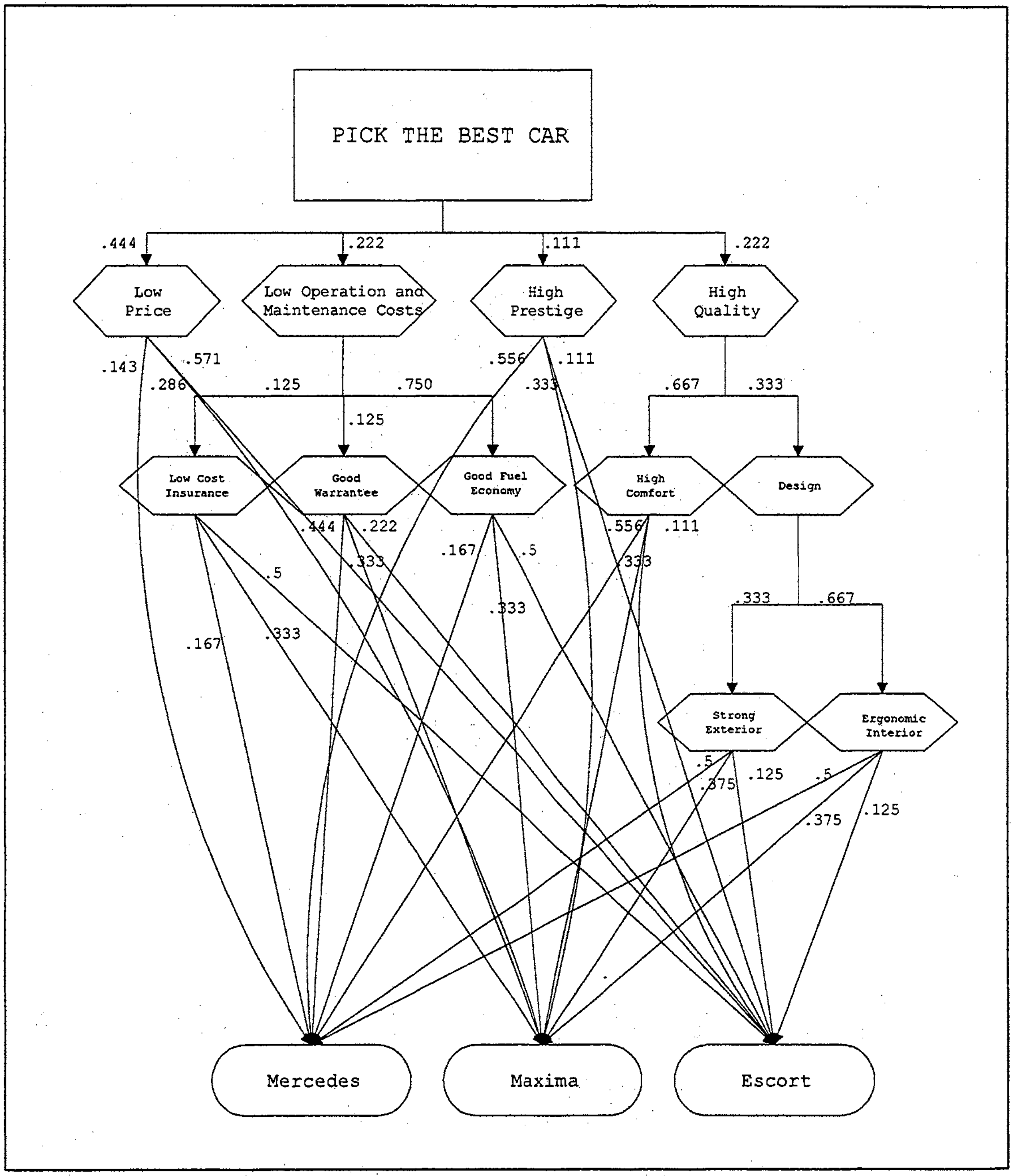

Figure III-3 AHP Hierarchy with Local Normalized Priority Weights

After all nodes have been normalized, then the "route weights" should be calculated. A route weight is the product of all the local normalized priority weights for a singular route from the primary goal to an alternative. *For the car selection example, the route weight from the primary goal through the "price" node to the "Mercedes" alternative is:*

= (the local normalized weight from the "goal" node to the "price" node)* (the local normalized weight from the "price" node to the "Mercedes" node)

= (0.444)*(0.143)

= 0.0635

After all route weights have been determined, the next step is to determine the overall score for each alternative. The score for each alternative is the sum of the route weights entering into an alternative. For example, the score for the "Mercedes" alternative is the sum of the route weights from the "Mercedes" (to the primary goal) through the following nodes:

["low price"] + ["low cost insurance"]
+ ["good warrantee"] + ["good fuel economy"]
+ ["high prestige"] + ["high comfort"]
+ ["strong exterior"] + ["ergonomic interior"]

= [(.444)(.143)] + [(.222)(.125)(.167)]

+ [(.222)(.125)(.444)] + [(.222)(.750)(.167)]

+ [(.111)(.556)] + [(.222)(.667)(.556)]

+ [(.222)(.333)(.333)(.5)] + [(.222)(.333)(.667)(.5)]

=0.289

In a similar manner the sum of the route weights entering the "Maxima" alternative is:

=0.315

In a similar manner the sum of the Route Weights entering the "Escort" alternative is:

=0.395

The scores for each alternative should represent a normalized ranking of the alternatives. Note that there are a few round-off errors, because (0.289) + (0.315) + (0.395) equals 0.999 when it should equal 1. In any case, because the Escort has the highest score, it is preferred over the other alternatives.

3.6.3.2 *Mathematical Explanation of Synthesis Phase*

According to Saaty [1982], there are two primary ways to calculate normalized local priority weights for each node in a hierarchy:

1. The Classical Linear Algebra Approach
2. The ECPro Website Approximation

The Classical Linear Algebra Approach:

To illustrate the synthesis process mathematically, assume that the objective is to establish the relative weights of n criteria. If we denote their weights by w_1, $w_2, \ldots w_n$, the pair-wise judgement matrix A may be expressed as the following reciprocal matrix:

	A_1	A_2	A_3	...	A_n
A_1	1	w_1/w_2	w_1/w_3	...	w_1/w_n
A_2	w_2/w_1	1	w_2/w_3	...	w_2/w_n
A_3	w_3/w_1	w_3/w_2	1	...	w_3/w_n
.	.	.	.	...	.
A_n	w_n/w_1	w_n/w_2	w_n/w_3	...	1

where w_i/w_j = the relative importance of w_i to w_j

To find the eigenvalues and associated nonzero eigenvectors of A, we seek a scalar λ and nonzero vector $\mathbf{X} = (x, y)$ such that $A\mathbf{X} = \lambda\mathbf{X}$. Via algebraic manipulation we have:

$$(\lambda - A)\mathbf{X} = 0$$

and now inserting the Identity Matrix I:

$$(\lambda - AI)\,X = 0$$

solving for X:

$$X = (A - \lambda I)^{-1}0 = 0$$

Therefore, for X to possess a nontrivial solution, the value of λ must be such that λ-AI becomes a singular matrix. This is a familiar eigenvalue problem, and the eigenvector approach is recommended as the methodology for deriving local priorities. For a more detailed description of calculating eigenvectors, see Saaty (1980).

To present a simple example, consider the following 2 by 2 matrix of judgements:

	Low Price	Low Operation and Maintenance Costs
Low Price	1	2
Low Operation and Maintenance Costs	1/2	1

in basic matrix form, we have:

$$\begin{bmatrix} 1 & 2 \\ 0.5 & 1 \end{bmatrix}$$

We seek a scalar λ and nonzero vector $X = \begin{bmatrix} x \\ y \end{bmatrix}$ such that

$$\begin{bmatrix} 1 & 2 \\ 0.5 & 1 \end{bmatrix} * \begin{bmatrix} x \\ y \end{bmatrix} = \lambda * \begin{bmatrix} x \\ y \end{bmatrix}$$

These equations can be rewritten as:

$$x + 2y = \lambda x \quad \text{and} \quad 0.5x + y = \lambda y$$

To setup the characteristic matrix, we multiply the basic matrix by (λ-I):

$$\begin{bmatrix} \lambda-1 & 2 \\ 0.5 & \lambda-1 \end{bmatrix} * \begin{bmatrix} x \\ y \end{bmatrix} \qquad \text{[Characteristic Matrix]}$$

These equations can be rewritten as:

$$(\lambda-1)x + 2y = \lambda x \qquad [1]$$

$$0.5x + (\lambda-1)y = \lambda y \qquad [2]$$

To find the eigenvalues, set the determinant of the characteristic matrix equal to zero and solve for λ.

This results in the following equations:

$$(\lambda-1)^2 - (0.5)*(2) = 0$$

which reduces to:

$$(\lambda-1)^2 - (1) = 0$$

Thus, $\lambda = 0$ is an eigenvalue.

To calculate the eigenvector, plug the eigenvalue back into equations [1] and [2]:

from [1] $\quad (0-1)x + 2y = 0x$

thus, $\quad 2y - x = 0$

from [2], $\quad 0.5x + (0-1)y = 0y$

thus, $\quad 0.5x - y = 0$

An eigenvector that satisfies these equations is:

$$X = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$$

Normalizing X, (such that the sum =1), we have

$$X = \begin{bmatrix} 0.666 \\ 0.333 \end{bmatrix}$$

The normalized eigenvector is $\begin{bmatrix} 0.666 \\ 0.333 \end{bmatrix}$ which would correspond to the priority weights for "low price" (0.666) and "low operation and maintenance costs" (0.333).

After the normalized eigenvectors for each criterion (within a level) are determined, they are weighted by the priority of their parent criteria (one level higher) using the route weights as explained earlier. By continuing this process of eigenvector extraction and prioritization by weighting node-by-node, an overall priority vector for the decision problem is derived. *For instance, the overall priority vector for the car selection example will be a relative ranking of which car best satisfies the criteria.*

Calculating eigenvectors by hand can be a long process. The official AHP process, as well as the Expert Choice software use the classical linear algebra approach to derive normalized eigenvectors. With the software, the computer quickly calculates normalized priority weights and overall priority vectors. However, on the ECPro website, Saaty has recommended a simple approximation to calculate normalized eigenvectors by hand.[f]

[f] From the AHP DEMO on the Web @ www.expertchoice.com

The ECPro Website Approximation:

A quick way to determine the local normalized priority weights is to complete the following steps:

1. Identify the comparison matrix "A"
2. Calculate A^2
3. Sum the rows of the A^2 matrix
4. Normalize the "Sum Column"
5. Repeat steps 2-4, until a successive iteration differs by only 1/100th of a normalized e-vector.

For example, consider the following car selection matrix:

	Price	Maintenance	Prestige	Quality
Price	1	2	4	2
Maintenance	1/2	1	2	1
Prestige	1/4	1/2	1	1/2
Quality	1/2	1	2	1

By squaring the matrix, we obtain:

	Price	Maintenance	Prestige	Quality	**SUM**	**NORM SUM**
Price	4	8	16	8	**36**	**.4444**
Maintenance	4	4	8	4	**18**	**.2222**
Prestige	1	2	4	2	**9**	**.1111**
Quality	2	4	8	4	**18**	**.2222**

The last two columns on the right show the row sums, and the normalized values of the SUM column. The NORM SUM column contains the eigenvectors corresponding to the criteria listed on the left side of the matrix. *For example, "price" has a normalized priority weight equal to 0.4444.* We could repeat steps 2 through 4, however we would obtain the same normalized eigenvector values.

Similar to the classical linear algebra approach, by continuing this process of eigenvector extraction and prioritization by weighting node-by-node, an overall priority vector for the decision problem is derived.

3.6.4 Verifying Consistency And Performing Sensitivity Analyses

Inconsistent judgements can be a factor when using the pair-wise comparison method. The consistency ratio test provides a method of checking the logic of a newly constructed hierarchy. This is accomplished by observing the consistency of the judgements made. *For example, if the decision-maker judges that the "Mercedes" is twice as prestigious as the "Maxima", and the "Maxima" is twice as prestigious as the "Escort", then (by logic) the decision maker should also have judged the "Mercedes" to be four times as prestigious as the "Escort". If this was not the result, then there is inconsistency in the judgements.* AHP keeps track of all comparisons between criteria to measure consistency. This is a particularly important benefit, since results can be based on subjective expert assessments. A consistency ratio value of less than 0.10 is generally acceptable. If the consistency ratio value is greater than 0.1, the judgements should be revised.

In addition to the consistency ratio test, the AHP allows for sensitivity analysis. By using sensitivity analysis, the decision-maker can increase or decrease the importance of specific criteria and measure the impact of the cumulative "scores" for each alternative. From the sensitivity analysis, the decision-maker can determine which criteria are critical.

After the AHP's four steps have been completed, the decision-maker should have a normalized ranking of the alternatives. According to the AHP, the alternative with the highest score is optimal. At this point, the decision-maker should make the final decision on which alternative (or combination thereof) to implement.

There are numerous other DSS, many combining the characteristics and methods of the aforementioned systems. However, AHP is unique and offers distinct advantages over the other DSS. AHP has also been more popular and successfully implemented in a variety of applications. The AHP is one of the most technically advanced decision support systems available today.

3.7 THE EXPERT CHOICE SOFTWARE

Expert Choice (ECPro) is a software package that is based on the AHP. ECPro automates AHP, making it easier to use and quicker to apply. With ECPro, all calculations are done automatically, from a windows-driven graphical user interface. Results are instantaneous, and provide for immediate feedback to the decision-maker. The decision-maker can even apply dynamic sensitivity analyses to observe how the selection will change as one criteria's importance is altered.

ECPro contains tutorials to help the decision-maker while using the program. For instance, during the hierarchical structuring phase, (which often is the most difficult task) ECPro provides instructions on how to turn "pros" and "cons" of alternatives into criteria.

Once the hierarchy is established, ECPro helps the decision-maker select the most appropriate environment for entering judgements. Judgements on criteria can be expressed verbally, numerically, or graphically. The ECPro tutorial guide will explain when to use each approach. ECPro also has a unique method of using redundancy to derive weights that more accurately reflect perceptions and values than any other approach.

3.8 PROBLEMS WITH THE AHP

AHP appears to be superior to other multiple-criteria decision-making systems because it insures consistency and transitivity of responses through the use of pair-wise comparisons, ratings or actual data. It also is relatively simple, yet allows the decision maker to weight the importance of criteria, as well as how well each alternative satisfies the criteria. However, the model has been criticized because of the problems associated with structuring a hierarchy. Three problem areas are most common:

1. *Interrelationship between criteria*
2. *The impact of external criteria that are not related to the alternatives*
3. *Manipulating the criteria to ask appropriate questions during the assessment process*

3.8.1 Interrelationship between criteria

The hierarchy must be structured so that every alternative's "pros" and "cons" are completely represented within the criteria or sub-criteria. Naturally, each alternative contains a unique set of "pros" and "cons", and some of these may inter-related. Any inter-dependencies between criteria in different branches of the hierarchy can cause problems with the AHP. *For example, in the car selection* *example, extended warrantee options could affect the price.* Ultimately, it is the responsibility of the decision-maker to structure the hierarchy so that inter-dependencies are minimized.

Because inter-dependant criteria are common in capital investment decision hierarchies, Varney, Sullivan and Cochran [1985] modified the basic AHP approach by constructing separate hierarchies for benefits and costs. Although the dual-hierarchy technique is a contribution and expansion of the AHP, two hierarchies may be more difficult to visualize than one. A singular hierarchy that is cleverly constructed can minimize the interdependency issues. The most recent trends show that this approach is more popular and efficient than using a dual hierarchy.

As will be shown in Chapter IV, this study will use a hierarchy with only one level of criteria between the primary goal and the alternatives. To further simplify the model, great effort will be expended to define criteria that are not inter-dependent. Detailed descriptions will also be made to help the reader distinguish differences in the objectives and alternatives.

3.8.2 Impact of External Criteria

External criteria (that are not related to the alternatives) can have an impact on the results from AHP. The effects of this problem can be minimized if the appropriate lowest-level criteria are carefully selected so they represent the cumulative effects of smaller criteria, (that may not be appropriate serving as individual criteria nodes).

For example, in an EMP financing decision, the desire to select an arrangement with a "low cost of capital" may be an objective. However, the cost of capital may depend on the host's credit, or the project's reliability. These sub-factors are externalities because they have minimal relations with the alternatives (using a loan, bond, or other choice of financial arrangement). It is very difficult to compare alternatives when they are indistinguishable to the lowest-level criteria. However, this problem can be resolved by using the NPV as one node within the lowest-level criteria. NPV would incorporate all the quantitative factors (cost of capital, cash flow timing, etc.). The NPV for each arrangement could be easily determined.

<u>3.8.3 Manipulating the crtieria to ask appropriate questions during the assessment proecess</u>

Manipulating a criterion's wording so that it asks a question can be problematic. Dyer [1990] found potential for rank-reversal of alternatives due to ambiguity in questions used during the pair-wise comparison process. Lockett and Stratford [1987] warn that the ratio type questions are capable of easy misinterpretation, and hence need careful explanation. If the questions relating to criteria are not clear, the effectiveness of the DSS can be destroyed. The effects of these problems can be minimized if the questions are clear and structured to address specific issues. In essence, <u>all criteria should relate to their parent and descendant nodes.</u>

For example, In the car selection example, it would be inappropriate to have a criteria simply stated as "prestige", because it is unclear whether a high or low prestige is desired. Criteria must be more specific. Instead, this criterion should be labeled "high prestige". Referring to Figure III-2, when assessing the importance of this criterion to the primary goal, the reader can assess how important it is to have a car with high prestige. When comparing alternatives ("Mercedes", "Maxima" and "Escort"), *the reader can also assess how well each car satisfies the "high prestige" criterion.*

Although AHP has some potential problems, these can be avoided with careful hierarchy construction. Thus, the AHP remains one of the most popular multi-criteria decision systems. This is evident by the proliferation of articles published in refereed journals and presented at conferences.

3.9 SURVEY DESIGN ISSUES

Survey design is very important when developing questions within the AHP. As will be discussed in chapter IV, this dissertation will use surveys to identify and prioritize decision criteria for selecting a financing arrangement for an EMP. One survey method used will be the Delphi Iterative Survey Process, which is described in the next section.

3.9.1 The Delphi Iterative Survey Process

Olaf Helmer and Norman Dalkey, scientists at the Rand Corporation developed the Delphi Iterative Survey Process (Delphi) in the 1950s. Delphi was developed to predict the future and answer questions when uncertainty and complexity surround the area of concern. Originating from Greek Mythology, Delphi's name comes from the oracle at Delphi, whom the Greeks visited for information about their future.

The oracle was not only intended to predict the future, but also to guide and direct the world's history at that time.

Preble [1983] claims the first experiment using a Delphi-style technique (as known today) was conducted in 1948 to predict the winners of horse races, and optimize the betting strategy. However, it was Helmer and Dalkey who advanced the technique to increase accuracy of forecasts. Delphi has since been deployed as a generic strategy for developing consensus and making group-based decisions in a variety of fields. Linstone and Turoff [1975] found that Delphi was also used for military applications during the Cold War.

As Brown [1968] describes, Delphi replaces direct debate by a carefully designed program of sequential individual interrogations interspersed with feedback about the group's responses. If desired, individual responses can be encrypted, such that anonymity is maintained.

The Delphi survey process consists of the primary steps listed below.

1. A group of experts is selected to give opinions on a particular topic.
2. A research coordinator sends each member of the group a question(s). Each member of the group answers the

question(s) and returns a response to the coordinator. When the responses have been turned in, a "round" of questions has been completed.

3. The coordinator analyzes the individual member responses and produces a report documenting the response of the group. In the next round, the members compare their individual answers to the group's normative response as a basis for discussion. The discussion is used to share, promote and challenge the different points of view. Each member is then allowed to adjust his/her original judgements to help the group progress towards a consensus.
4. Successive rounds of the question and feedback process continue until the group reaches a desired level of consensus, or stable disagreement.

Consensus is achieved when 100 percent of the judgements fall within the inter-quartile range of the panel's original judgements. The inter-quartile range is the difference between the 25th and 75th percentage in the frequency distribution.

Stability is a useful means of determining whether panel responses have stabilized and will avoid forced consensus through subsequent rounds. The measurement of stability is expressed as a percentage and is defined as the number of net person-changes of votes divided by the number of panel members. Based on the recommendations of Schiebe, Skutsch and Schofer [1975], any two distributions that attained stability measurements of less than fifteen percent are considered to have achieved stability since percentages up to fifteen percent represent the normal movement of a panel's votes.

Delphi can be one of the most efficient and economical methods of soliciting expert opinion and arriving at a group consensus from a broad variety of experts with respect to background, experience, and location. This is especially true when using an electronic mail or facsimile transmission to communicate with panel members. As one researcher discovered, with these modes of communication, the speed of delivery and response is almost immediate [McNeil, 1997].

Woudenberg [1991] found that survey methods that allow group interaction are superior to those based only on the assessment of knowledgeable individuals. Delphi's ability to maintain the experts' anonymity can foster greater inter-group communication. As Dailey [1990] describes, anonymity offers a distinct advantage for all respondents: it can offset a domineering personality, or minimize the fear of bringing up original ideas and contradicting individuals of higher rank. Therefore, Delphi appears to be a good way to structure communication among the members of an expert group in order to create what Linstone and Turoff [1975] call a "collective human intelligence", which includes qualitative criteria such as attitudes and feelings.

3.10 CHAPTER SUMMARY

The Delphi Survey Process and the AHP were discussed in this chapter. Delphi was shown to be an efficient method to gather expert opinion. AHP was shown to have advantages over other DSS, especially when applied to financial decision making. AHP can incorporate quantitative and qualitative criteria, while allowing the facility manager (decision-maker) to weight these criteria as it applies to a particular EMP within a particular facility. Thus, the AHP is well suited to serve as the foundation of a DSS for financing EMPs.

Chapter I defined the problem: No one has developed a standard procedure to help the facility manager identify which financial arrangement is best, based on facility and EMP characteristics. The "next step" is to use Delphi and the AHP to develop a DSS to select financial arrangements for EMPs.

IV. METHODOLOGY, RESULTS AND DATA ANALYSIS

4.1 CHAPTER OUTLINE

4.2 INTRODUCTION

This chapter describes the research that was conducted within this dissertation. The primary goal was to learn about financial arrangement selection for energy management projects (EMPs) and develop a model (E-FUND) that could predict which financial arrangement is most appropriate based on site-specific EMP and facility characteristics. *Seven different financial arrangements were included in the model: using cash, a loan, a bond, selling stock, a capital lease, a true lease and a performance contract. As described in chapter II, these are the basic arrangements used to finance energy management projects. The true lease and performance contract are generally structured with maintenance service and/or project management agreements. All other arrangements are "host-managed", thus the host manages the project.*

This research involved a multi-phase process of surveys, data analysis and model development. Because the final phases of the research were influenced by the results from the initial phases, the methods, results and data analyses are presented in chronological order within this chapter. Section 4.3 provides a brief overview of the methodology. Section 4.4 provides a more detailed description of the procedures that were executed. All survey questionnaires are included under Appendix A. Appendix B contains quantitative information about the case studies used to test E-FUND. Appendix C contains a user's guide to E-FUND. Appendix D contains additional information such as the Institutional Review Board approval, the author's vita and document summary sheet.

4.3 OVERVIEW OF THE METHODOLOGY

The development and testing of E-FUND was based on the input from two sample populations; a panel of financiers (panel), and a group of facility managers (FM Group). The panel members, (specialists in financing EMPs) helped develop the foundation for E-FUND, and the FM Group tested it in four case studies.

To assist in the development of E-FUND, the panel responded to three questionnaires. In Panel Questionnaire #1, the panel created a list of ten general objectives (criteria) that a facility manager should consider when selecting a financial arrangement for EMPs. *For the remainder of this dissertation, "objectives" will be used instead of "criteria", because the participants found this term easier to understand.*

Panel Questionnaire #2 had two parts: A and B. In part A, the panel prioritized the list of ten objectives (by importance) in an attempt to identify and eliminate any insignificant objectives. However, all objectives were found to be relatively significant. Thus, all ten objectives qualified to serve as the "default objectives" in the model. The default objectives were inserted into an AHP hierarchy, which became E-FUND. Figure IV-1 illustrates the structure of the E-FUND model with some of the default objectives in the middle of an AHP hierarchy. *With a larger figure, all ten default objectives could be shown in the middle level of the hierarchy.* The primary goal was "to pick the best financial arrangement for a particular EMP in a particular facility".

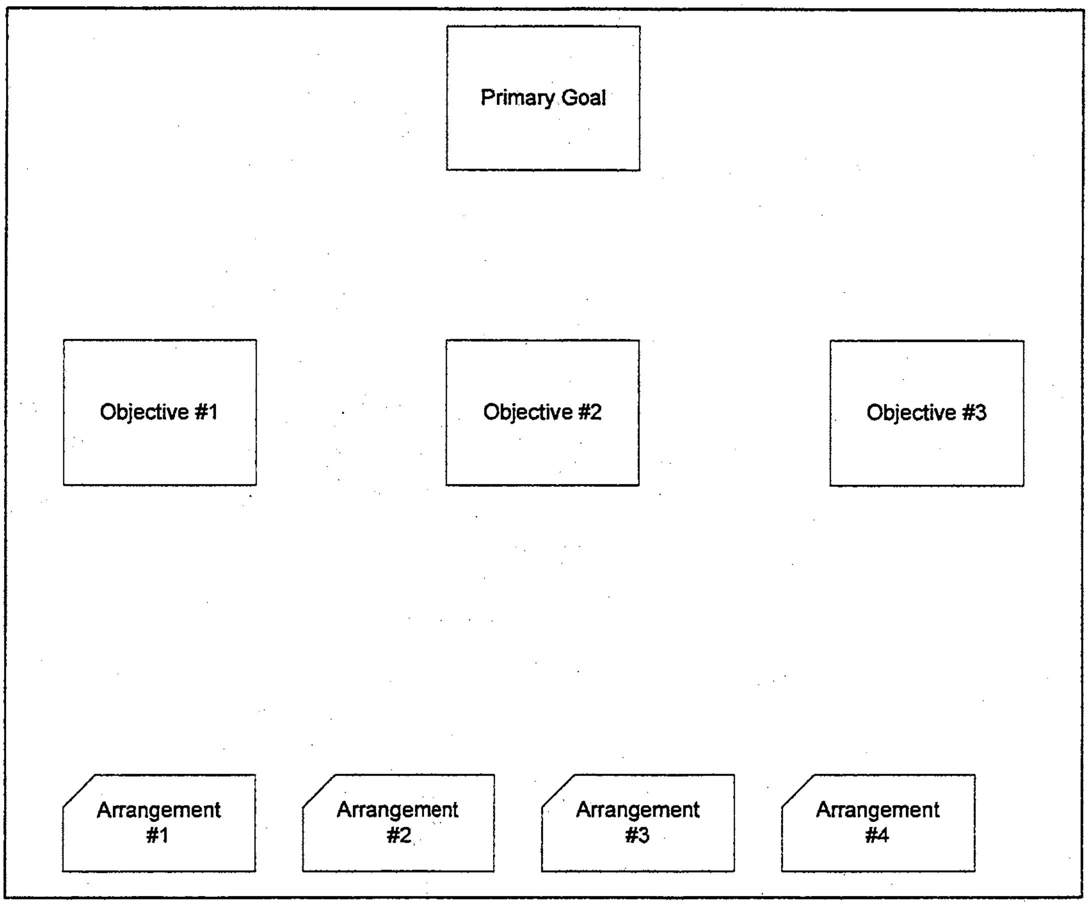

Figure IV-1 E-FUND Concept with Default Objectives

In Panel Questionnaire #2 part B, the panel determined the relationship (priority weights) between each default objective (in the middle level of the hierarchy) and the financial arrangements (at the bottom of the hierarchy). The panel assessed how well the financial arrangements satisfied each objective. Each panelist's judgements were normalized and the panel's average responses were used as priority weights. This was done for all default objectives, except Objective #1: "the desire to have a high economic benefit". The degree to which the arrangements satisfied this objective was determined by Net Present Value (NPV) data once E-FUND was applied. Figure IV-2 shows the E-FUND hierarchy, (before application).

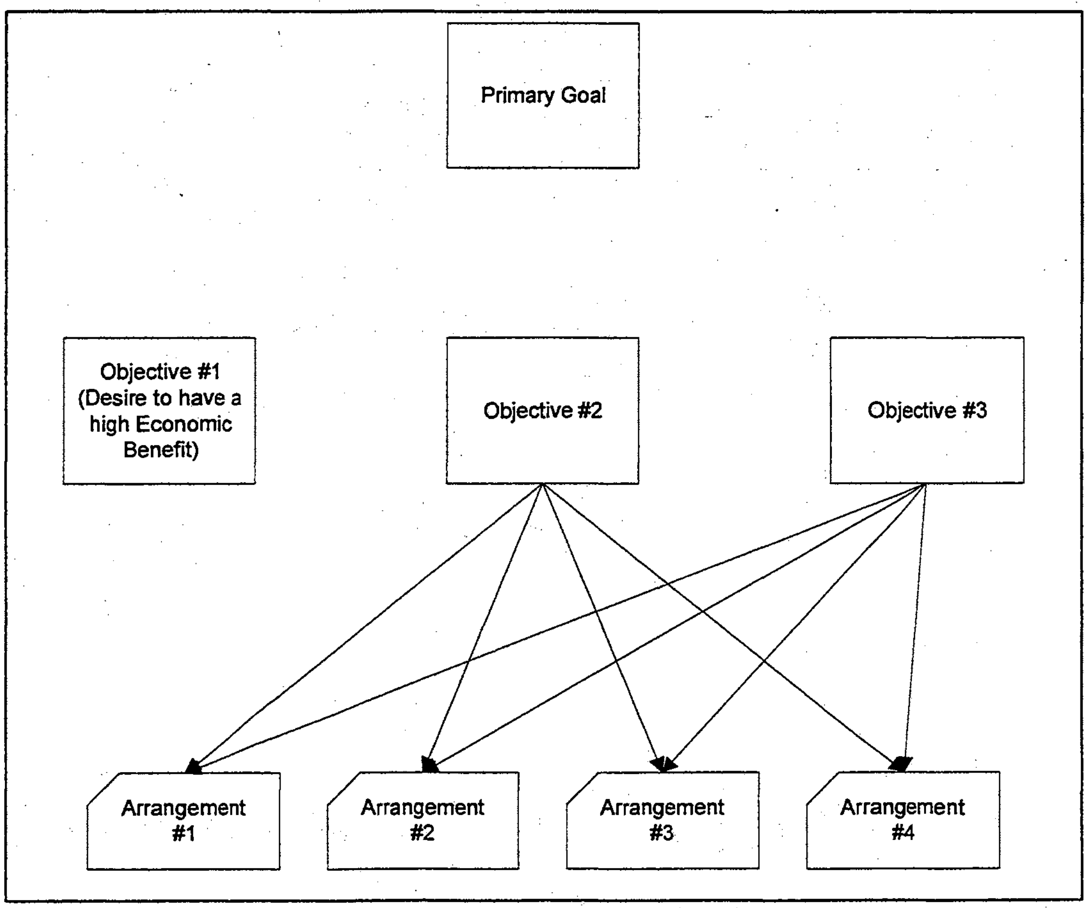

Figure IV-2 E-FUND Before Application

After establishing the priority weights for the bottom half of the hierarchy, E-FUND was tested by the FM Group in four separate case studies. In the FM Group Survey, the task for the FM Group was to customize the E-FUND model to each case study by determining the priority weights in the top half of the hierarchy (from the primary goal to each objective). Thus, after applying E-FUND, there would be a unique model representing each case study. For each case study, a qualitative description of the facility and the EMP was provided to the facility manager, who judged the relative importance of the default objectives. Each facility manager's judgements were normalized, and the FM Group's average priority weights were inserted into the E-FUND hierarchy for each case study. The NPVs for all arrangements were also converted into normalized priority weights and inserted into the E-FUND hierarchy for each case study. The dashed lines in Figure IV-3 represent the priority weights developed once E-FUND was applied.

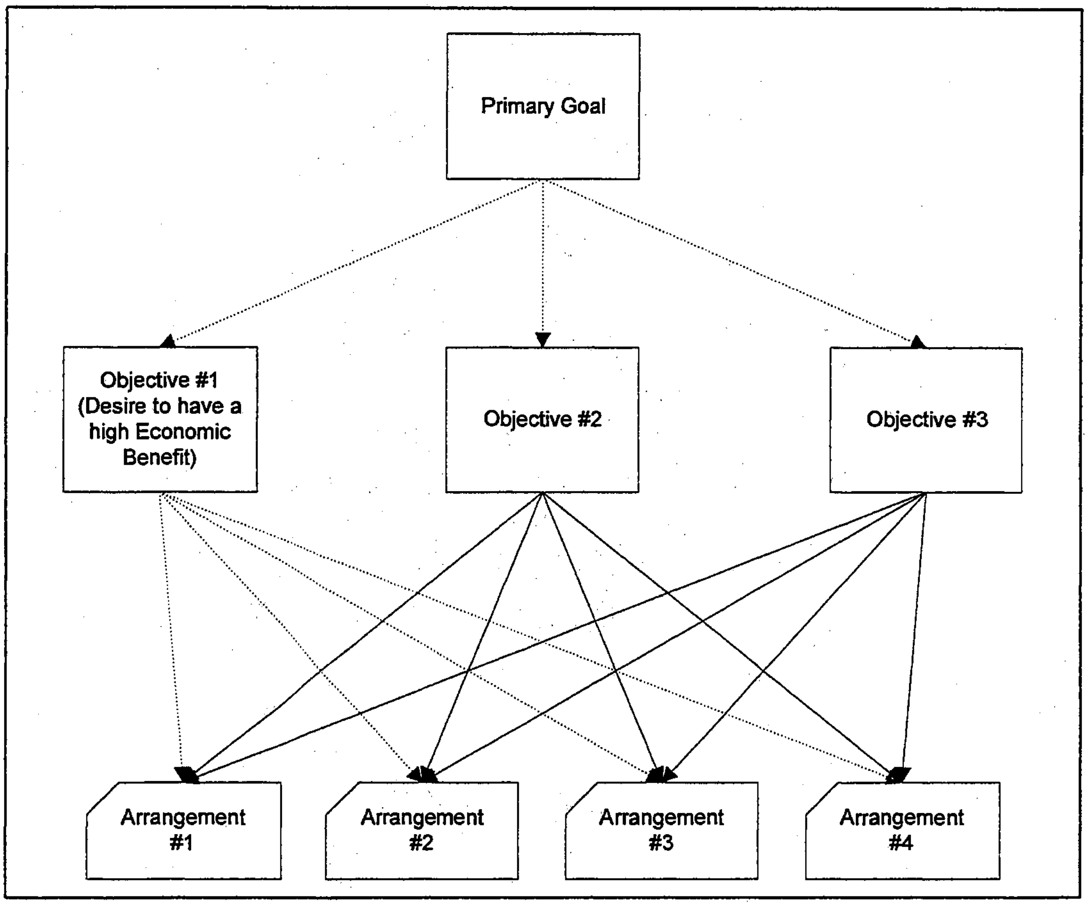

Figure IV-3 E-FUND that has been Customized to a Particular Case Study

Once all priority weights were determined, the hierarchies were synthesized. Within all case studies, each arrangement was given an overall score, indicating its ability to satisfy the primary goal. The highest scoring arrangement within each case study was E-FUND's selection as the most appropriate arrangement.

In the Final Questionnaire, the panelists and facility managers indicated whether E-FUND selected the appropriate financial arrangement within each case study. The data from the various phases were then analyzed as discussed throughout this chapter.

4.4 DETAILED DESCRIPTION OF THE METHODOLOGY

This section explains the methodology, results and data analysis in greater detail. Expanding on the previous section, each procedure is described in chronological order, step-by-step. Figure IV-4 is a detailed flow chart of the methodology.

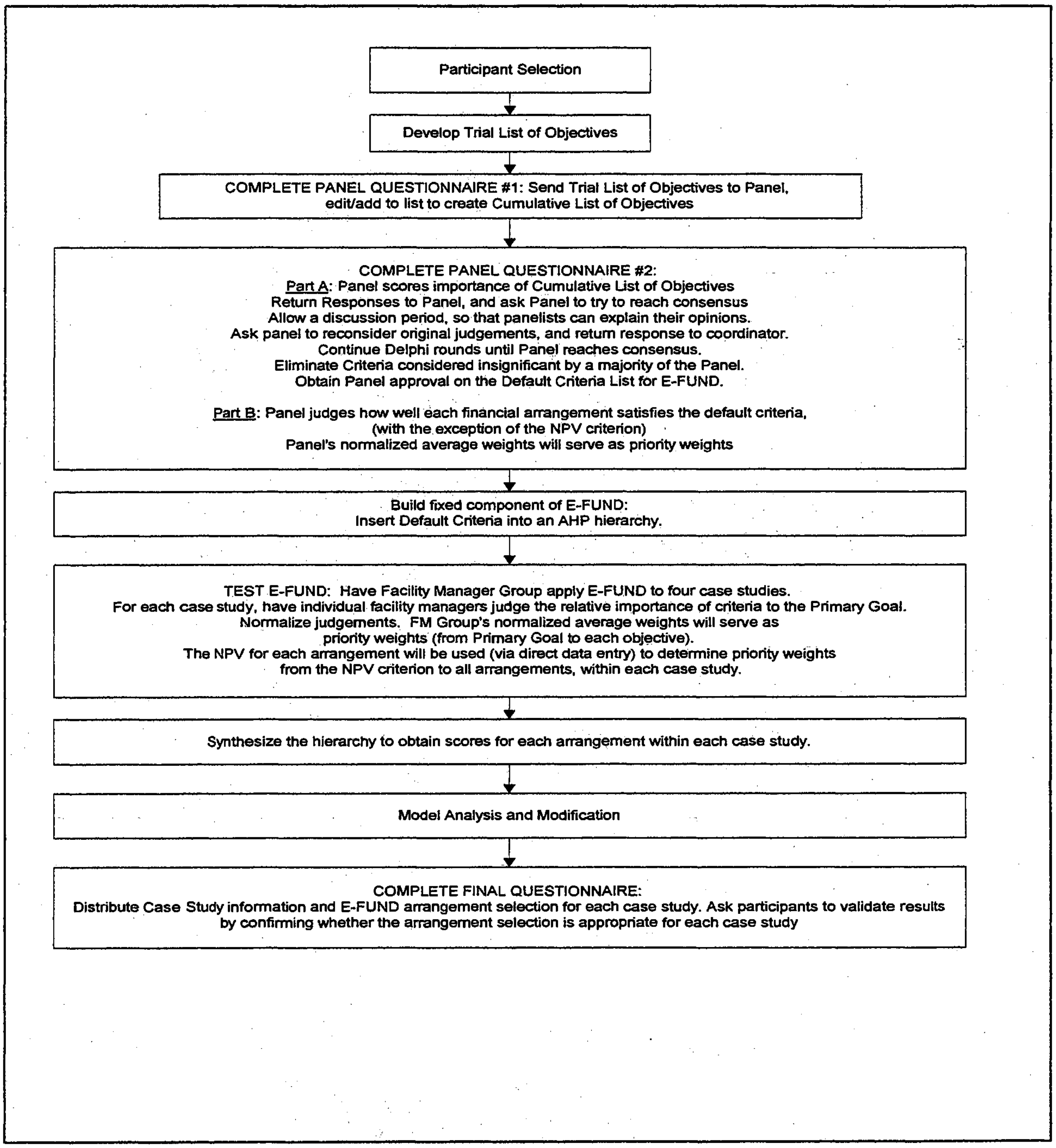

Figure IV-4 Detailed Flow Chart of Methodology

4.4.1 Participant Selection

Two participant groups were selected to help develop and test E-FUND. A panel of financiers helped develop the basic E-FUND model and a group of facility managers tested it. Only the research coordinator knew the identity of the participants. To maintain anonymity, each participant's name was associated with a number. Panelists were numbered P1, P2, P3… P6. Facility managers were numbered FM1, FM2, FM3… FM10.

Financial Panelist Selection

The panel of EMP financiers (panel) was created to help develop the fixed components of E-FUND. To qualify as a panelist, interested professionals must have had experience with four of the seven primary financial arrangements used for EMPs, (i.e., using cash, loans, bonds, selling stock, capital leases, true leases and performance contracts). In addition, panelists also were required to satisfy one of the two objectives below:

1. Have at least 5 years experience as a facility manager, an energy manager, or a financier/lender;
2. Be a certified public accountant (CPA) or have a masters degree in business administration (MBA)

Fifteen financial experts were interviewed as potential panelists however, only eight qualified under the requirements. Six of the eight panelists responded to all the questionnaires. The six panelists had over 82 years of combined experience in financial arrangement selection.

The primary job function for four panelists (P1, P2, P3 and P5) was structuring financing for performance contracts. However, they also secured financing for lease contracts. The remaining two panelists (P4 and P6) were primarily involved with lease financing. Three of the panelists were company presidents. Three of the panelists had experience with bond financing. Three of the panelists had experience with loan financing. Three of the panelists had experience with using retained earnings. All panelists had experience with using cash arrangements. None of the panelists had experience with selling stock to finance energy management projects. Table IV-1 is a summary of the panelists' experience.

TABLE IV-1 Panelists' Experience

PANELISTS	EXPERIENCE WITH THE FOLLOWING ARRANGEMENTS						TOTAL YEARS EXP.
	Loans	Bonds	Selling Stock	Capital Leases	True Leases	Perf. Cont.	
P1	X	X		X	X	X	15
P2	X			X	X	X	5
P3	X			X	X	X	20
P4		X		X	X	X	25
P5				X	X	X	5
P6		X		X	X	X	11

Facility Manager Selection

A population of facility managers (FM Group) was selected to test E-FUND. To participate, interested professionals must have had at least 5 years experience in facility management or energy management. Fifteen facility managers were interviewed as potential participants, however only eleven qualified under the specified criteria. Ten of the eleven facility managers responded to the FM Group Survey. Five facility managers made an extra contribution by responding to the Final Questionnaire.

The ten facility managers had over 157 years of combined experience in facilities management. They also had 103 years combined experience in energy management, and 117 years combined experience in financial arrangement selection. Table IV-2 shows a summary of each facility manager's experience in the different categories, as well as the type of facility he/she was managing.

Table IV-2 Experience of Facility Managers

FACILITY MANAGERS	**Facility Type**	**YEARS EXPERIENCE IN**		
		Facility Management	**Energy Management**	**Financial Arrangement Selection**
FM1	Sheet Metal Mfg.	10	10	10
FM2	Food Proc.	30	12	25
FM3	Pipe Mfg.	21	21	21
FM4	Food Proc.	10	6	8
FM5	Heavy Equip. Mfg.	25	15	15
FM6	Heavy Equip. Mfg.	15	10	10
FM7	Fed. Govt. (Hospitals)	9	3	0
FM8	Fed. Govt. (Army Base)	7	5	0
FM9	Food Proc.	25	16	25
FM10	Food Proc.	5	5	3

The FM Group represented a diverse set of industries. Four experts were currently managing facilities in the food processing industry. Two experts were currently managing facilities involved in manufacturing of heavy equipment. One expert was managing a pipe manufacturing facility. One expert managed a facility engaged in sheet metal manufacturing. Two of the experts managed federal government facilities.

4.4.2 Survey Processes for all Questionnaires

A research coordinator distributed the questionnaires and recorded feedback from all participants. All correspondence was transmitted via electronic mail or facsimile.

4.2.2.1 Note on Questionnaire Design and Applicability to the AHP.

The participants in this survey volunteered their time for this research effort. Making their work efficient was absolutely necessary to obtain a high response rate. All questions that were seeking feedback about an objective or financial arrangement used a nine-point semantic differential (Likert) scale. The participants' scores were normalized to obtain priority weights. This technique (the ratings method) was more efficient for the participants than using pair-wise comparisons. As a result, the minimal amount of judgements required from each panelist was reduced from 510 to 80 judgements. The minimal amount of judgements required from each facility manager was reduced from 360 to 40 judgements.

As mentioned in Chapter III, section 3.6.2, the "ratings" entry method is a legitimate procedure to determine priority weights, however it does not create a matrix of judgements from which consistency ratio tests can be determined. Thus, this research study sacrificed the benefit of the consistency ratio test in the interest of collecting the maximum amount of useful data from the participants, (i.e. getting participants to respond to all questionnaires).

4.4.3 Developing a Trial List of Objectives

A "Trial List" of decision objectives (that a facility manager should consider when selecting a financial arrangement) was developed based on general industry knowledge. The trial list incorporated some of the facility, project and financial arrangement characteristics that affect financing EMP decisions. As Table IV-3 shows, each objective was defined and explained with a short example.

Table IV-3 The Trial List of Objectives

TRIAL LIST OF OBJECTIVES	EXPLANATION / EXAMPLE
To have a high economic benefit (high Net Present Value, or short Payback Period)	Facility managers often select projects with a short Payback Period, or projects with a high Net Present Value. *The NPV of each arrangement incorporates all quantitative factors; such as the finance rate assigned by the lender, the timing and amount of the cash flows, as well as the additional costs (administrative, maintenance, legal) required by a certain EMP under a particular arrangement.* Thus, the NPV of each arrangement is the cumulative assessment of all quantitative objectives relating to installing the EMP in a particular facility, using a particular financial arrangement.
To have a guaranteed savings contract, where the project's costs are "paid from savings"	A guaranteed amount of savings (as offered by a performance contract) can reduce the host's risk if the EMP is technically or financially challenging. "Paid from Savings" contracts require no up-front investment, allowing the host to preserve in-house funds for other company purposes.
To minimize the additional impact on the maintenance and energy management teams	Based on the EMP's complexity and the host's in-house resources, the maintenance and energy management teams may need to devote attention that should be focused elsewhere (i.e. implementing other profit improvement measures). However, if the financial arrangement provides maintenance and technical services, the in-house resources can focus their attention on other tasks.
To minimize the additional impact on the administration or upper-level management	Based on the complexity of contracts and interaction with external parties (lawyers, lenders, etc.), the host's administrative and upper-level personnel may need to devote attention that should be focused elsewhere, such as on core business goals.
To minimize contractual restraints, in case operations change significantly	A performance contract can require the host to operate a minimum number of hours per year, thereby restricting the host's ability to change operations and react to unforeseen circumstances.
To increase equity capital	This criterion relates to the host's desire to sell stock to finance the EMP. Selling stock can help the host achieve its target capital structure, thereby maximizing firm value.
The strategic desire to use off-balance sheet financing	Off-balance sheet financing (as with a True Lease) allows the host to keep project liabilities off the balance sheet to retain a stronger financial image.

4.4.4 Complete Panel Questionnaire #1

In this questionnaire, the panel was asked to refine the Trial List of Objectives. Panel Questionnaire #1 was sent to the panelists, and all eight panelists responded. The panelists edited the seven objectives and added three new objectives, which produced a Cumulative Objective List. It should be noted that the objective relating to increasing equity capital by selling stock was removed.

In regard to all objectives, the research coordinator collaborated with the panelists to ensure that each objective was worded such that it related to the primary goal, and also could be used to distinguish the different financial arrangements. All panelists approved the sentence structure and content of the final version of the Cumulative List of Objectives. The Cumulative List of Objectives is presented in Table IV-4.

Table IV-4 The Cumulative List of Objectives

#	CUMULATIVE LIST OF OBJECTIVES	EXPLANATIONS/ EXAMPLES
1	To have a high economic benefit (High Net Present Value, or Short Payback Period).	Facility managers often select projects with a short Payback Period, or projects with a high Net Present Value. *The NPV of each arrangement incorporates all quantitative factors; such as the finance rate assigned by the lender, the timing and amount of the cash flows, as well as the additional costs (administrative, maintenance, legal) required by a certain EMP under a particular arrangement.* Thus, the NPV of each arrangement is the cumulative assessment of all quantitative objectives relating to installing the EMP in a particular facility, using a particular financial arrangement.
2	To reduce the host's risk by using a guaranteed savings performance contract, where the host makes no initial investment, and the project's costs are "paid from savings".	In this case, an Energy Service Company installs and operates the equipment. The ESCO shares the savings with the host, which encourages both parties to maximize savings, and look out for each other. A guaranteed amount of savings (as offered by a performance contract) can reduce the host's risk if the EMP is technically or financially challenging. "Paid from savings" contracts require no up-front investment, allowing the host to preserve in-house funds for other company purposes.
3	To minimize the additional impact on the maintenance and energy management teams. or To compliment maintenance goals and improve effectiveness.	Based on the EMP's complexity and the host's in-house expertise, the host's maintenance and energy management teams may need to devote attention that should be focused elsewhere (i.e. implementing other profit improvement measures). However, if the financial arrangement (such as a performance contract) provides maintenance and technical services or improves maintenance effectiveness, the in-house resources can focus their attention on core business goals.
4	To use a comprehensive, "system-wide" approach to maximize the replacement of outdated equipment.	Performance Contracts can be "bundled" to include other services and projects, creating a larger, more comprehensive package. This is the opposite of "cream skimming." For example, a lighting retrofit may be "bundled" with a chiller retrofit to obtain additional "system-wide" benefits.
5	To have an "easy to understand" agreement that minimizes the impact on the host's administrative personnel.	A simple agreement can "stand by itself" (no matter who is interpreting it) and minimize the potential for litigation in the future. Complex contracts may require the host's administrative personnel to devote attention that should be focused on achieving core business goals.
6	To minimize contractual restraints, so the facility manager has greater flexibility and control over the project.	A performance contract can require the host to operate a minimum number of hours per year, thereby restricting the host's ability to change operations and react to unforeseen circumstances. In addition, contracts may restrict the facility manager's ability to specify equipment, use specific vendors or obtain other preferences.

7	To protect the host's financial image by using off-balance sheet financing and avoid using collateral that could be spared to support future financing.	If available, "off-balance sheet" financing, as with a True Lease (a rental agreement), allows the host to use the equipment without purchasing it. This keeps project liabilities off the balance sheet, allowing the host to retain a stronger financial image. Minimizing the amount of collateral (on Uniform Commercial Code filings) improves the host's ability to obtain future financing.
8	To structure an arrangement such that annual savings are always greater than annual payments. Thus, the project only has positive cash flows.	If the maximum payment is set equal to the minimum savings estimate, the project should have only positive cash flows, (provided the equipment will last long enough to pay itself off). In the event of unforeseen or periodic project expenses, an agreement with adjustable payments can be used to eliminate annual profit shortfalls. In such a case, the agreement could be changed so the host makes smaller payments for a longer time period.
9	To secure fixed interest rate financing for the length of the project.	If possible, securing fixed interest rate financing would reduce risk relating to interest rate fluctuation. This can be helpful when financing the construction and operational phases of the project.
10	To be able to easily expand the scope of the arrangement.	Certain arrangements permit either party to suggest improvements that can be added easily to the scope of work. Also in certain financial arrangements, it is easy to acquire additional financing with minimal paperwork.

4.4.5 Complete Panel Questionnaire #2

This questionnaire had two parts. In part A, the panelists were asked to prioritize the Cumulative List of Objectives. The goal was to identify and remove any insignificant objectives. In part B, the panelists were asked how well each financial arrangement satisfied each objective. Six of the eight panelists returned responses to the research coordinator.

4.4.5.1 Questionnaire #2, Part A

On a Likert scale of "1" to "9", the panelists were asked to score the importance of each objective as applied to selecting a financial arrangement for most EMPs in most facilities. A score of "9" indicated that an objective was very important. A score of "1" indicated that an objective was insignificant.

Each panelist's responses were normalized and inserted into a Microsoft Excel spreadsheet that would perform the AHP calculations. The spreadsheet was used because the ECPro program (academic version) only allowed 9 nodes, and the E-FUND model required 10 nodes (objectives). Table IV-5 shows each panelist's actual response and the corresponding normalized score (as a percent of importance). The panel's average response is also presented. Figure IV-5 shows the panelists' responses in a graphical format. The first and third quartiles are presented as "Q1" and "Q3" respectively.

Table IV-5 Panel Questionnaire #2 Part A: Original Responses

Obj.	PANELISTS												Avg. Wt.
	P1		P2		P3		P4		P5		P6		
#	Score	% Imp.	Score	% Imp.	Score	% Imp.	Score	% Imp.	Score	% Imp.	Score	% Imp.	% Imp.
1	7	15.2%	9	13.0%	8	11.8%	1	1.9%	8	15.7%	8	16.3%	12.3%
2	1	2.2%	7	10.1%	9	13.2%	4	7.7%	6	11.8%	5	10.2%	9.2%
3	6	13.0%	3	4.3%	7	10.3%	7	13.5%	7	13.7%	4	8.2%	10.5%
4	5	10.9%	7	10.1%	8	11.8%	3	5.8%	9	17.6%	7	14.3%	11.7%
5	4	8.7%	6	8.7%	5	7.4%	5	9.6%	6	11.8%	3	6.1%	8.7%
6	9	19.6%	9	13.0%	4	5.9%	6	11.5%	5	9.8%	2	4.1%	10.7%
7	3	6.5%	7	10.1%	8	11.8%	7	13.5%	1	2.0%	1	2.0%	7.6%
8	2	4.3%	8	11.6%	8	11.8%	8	15.4%	3	5.9%	7	14.3%	10.5%
9	1	2.2%	7	10.1%	5	7.4%	9	17.3%	2	3.9%	6	12.2%	8.9%
10	8	17.4%	6	8.7%	6	8.8%	2	3.8%	4	7.8%	6	12.2%	9.8%
Sum	46	100.0%	69	100.0%	68	100.0%	52	100.0%	51	100.0%	49	100.0%	100.0%

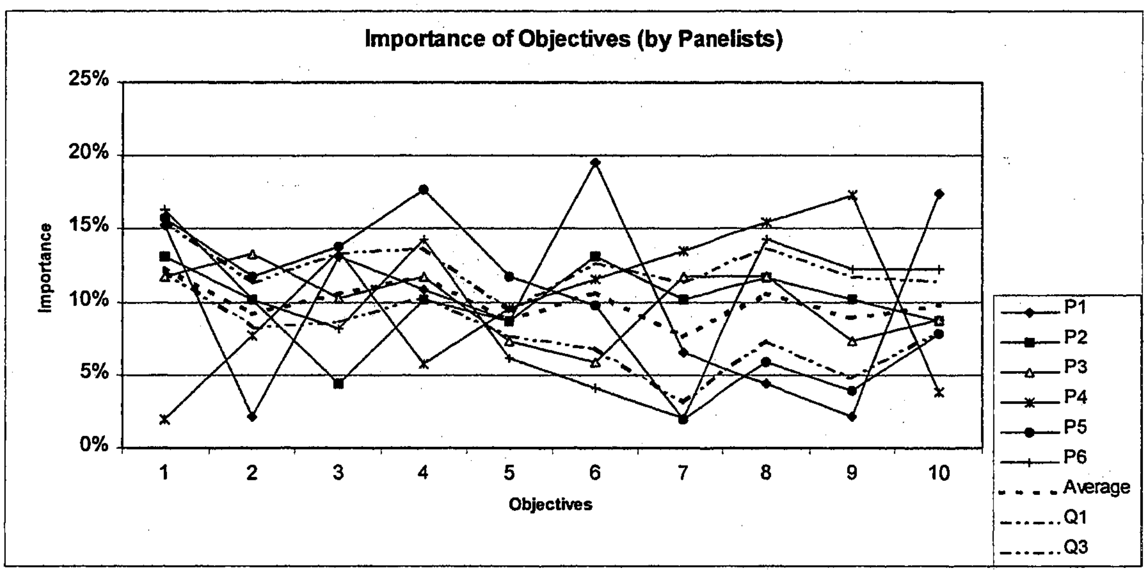

Figure IV-5 Panel Questionnaire #2 Part A: Original Responses

Discussion about results from Panel Questionnaire #2, Part A

As evident from Figure IV-5, the panelists had different opinions regarding the importance of objectives. In an attempt to reach a greater degree of consensus, the panelists' original responses were revised using a Delphi Survey Procedure.

Detailed Description of the Delphi Procedure

After the panelists had responded to Questionnaire #2, Part A, Table IV-5 and Figure IV-5 were redistributed to the panel. Each panelist was able to see his/her responses relative to the responses from all the other panelists (labeled only by panelist number). The panel's average response and inter-quartile ranges were presented. All panelists had the opportunity to explain their original judgements. Each panelist then had the option to change his/her original judgements to allow the group to progress towards consensus. In the standard Delphi procedure, "consensus" means having all revised responses between the original first and third quartiles. Any revised judgements were submitted to the research coordinator.

Table IV-6 and Figure IV-6 show the revised data after the Delphi process. In general, the group attained consensus or "near consensus" on the importance of all objectives. In Figure IV-6, the Q1 and Q3 lines represent the quartiles from the panelists' original judgements.

Table IV-6 Panel Questionnaire #2 Part A: Revised Responses

	PANELISTS												
Obj.	P1		P2		P3		P4		P5		P6		Avg. Wt.
#	Score	% Imp.	Score	% Imp.	Score	% Imp.	Score	% Imp.	Score	% Imp.	Score	% Imp.	% Imp.
1	8	17.4%	9	13.2%	9	13.6%	9	15.3%	8	16.0%	7	15.2%	15.1%
2	4	8.7%	7	10.3%	7	10.6%	5	8.5%	6	12.0%	5	10.9%	10.2%
3	5	10.9%	6	8.8%	7	10.6%	6	10.2%	6	12.0%	4	8.7%	10.2%
4	5	10.9%	7	10.3%	8	12.1%	5	8.5%	7	14.0%	6	13.0%	11.5%
5	5	10.9%	6	8.8%	5	7.6%	6	10.2%	5	10.0%	4	8.7%	9.4%
6	6	13.0%	7	10.3%	5	7.6%	6	10.2%	5	10.0%	3	6.5%	9.6%
7	2	4.3%	6	8.8%	7	10.6%	7	11.9%	2	4.0%	2	4.3%	7.3%
8	3	6.5%	7	10.3%	7	10.6%	6	10.2%	4	8.0%	6	13.0%	9.8%
9	3	6.5%	7	10.3%	5	7.6%	6	10.2%	3	6.0%	5	10.9%	8.6%
10	5	10.9%	6	8.8%	6	9.1%	3	5.1%	4	8.0%	4	8.7%	8.4%
Sum	46	100%	68	100%	66	100%	59	100%	50	100%	46	100%	100%

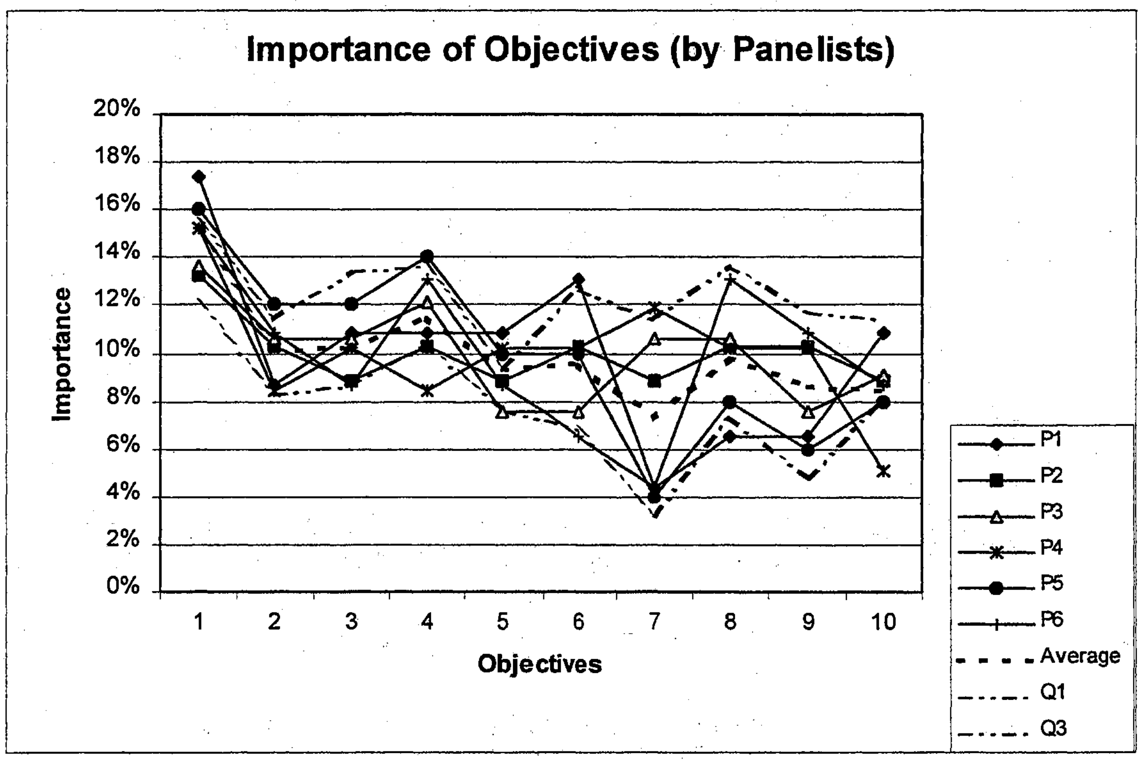

Figure IV-6 Panel Questionnaire #2 Part A: Revised Responses

From the panel's average weights (on the far right of Table IV-6), the highest weight for an objective's importance was

15.1%. The objective with the lowest weight was 7.3%, and the remaining eight objectives were within two percentage points of 10%. Thus, the panel's average responses showed that all objectives were considered relatively important by the panel. Therefore all ten objectives qualified to serve as the default objectives in the E-FUND model.

Although there was not a substantial difference in the average importance of the objectives, there was a noticeable variance in the panelists' opinions on certain objectives. As measured by the inter-quartile range (difference between Q1 and Q3) in Figure IV-6, it is clear that the panelists had a greater difference of opinion for objectives #6, #7, #8 and #9. This variance could be due to each panelist's professional bias, or it could be that there is a greater uncertainty on the importance of these objectives.

4.4.5.2 Questionnaire #2, Part B

On a Likert scale of "1" to "9", the panelists were asked to score how well each financial arrangement satisfied each objective. If a financial arrangement did not at all satisfy the objective, a score of "1" was appropriate. If a financial arrangement completely satisfied the objective, a score of "9" was appropriate. If the panelist was unsure about how well a financial arrangement satisfies an objective, a score of "0" was appropriate. *The panelists did not evaluate how well the arrangements satisfied Objective #1, because these judgements would be determined from actual NPV data within each case study.*

The Delphi procedure was not used to obtain consensus on each question in Part B, or in all remaining surveys within this research study. Instead, the group's original average responses were used as the basis for the model. Delphi was not used because there was a greater degree of consensus among the panel's original responses in Part B. In other words, the panelists generally agreed on many of the questions.

In addition, Delphi was avoided to minimize the work required by participants. This modification was necessary because the Delphi procedure was consuming too much time, (causing panelists to "drop out") and it was not adding significant benefits. When comparing the original and revised responses in Questionnaire #2 Part A, the panel's average weight did not change substantially, and the range was merely condensed.

Tables IV-7 through IV-15 and Figures IV-7 through IV-15 show the panelists' responses to Questionnaire #2, Part B.

The italicized description at the top of each page is the objective. A summary table and discussion is presented after the data from Part B.

Objective # 2:

To reduce the host's risk by using a guaranteed savings performance contract, where the host makes no initial investment, and the project's costs are "paid from savings".

Table IV-7 How Well Each Arrangement Satisfied Objective #2

		PANELISTS												
	Satisfaction via	**P1**		**P2**		**P3**		**P4**		**P5**		**P6**		**Avg. Wt.**
Obj.	**Financial Arrangements**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**%**
#2	Cash (Ret. Earnings)	2	5%	1	4%	1	3%	1	4%	1	7%	1	5%	4.8%
	Sell Stock	1	3%	1	4%	1	3%	1	4%	1	7%	1	5%	4.4%
	Loan	6	16%	1	4%	1	3%	1	4%	1	7%	2	11%	7.4%
	Bond	7	18%	1	4%	1	3%	1	4%	1	7%	2	11%	7.9%
	Capital Lease	5	13%	3	12%	9	29%	1	4%	1	7%	2	11%	12.6%
	True Lease	8	21%	9	36%	9	29%	9	39%	1	7%	2	11%	23.7%
	Performance Contract	9	24%	9	36%	9	29%	9	39%	9	60%	9	47%	39.2%
	Sums	38	100%	25	100%	31	100%	23	100%	15	100%	19	100%	100%

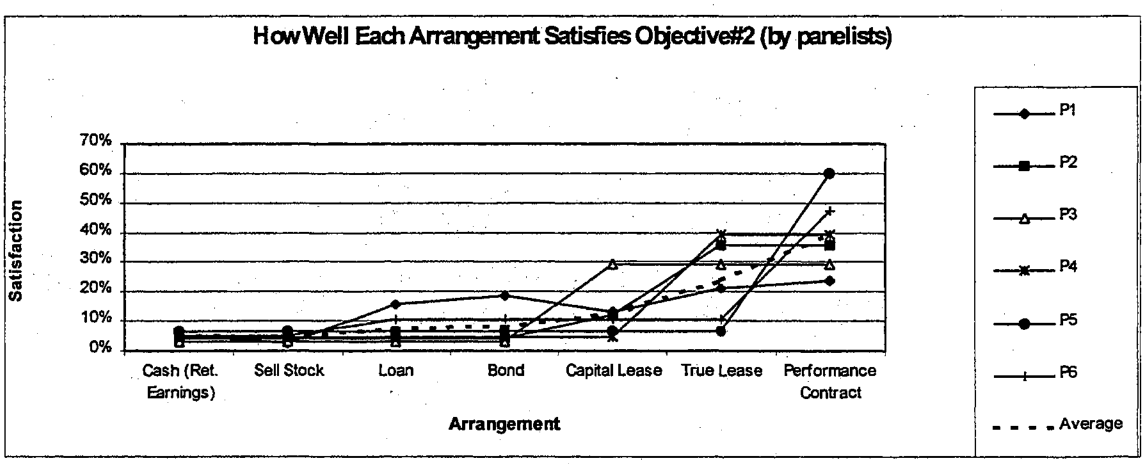

Figure IV-7 How Well Each Arrangement Satisfied Objective #2

Objective # 3:

To minimize the additional impact on the maintenance and energy management teams.

or

To compliment maintenance goals and improve effectiveness.

Table IV-8 How Well Each Arrangement Satisfied Objective #3

		PANELISTS												
	Satisfaction via	**P1**		**P2**		**P3**		**P4**		**P5**		**P6**		**Avg. Wt.**
Obj.	**Financial Arrangements**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**%**
#3	Cash (Ret. Earnings)	2	5%	1	7%	0	0%	1	4%	1	4%	1	6%	4.3%
	Sell Stock	1	3%	1	7%	0	0%	1	4%	1	4%	1	6%	3.9%
	Loan	7	19%	1	7%	0	0%	1	4%	1	4%	2	11%	7.5%
	Bond	9	24%	1	7%	0	0%	1	4%	1	4%	2	11%	8.4%
	Capital Lease	6	16%	1	7%	0	0%	1	4%	5	20%	2	11%	9.7%
	True Lease	8	22%	1	7%	8	47%	9	39%	7	28%	1	6%	24.7%
	Performance Contract	4	11%	9	60%	9	53%	9	39%	9	36%	9	50%	41.5%
	Sums	37	100%	15	100%	17	100%	23	100%	25	100%	18	100%	100%

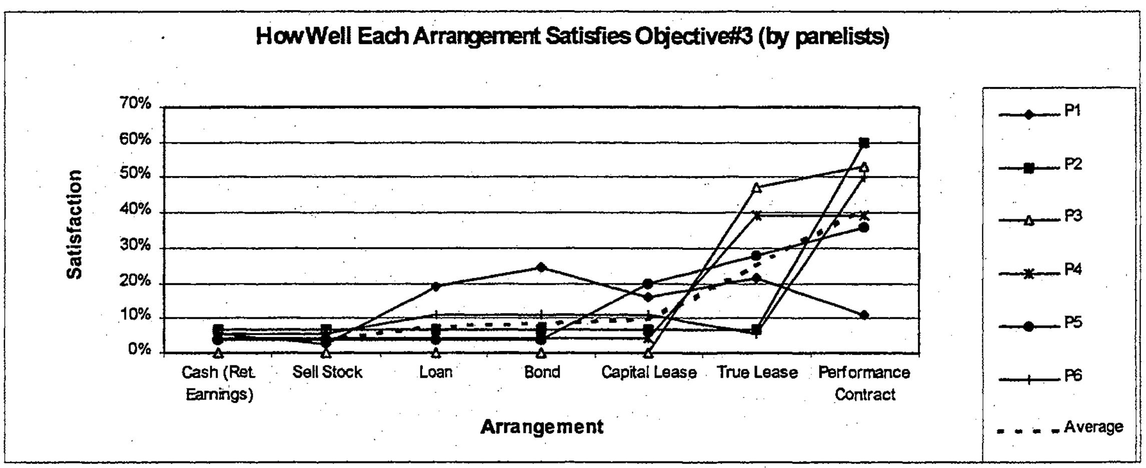

Figure IV-8 How Well Each Arrangement Satisfied Objective #3

Objective # 4:

To use a comprehensive, "system-wide" approach to maximize the replacement of outdated equipment.

Table IV-9 How Well Each Arrangement Satisfied Objective #4

		PANELISTS												
	Satisfaction via	**P1**		**P2**		**P3**		**P4**		**P5**		**P6**		**Avg. Wt.**
Obj.	**Financial Arrangements**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**%**
#4	Cash (Ret. Earnings)	2	5%	1	7%	0	0%	5	12%	5	14%	1	3%	6.7%
	Sell Stock	1	3%	1	7%	0	0%	5	12%	1	3%	1	3%	4.4%
	Loan	7	19%	1	7%	0	0%	5	12%	5	14%	7	19%	11.7%
	Bond	9	24%	1	7%	0	0%	5	12%	1	3%	7	19%	10.8%
	Capital Lease	6	16%	1	7%	0	0%	5	12%	9	24%	7	19%	13.0%
	True Lease	8	22%	1	7%	0	0%	9	21%	9	24%	7	19%	15.5%
	Performance Contract	4	11%	9	60%	9	100%	9	21%	7	19%	6	17%	37.9%
	Sums	37	100%	15	100%	9	100%	43	100%	37	100%	36	100%	100%

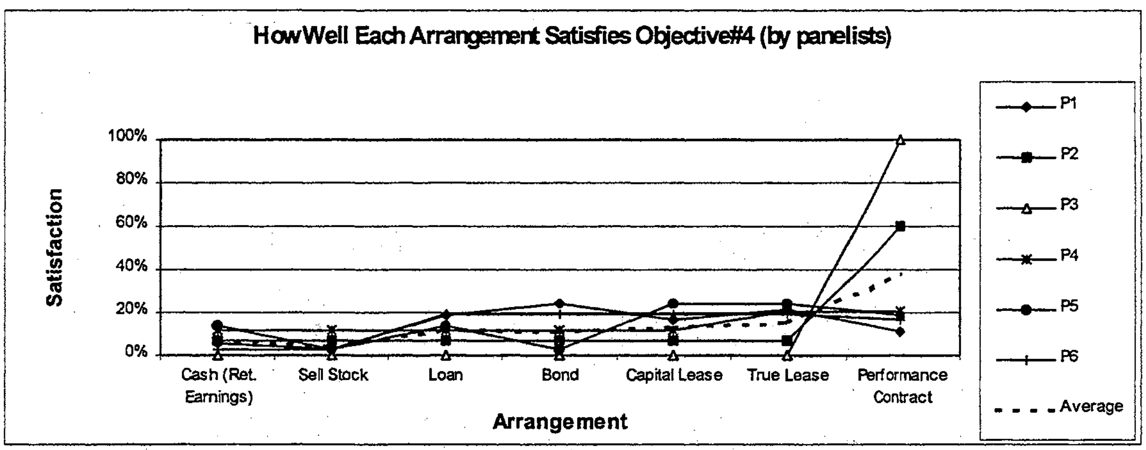

Figure IV-9 How Well Each Arrangement Satisfied Objective #4

Objective # 5:

To have an "easy to understand" agreement that minimizes the impact on the host's administrative personnel.

Table IV-10 How Well Each Arrangement Satisfied Objective #5

		PANELISTS												
	Satisfaction via	**P1**		**P2**		**P3**		**P4**		**P5**		**P6**		**Avg. Wt.**
Obj.	**Financial Arrangements**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**%**
#5	Cash (Ret. Earnings)	2	5%	9	30%	9	26%	9	26%	5	13%	1	4%	17.2%
	Sell Stock	1	3%	1	3%	3	9%	1	3%	1	3%	1	4%	3.9%
	Loan	7	19%	4	13%	8	23%	5	14%	9	23%	7	25%	19.6%
	Bond	9	24%	1	3%	3	9%	5	14%	1	3%	4	14%	11.2%
	Capital Lease	6	16%	6	20%	5	14%	1	3%	9	23%	7	25%	16.9%
	True Lease	8	22%	6	20%	5	14%	9	26%	7	18%	4	14%	19.0%
	Performance Contract	4	11%	3	10%	2	6%	5	14%	7	18%	4	14%	12.2%
	Sums	37	100%	30	100%	35	100%	35	100%	39	100%	28	100%	100%

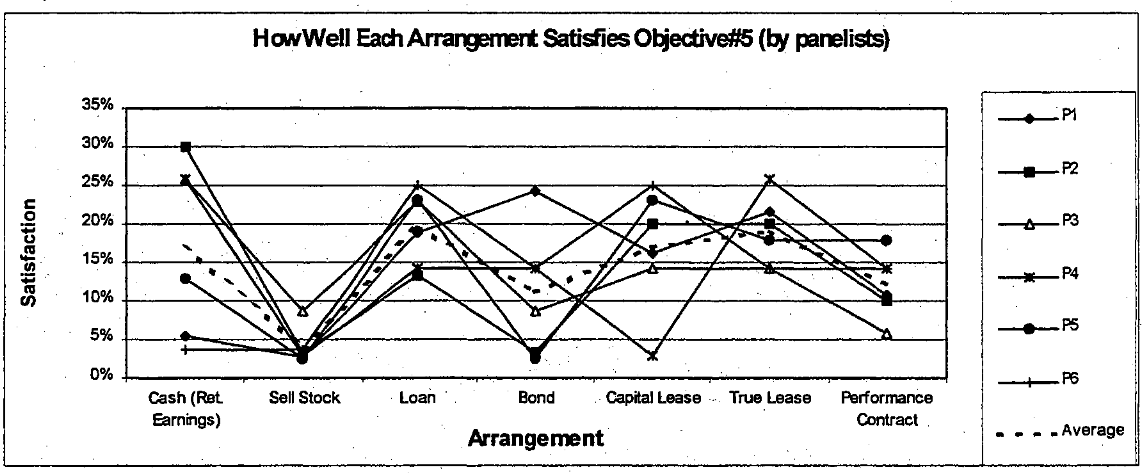

Figure IV-10 How Well Each Arrangement Satisfied Objective #5

Objective # 6:

To minimize contractual restraints, so the facility manager has greater flexibility and control over the project.

Table IV-11 How Well Each Arrangement Satisfied Objective #6

		PANELISTS												
	Satisfaction via	**P1**		**P2**		**P3**		**P4**		**P5**		**P6**		**Avg. Wt.**
Obj.	**Financial Arrangements**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**%**
#6	Cash (Ret. Earnings)	7	17%	9	24%	8	17%	7	25%	6	21%	5	15%	19.8%
	Sell Stock	1	2%	7	18%	8	17%	1	4%	1	4%	1	3%	8.0%
	Loan	7	17%	7	18%	6	13%	5	18%	5	18%	7	21%	17.5%
	Bond	9	21%	7	18%	8	17%	5	18%	4	14%	7	21%	18.4%
	Capital Lease	6	14%	3	8%	6	13%	4	14%	4	14%	7	21%	14.1%
	True Lease	8	19%	3	8%	6	13%	5	18%	7	25%	5	15%	16.3%
	Performance Contract	4	10%	2	5%	5	11%	1	4%	1	4%	1	3%	5.9%
	Sums	42	100%	38	100%	47	100%	28	100%	28	100%	33	100%	100%

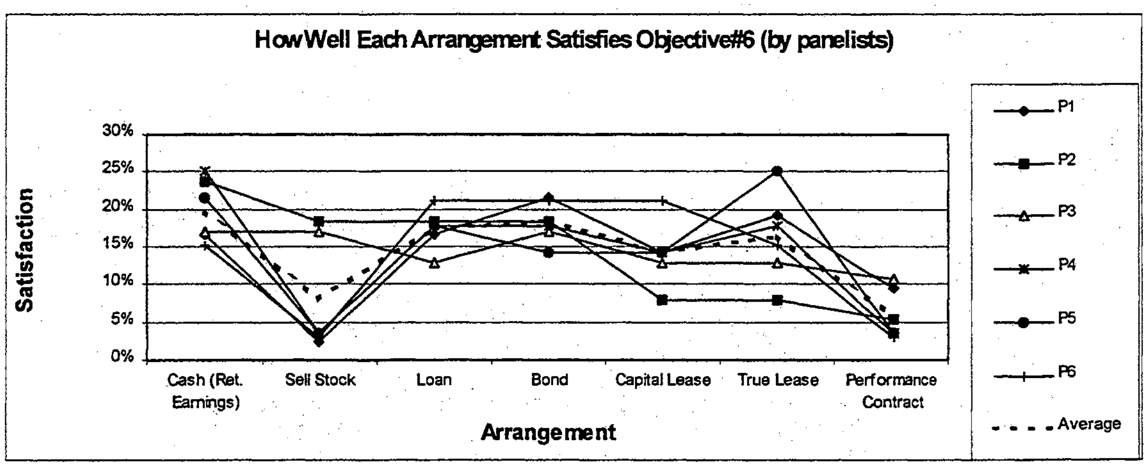

Figure IV-11 How Well Each Arrangement Satisfied Objective #6

Objective # 7:

To protect the host's financial image by using off-balance sheet financing and avoid using collateral that could be spared to support future financing.

Table IV-12 How Well Each Arrangement Satisfied Objective #7

Obj.	Satisfaction via Financial Arrangements	P1 cor	P1 %	P2 cor	P2 %	P3 cor	P3 %	P4 cor	P4 %	P5 cor	P5 %	P6 cor	P6 %	Avg. Wt. %
#7	Cash (Ret. Earnings)	2	7%	1	5%	1	5%	1	4%	1	4%	5	19%	7.4%
	Sell Stock	1	3%	1	5%	1	5%	1	4%	1	4%	1	4%	4.3%
	Loan	3	10%	1	5%	1	5%	1	4%	1	4%	1	4%	5.4%
	Bond	3	10%	1	5%	1	5%	1	4%	1	4%	1	4%	5.4%
	Capital Lease	3	10%	1	5%	1	5%	1	4%	1	4%	1	4%	5.4%
	True Lease	9	31%	9	43%	9	45%	9	39%	9	39%	9	35%	38.6%
	Performance Contract	8	28%	7	33%	6	30%	9	39%	9	39%	8	31%	33.3%
	Sums	29	100%	21	100%	20	100%	23	100%	23	100%	26	100%	100%

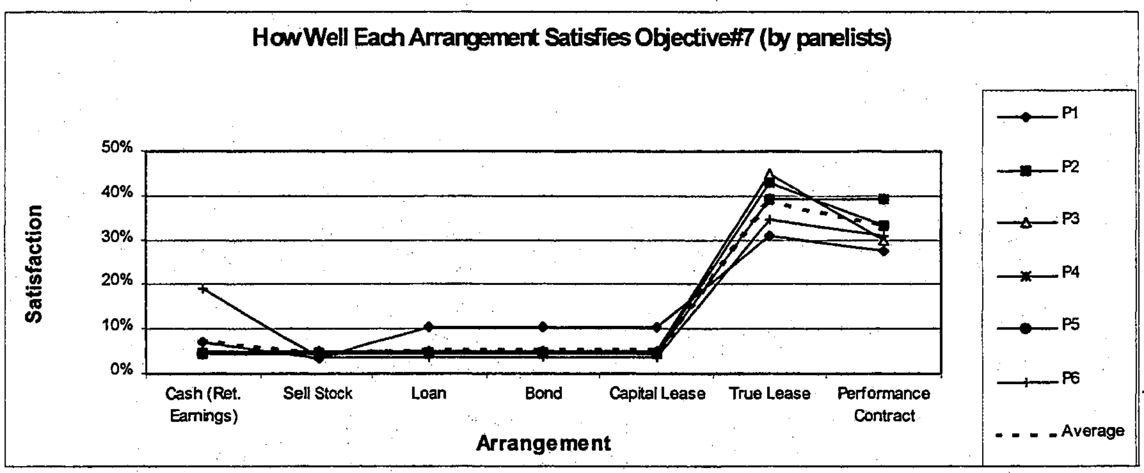

Figure IV-12 How Well Each Arrangement Satisfied Objective #7

Objective # 8:

To structure an arrangement such that annual savings are always greater than annual payments.

Table IV-13 How Well Each Arrangement Satisfied Objective #8

		PANELISTS												
	Satisfaction via	**P1**		**P2**		**P3**		**P4**		**P5**		**P6**		**Avg. Wt.**
Obj.	**Financial Arrangements**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**cor**	**%**	**%**
#8	Cash (Ret. Earnings)	9	24%	1	3%	8	15%	1	2%	1	3%	1	3%	8.4%
	Sell Stock	5	14%	1	3%	7	13%	1	2%	1	3%	2	6%	6.8%
	Loan	7	19%	3	10%	7	13%	9	19%	5	16%	6	17%	15.6%
	Bond	6	16%	1	3%	7	13%	9	19%	1	3%	5	14%	11.5%
	Capital Lease	8	22%	8	27%	8	15%	9	19%	7	23%	6	17%	20.2%
	True Lease	1	3%	8	27%	8	15%	9	19%	7	23%	8	22%	18.0%
	Performance Contract	1	3%	8	27%	9	17%	9	19%	9	29%	8	22%	19.4%
	Sums	37	100%	30	100%	54	100%	47	100%	31	100%	36	100%	100%

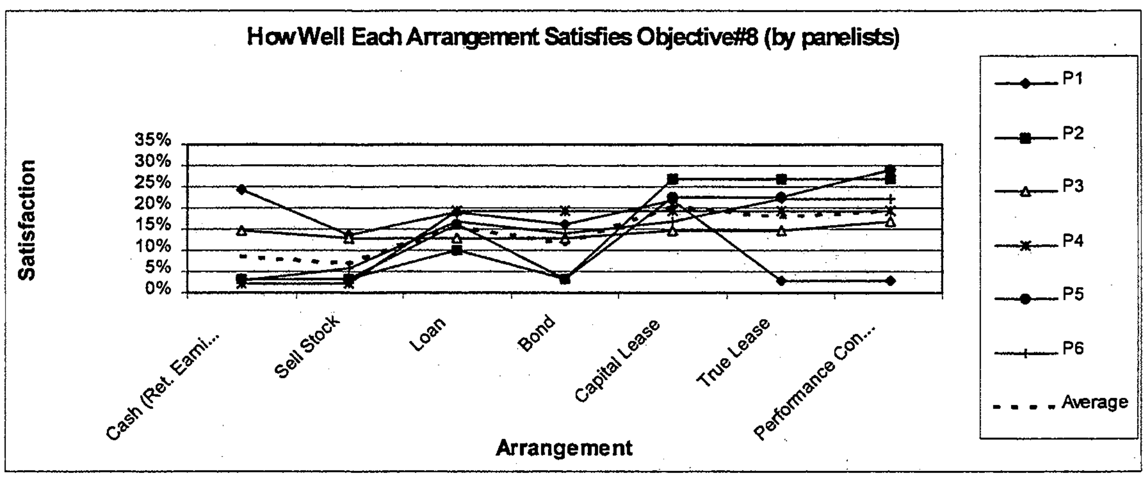

Figure IV-13 How Well Each Arrangement Satisfied Objective #8

Objective # 9:

To secure fixed interest rate financing for the length of the project.

Table IV-14 How Well Each Arrangement Satisfied Objective #9

		PANELISTS												
	Satisfaction via	P1		P2		P3		P4		P5		P6		Avg. Wt.
Obj.	Financial Arrangements	cor	%	cor	%	cor	%	cor	%	cor	%	cor	%	%
#9	Cash (Ret. Earnings)	1	3%	1	2%	0	0%	1	2%	1	3%	1	3%	2.2%
	Sell Stock	2	5%	1	2%	0	0%	1	2%	1	3%	1	3%	2.6%
	Loan	7	18%	9	20%	9	20%	9	19%	5	14%	9	29%	20.1%
	Bond	8	21%	9	20%	9	20%	9	19%	3	9%	9	29%	19.6%
	Capital Lease	9	24%	9	20%	9	20%	9	19%	9	26%	9	29%	22.9%
	True Lease	6	16%	9	20%	9	20%	9	19%	7	20%	1	3%	16.4%
	Performance Contract	5	13%	7	16%	9	20%	9	19%	9	26%	1	3%	16.1%
	Sums	38	100%	45	100%	45	100%	47	100%	35	100%	31	100%	100%

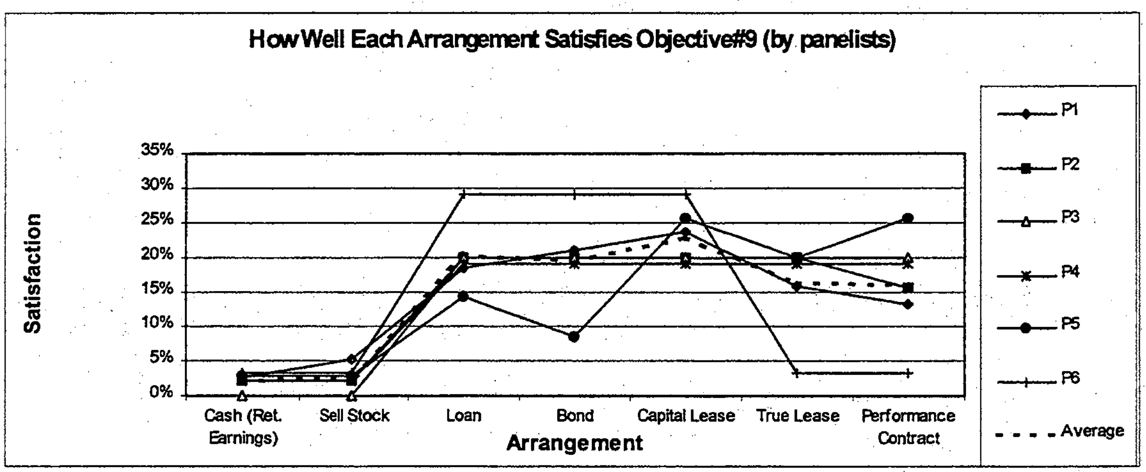

Figure IV-14 How Well Each Arrangement Satisfied Objective #9

Objective # 10:

To be able to easily expand the scope of the arrangement.

Table IV-15 How Well Each Arrangement Satisfied Objective #10

		PANELISTS												
	Satisfaction via	P1		P2		P3		P4		P5		P6		Avg. Wt.
Obj.	Financial Arrangements	cor	%	cor	%	cor	%	cor	%	cor	%	cor	%	%
#10	Cash (Ret. Earnings)	1	3%	8	21%	3	10%	1	3%	5	14%	4	12%	10.5%
	Sell Stock	2	5%	1	3%	1	3%	1	3%	1	3%	1	3%	3.4%
	Loan	7	18%	4	10%	3	10%	3	9%	5	14%	3	9%	11.9%
	Bond	8	21%	1	3%	1	3%	1	3%	1	3%	3	9%	7.0%
	Capital Lease	6	16%	8	21%	7	24%	9	27%	7	20%	7	21%	21.5%
	True Lease	9	24%	8	21%	7	24%	9	27%	7	20%	7	21%	22.8%
	Performance Contract	5	13%	9	23%	7	24%	9	27%	9	26%	8	24%	22.9%
	Sums	38	100%	39	100%	29	100%	33	100%	35	100%	33	100%	100%

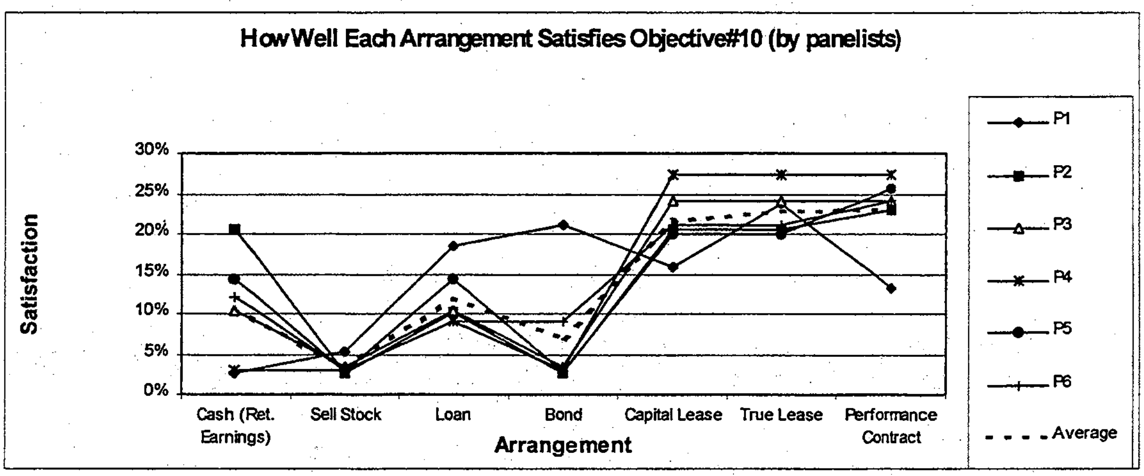

Figure IV-15 How Well Each Arrangement Satisfied Objective #10

Table IV-16 summarizes the panel's average responses by showing which arrangements best satisfied each objective. It is clear that the panelists did have different opinions on some questions. However, the panel's average weight should provide a good basis for the model.

Table IV-16 Which Arrangements Best Satisfied each Objective

OBJECTIVES	PANEL'S TOP THREE CHOICES 1st Choice	 2nd Choice	 3rd Choice
2: To reduce the host's risk by using a guaranteed savings performance contract, where the host makes no initial investment, and the project's costs are "paid from savings".	Perf. Cont. (39.2%)	True Lease (23.7%)	Capital Lease (12.6%)
3: To minimize the additional impact on the maintenance and energy management teams. or To compliment maintenance goals and improve effectiveness.	Perf. Cont. (41.5%)	True Lease (24.7%)	Capital Lease (9.7%)
4: To use a comprehensive, "system-wide" approach to maximize the replacement of outdated equipment.	Perf. Cont. (37.9%)	True Lease (15.5%)	Capital Lease (13.0%)
5: To have an "easy to understand" agreement that minimizes the impact on the host's administrative personnel.	Loan (19.6%)	True Lease (19.0%)	Cash (17.2%)
6: To minimize contractual restraints, so the facility manager has greater flexibility and control over the project.	Cash (19.8%)	Bond (18.4%)	Loan (17.5%)
7: To protect the host's financial image by using off-balance sheet financing and avoid using collateral that could be spared to support future financing.	True Lease (38.6%)	Perf. Cont. (33.3%)	Cash (7.4%)
8: To structure an arrangement such that annual savings are always greater than annual payments. Thus, the project only has positive cash flows.	Capital Lease (20.2%)	Perf. Cont. (19.4%)	True Lease (18.0%)
9: To secure fixed interest rate financing for the length of the project.	Capital Lease (22.9%)	Loan (20.1%)	Bond (19.6%)
10: To be able to easily expand the scope of the arrangement.	Perf. Cont. (22.9%)	True Lease (22.8%)	Capital Lease (21.5%)

Discussion about results from Panel Questionnaire #2 Part B

From Table IV-16, there are some issues worthy of discussion. The following discussion will address observations within each of the questions relating to each objective. Please refer to the table on the previous page, or Table IV-4 for the complete description (with examples) of the Cumulative List of Objectives.

Objective #2:

According to the panel, objective #2 was best satisfied by the performance contract, which is logical because it is the only arrangement that offered guaranteed savings. However, it is surprising that the performance contract did not attain a higher score. It was surprising that the true lease did attain a significant score, and was the "second choice."

One reason why the performance contract did not score higher could be due to score dispersion. Score dispersion occurs when using a Likert scale, with a small range. In this study, "1" represented an insignificant amount of satisfaction, and "9" meant that an arrangement completely satisfied an objective. Perhaps the difference between the two extremes was not large enough. For example, in Table IV-7, panelist #5 (P5) scored the performance contract as a

"9". P5 scored all other arrangements as "1". Even with this strong indication that the performance contract dominates this objective, the other arrangements (when normalized) received approximately 7% each, which leaves the performance contract with only a 60% score.

Score dispersion exists throughout the entire AHP approach, because of the "1" (as opposed to "0") in the Likert scale. However, score dispersion should balance itself in a properly designed AHP model. For example, in a performance contract-related objective, score dispersion inappropriately increases the loan's score, while in a loan-related objective, dispersion inappropriately increases the performance contract's score.

Objective #3:

Objective #3 was best satisfied by the performance contract, which is logical because that arrangement provides project management, which would minimize the impact on in-house personnel. As specified in the arrangement assumptions, a true lease offers a maintenance agreement, yet the performance contract scored higher probably due to its superiority at complementing maintenance goals and improving effectiveness.

Objective #4:

Objective #4 was best satisfied by the performance contract, which is logical because that arrangement uses a system-wide approach, and often leads to a more comprehensive, facility-wide project.

Objective #5:

Although the host-managed arrangements (especially using cash) would have less agreements and contracts for administrative personnel to negotiate and monitor, they did not substantially dominate this objective over the performance contract and true lease. This surprising result could be due to the fact that the "host-managed" arrangements shared panelists' votes, which did not allow any one arrangement to dominate.

Although selling stock is a host-managed arrangement, it did not score highly with any panelists, which is logical because stock arrangements can be complex for administrative personnel. In addition, none of the panelists had experience with selling stock to finance a project. Thus, the low scores could be attributed to the panelists' unfamiliarity with the arrangement.

Objective #6:

As in Objective #5, the host-managed projects probably shared the panelist's votes, however the performance contract and selling stock arrangements received significantly lower scores, which is logical, because they usually involve lengthy contracts.

Objective #7:

The true lease and performance contract dominate this objective, which is perfectly logical because both can be structured as off-balance sheet arrangements. Although the panel judged appropriately, a more defined description of the assumptions within the performance contract would have been helpful. To differentiate the performance contract from the true lease, the performance contract in this study should have had an assumption stating that the equipment would be listed on the balance sheet.

Objective #8:

The capital lease received the highest average score, with the performance contract and true lease close behind. Although it is possible to structure all three of the above arrangements so the project only has positive cash flows, the performance contract was based on this concept. It is surprising that the performance contract did not score higher. Perhaps the statement in the assumptions that the project was "paid from savings" should have also included a direct statement that the project would "only have positive cash flows for the host".

Objective #9:

The capital lease, loan and bond dominate, which is logical because they are most likely to secure a fixed interest rate.

Objective #10:

The performance contract and the leasing arrangements typically minimize paperwork for additions to a project. Therefore, it is appropriate that these arrangements best satisfy this objective.

One possible reason why the performance contract scored so high is because the performance contract has a broader definition than the other arrangements. Such a contract can be tailored to meet practically any customer's needs and "hybridized" with other financial arrangements. Although within the survey form, a list of assumptions about the arrangements was included to help the panelists understand what a performance contract means within this survey, the panelists may have used their career experiences to broaden this definition. Thus, the panelists may believe that a performance contract can best satisfy more objectives than any other arrangement, based on the fact that a performance contract can be coupled with many of the other arrangements.

4.4.6 Building the Fixed Component of E-FUND

From the results of Panel Questionnaire Parts A and B, the fixed component of E-FUND (bottom half of the AHP hierarchy) was constructed.

4.4.6.1 Using the Results from Panel Questionnaire #2 Part A

As mentioned earlier, the results from Part A showed that all of the ten objectives were generally important and qualified to serve as the default objectives (unweighted) for E-FUND. With, this design, E-FUND had a broad-based set of objectives, enabling it to adapt to site-specific conditions in many different EMPs and types of facilities. The default objectives were inserted beneath the primary goal into the middle level of an AHP hierarchy. The hierarchy only had one level of objectives so that all objectives had an equal opportunity to represent site-specific facility and EMP conditions. This concept is displayed in Figure IV-1.

4.4.6.2 Using the Results from Panel Questionnaire #2 Part B

The results from Part B determined how well the arrangements satisfied each of the ten objectives. The panel's average weights served as the local normalized priority weights in the bottom of the E-FUND hierarchy. The visual concept of this model is shown in Figure IV-2. The missing local priority weights (determined once E-FUND is applied) customize E-FUND, to a specific EMP and facility.

4.4.7 Testing E-FUND: The FM GROUP SURVEY

The population of facility managers (FM Group) applied E-FUND to four different case studies. Each case study proposed a particular EMP to be installed in a particular type of facility. The facility managers were given qualitative information describing the facility and the EMP to be installed. Based on this information, each facility manager judged the relative importance of the default objectives in each case study. The judgements were made on a nine-point Likert scale.

Although not stated in the survey given to the FM Group, the cases were constructed to favor particular arrangements. Case A was designed to favor a true lease. Case B was designed to favor a host-managed arrangement. Case C was designed to favor a performance contract. Case D was designed to favor a host-managed arrangement (preferably a bond). All case information (quantitative and qualitative) is presented in Appendix B.

In an effort to improve future models, the facility managers were also asked if they had other objectives that should have been included in the Cumulative Objective List. Two facility managers responded, and their exact comments are included in Table IV-17.

Table IV-17 Facility Manger Contributions of Objectives for Future Models

CONTRIBUTING FACILITY MANAGER	ADDITIONAL OBJECTIVES	EXPLANATION/EXAMPLE
FM 6	Multi-tier Annual Savings Combined with Guaranteed Savings	Where an initial investment buys first tier of equipment and additional equipment is purchased from annual savings (these may or may not be guaranteed by the ESCO)
FM 8	To have input on, or concurrence with, the chosen life cycle cost methodology	To comply with the intent of the code of federal regulations (CFR) parts 435, 436 & 450.
FM 8	To have input on the type of refrigerants for chillers	To comply with the intent of section 608 of the Clean Air Act and CFR 40, part 82.

Results and Discussion for the FM Group Survey

Tables IV-18 through IV-21 and Figures IV-16 through IV-19 present the results from the FM Group Survey. The tables show each facility manager's scores and corresponding normalized values. As evident from the figures, the facility managers did have a high degree of correlation on many of the objectives. The most important and least important objectives varied from case to case, which shows that the facility managers did understand and react to the priorities and needs of each case study. Following each table is a discussion of the logic behind the FM Group's judgements relating to the highest and lowest scoring objectives in each case.

Table IV-18 Importance of Objectives in Case Study A

	FACILITY MANAGERS																				
Obj.	FM1		FM2		FM3		FM4		FM5		FM6		FM7		FM8		FM9		FM10		Avg. Wt.
#	Score	%	Score	% Im	Score	% Im	Score	% Im	Score	% Im	Score	% Im	Score	% Im	Score	% Im	Score	% Im	Score	% Imp.	
1	9	16%	8	17%	8	14%	8	17%	9	15%	9	16%	7	13%	7	14%	9	18%	6	11%	15.1%
2	7	12%	8	17%	8	14%	1	2%	8	13%	8	15%	2	4%	8	16%	7	14%	6	11%	11.7%
3	7	12%	5	11%	6	10%	2	4%	9	15%	8	15%	7	13%	8	16%	8	16%	8	15%	12.7%
4	4	7%	3	6%	3	5%	1	2%	2	3%	1	2%	2	4%	1	2%	1	2%	2	4%	3.7%
5	6	11%	3	6%	7	12%	7	15%	9	15%	5	9%	6	11%	4	8%	6	12%	6	11%	11.0%
6	6	11%	4	9%	7	12%	9	19%	1	2%	4	7%	5	9%	2	4%	1	2%	5	9%	8.3%
7	8	14%	2	4%	8	14%	9	19%	3	5%	8	15%	8	15%	9	18%	8	16%	9	16%	13.6%
8	4	7%	9	19%	5	8%	6	13%	4	7%	7	13%	7	13%	9	18%	6	12%	7	13%	12.2%
9	4	7%	2	4%	3	5%	3	6%	7	12%	3	5%	7	13%	2	4%	2	4%	4	7%	6.8%
10	2	4%	3	6%	4	7%	2	4%	8	13%	2	4%	2	4%	1	2%	1	2%	2	4%	4.9%
Sum	57	100%	47	100%	59	100%	48	100%	60	100%	55	100%	53	100%	51	100%	49	100%	55	100%	100%

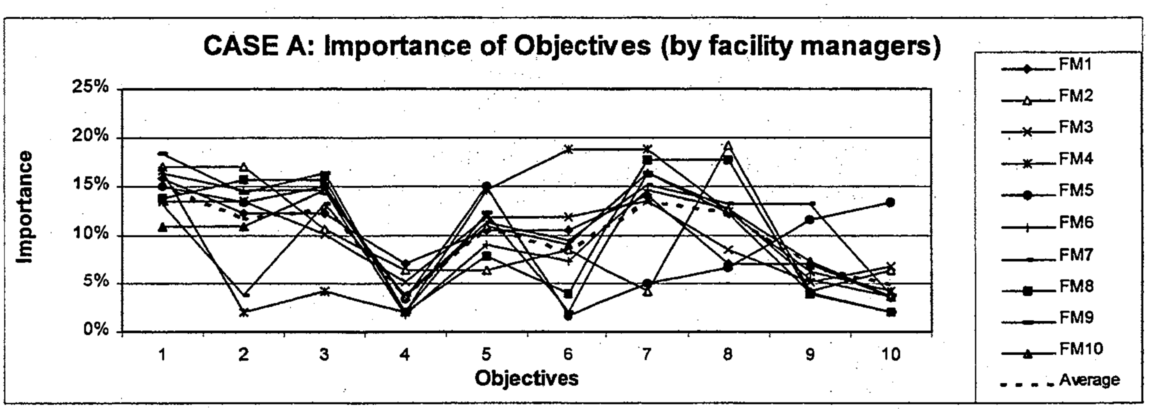

Figure IV-16 Importance of Objectives in Case Study A

From the FM Group's average responses in Case A, objectives #1, #7, #3, and #8 were the four most important objectives (in order: highest to lowest importance). Based on the information about Case A (supplied to the FM Group), this is logical because the privately-held facility was extremely concerned about economic benefit (Obj. #1), improving financial image (#7), minimizing the impact on the over-burdened maintenance team (#3) and keeping project balances positive (#8) by funding projects with immediate payback periods.

The objectives with the four lowest scores were #4, #10, #9 and #6 (in order: lowest to highest importance). This is logical because these objectives support the fact that this facility was interested in short-term financial improvement, not maximizing equipment replacement (#4), or entering expandable arrangements (#10) or fixed interest rate financing (#9), because the company was moving in five years.

Objective #6 could have scored higher, since the facility manager wanted the maximum flexibility regarding production operations. However, when considering all the FM Group's judgements, they seemed appropriate for this case.

Table IV-19 Importance of Objectives in Case Study B

Obj.	FACILITY MANAGERS																				Avg. Wt.
	FM1		FM2		FM3		FM4		FM5		FM6		FM7		FM8		FM9		FM10		
#	Score	%	Score	% Im	Score	% Im	Score	% Im	Score	% Im	Score	% Im	Score	% Im	Score	% Im	Score	% Im	Score	% Imp.	
1	6	9%	9	20%	8	11%	4	10%	7	14%	2	4%	8	15%	7	16%	6	13%	6	11%	12.2%
2	7	11%	2	4%	8	11%	2	5%	2	4%	2	4%	2	4%	2	4%	1	2%	4	7%	5.7%
3	5	8%	2	4%	8	11%	2	5%	4	8%	4	8%	4	7%	5	11%	2	4%	5	9%	7.6%
4	7	11%	7	15%	9	12%	7	18%	8	16%	7	14%	7	13%	8	18%	8	17%	7	13%	14.6%
5	6	9%	3	7%	3	4%	3	8%	9	18%	6	12%	5	9%	4	9%	3	6%	7	13%	9.5%
6	7	11%	8	17%	8	11%	3	8%	1	2%	7	14%	6	11%	5	11%	8	17%	6	11%	11.3%
7	5	8%	3	7%	7	10%	2	5%	2	4%	5	10%	4	7%	2	4%	2	4%	2	4%	6.3%
8	6	9%	3	7%	7	10%	3	8%	4	8%	6	12%	4	7%	3	7%	5	10%	6	11%	8.9%
9	8	12%	7	15%	8	11%	5	13%	4	8%	3	6%	7	13%	2	4%	4	8%	3	5%	9.6%
10	8	12%	2	4%	7	10%	8	21%	9	18%	7	14%	8	15%	7	16%	9	19%	9	16%	14.4%
Sum	65	100%	46	100%	73	100%	39	100%	50	100%	49	100%	55	100%	45	100%	48	100%	55	100%	100%

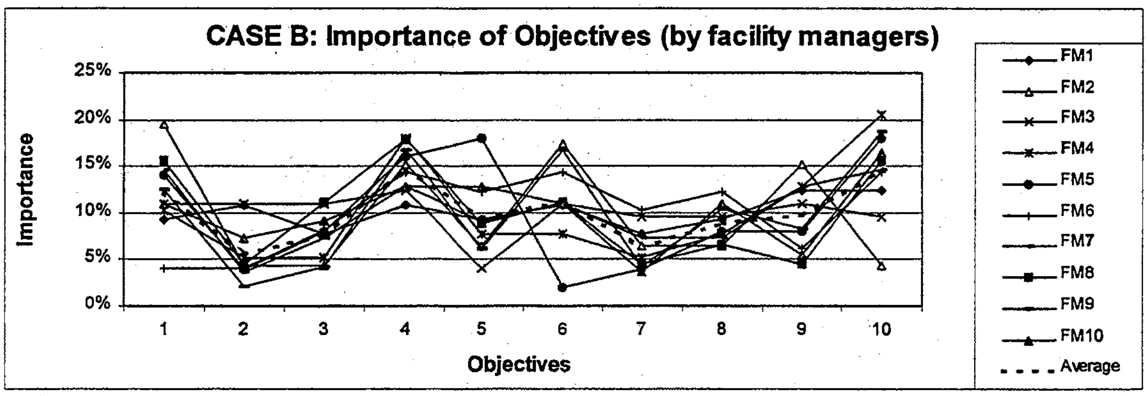

Figure IV-17 Importance of Objectives in Case Study B

From the FM Group's average responses in Case B, objectives #4, #10, #1, and #6 were the four most important objectives (in order). Based on the information about Case B, this is logical because the facility was expanding and looking for system-wide (#4), long-term projects, that could be expanded (#10). Attaining a high economic benefit was still important (#1), and the company wanted to manage the projects themselves and avoid contractual restraints (#6).

The objectives with the four lowest scores were #2, #7, #3 and #8 (in order). This is logical because these objectives support the fact that the company did not need to reduce risk via a performance contract (#2) because they had the experience to manage this complex project (#3). The company was willing to take risks, adding liabilities to the balance sheet, so off-balance sheet financing was not a requirement (#7). The company was willing to invest in projects with less than a 5-year payback; thus immediate payback periods were not required and project balances did not always have to be positive (#8).

Objective #5 could have scored higher, since management was implementing an employee empowerment program and preferred to relieve administration of some management tasks. However, when considering all the FM Group's judgements, they seemed appropriate for this case.

Table IV-20 Importance of Objectives in Case Study C

Obj.	FACILITY MANAGERS																				Avg. Wt.
	FM1		FM2		FM3		FM4		FM5		FM6		FM7		FM8		FM9		FM10		
#	Score	%	Score	% Im	Score	% Im	Score	% Im	Score	% Im	Score	% Im	Score	% Im	Score	% Im	Score	% Im	Score	% Imp.	
1	4	7%	3	5%	9	12%	2	4%	3	5%	2	4%	7	13%	7	12%	7	11%	6	12%	8.6%
2	8	15%	9	15%	9	12%	9	18%	9	14%	9	17%	7	13%	9	16%	9	15%	9	18%	15.3%
3	6	11%	8	13%	7	10%	6	12%	8	13%	7	13%	7	13%	7	12%	7	11%	8	16%	12.5%
4	5	9%	3	5%	9	12%	7	14%	1	2%	6	12%	5	10%	8	14%	6	10%	8	16%	10.3%
5	8	15%	8	13%	8	11%	2	4%	9	14%	2	4%	5	10%	5	9%	3	5%	7	14%	9.8%
6	3	6%	3	5%	7	10%	5	10%	9	14%	3	6%	7	13%	2	3%	7	11%	2	4%	8.2%
7	3	6%	7	12%	2	3%	2	4%	5	8%	1	2%	3	6%	2	3%	2	3%	1	2%	4.8%
8	7	13%	7	12%	9	12%	8	16%	7	11%	8	15%	3	6%	7	12%	8	13%	5	10%	12.0%
9	5	9%	6	10%	9	12%	1	2%	8	13%	7	13%	3	6%	3	5%	5	8%	2	4%	8.3%
10	5	9%	6	10%	4	5%	7	14%	5	8%	7	13%	5	10%	8	14%	7	11%	3	6%	10.1%
Sum	54	100%	60	100%	73	100%	49	100%	64	100%	52	100%	52	100%	58	100%	61	100%	51	100%	100%

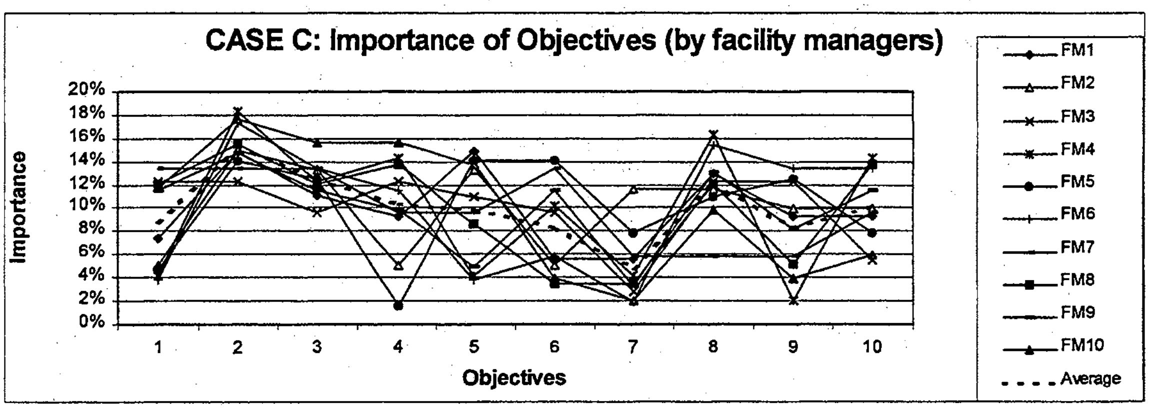

Figure IV-18 Importance of Objectives in Case Study C

From the FM Group's average responses in Case C, objectives #2, #3, #8, and #4 were the four most important objectives (in order). Based on the information about Case C, this was logical because this government facility had no budget funds for the initial investment (#2), and project balances needed to be positive (#8). Minimizing the impact on the over-burdened maintenance staff was also a priority (#3). The facility could also benefit from a system-wide approach, to capture additional savings while replacing more equipment (#4).

The objectives with the four lowest scores were #7, #6, #9 and #1 (in order). This was logical because the government had no desire to improve its financial image for stockholders or for stronger credit ratings (#7). Without budget funds or an adequate maintenance team, the facility manager essentially needed to enter a risk-sharing relationship via a performance contract, which would have some contractual restraints. However, because this building's operational hours and loads were predictable, constraining the facility to specific operational hours was not a major concern (#6). Securing fixed interest rate financing was also not a major concern (#9). As long as the equipment was installed and the project paid for itself, attaining a high NPV was not a major concern to the government facility manager (#1). This made sense, because the government facility manager's job was to make the building operate within the budget. If he could do this with a risk-free performance contract that pays for itself, the facility manager had accomplished his job.

When considering all the FM Group's judgements, they seemed appropriate for this case.

Table IV-21 Importance of Objectives in Case Study D

Obj. #	FACILITY MANAGERS																				Avg. Wt.
	FM1		FM2		FM3		FM4		FM5		FM6		FM7		FM8		FM9		FM10		
	Score	%	Score	% Im	Score	% Im	Score	% Im	Score	% Im	Score	% Im	Score	% Im	Score	% Im	Score	% Im	Score	% Imp.	
1	2	4%	3	10%	8	14%	2	7%	5	14%	5	13%	8	18%	8	32%	8	20%	6	13%	14.4%
2	5	9%	2	6%	8	14%	1	3%	1	3%	3	8%	1	2%	1	4%	2	5%	3	6%	6.1%
3	9	16%	3	10%	3	5%	1	3%	1	3%	3	8%	3	7%	3	12%	3	8%	2	4%	7.6%
4	8	15%	2	6%	3	5%	1	3%	1	3%	4	10%	3	7%	1	4%	6	15%	9	19%	8.7%
5	4	7%	3	10%	3	5%	5	17%	2	6%	6	15%	5	11%	2	8%	4	10%	7	15%	10.4%
6	7	13%	3	10%	2	4%	4	13%	3	8%	6	15%	5	11%	3	12%	5	13%	8	17%	11.6%
7	3	5%	4	13%	4	7%	2	7%	1	3%	1	3%	4	9%	1	4%	1	3%	1	2%	5.5%
8	6	11%	4	13%	8	14%	6	20%	9	25%	6	15%	6	14%	3	12%	3	8%	2	4%	13.5%
9	5	9%	4	13%	9	16%	6	20%	9	25%	4	10%	6	14%	2	8%	1	3%	5	11%	12.8%
10	6	11%	3	10%	8	14%	2	7%	4	11%	2	5%	3	7%	1	4%	7	18%	4	9%	9.4%
Sum	55	100%	31	100%	56	100%	30	100%	36	100%	40	100%	44	100%	25	100%	40	100%	47	100%	100%

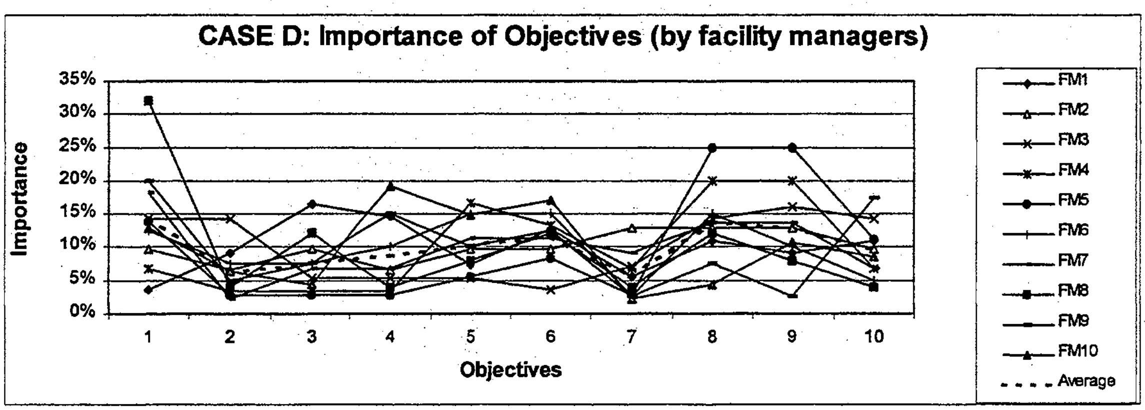

Figure IV-19 Importance of Objectives in Case Study D

From the FM Group's average responses in Case D, objectives #1, #8, #9, and #6 were the four most important objectives (in order). It is clear that one of this facility's goals was to maximize value per dollar spent (#1). It is also clear that outsourcing was not desired, and maximum project control should be delegated to in-house staff (#6). However, it was surprising that objectives #8 and #9 scored so high. This facility does have capital, and was willing to invest in good projects, thus project balances did not need to be always positive (#8). Securing fixed interest rate financing was not a stated desire in the case description.

The objectives with the four lowest scores were #7, #2, #3 and #4 (in order). As in Case C, the government had no desire to improve its financial image for stockholders or for stronger credit ratings (#7). In contrast to Case C, this facility had budget funds and an adequate maintenance team available. Thus, sharing risk via a performance contract or trying to minimize the impact on the maintenance team were not high priorities (#2 and #3). Because this project was the final phase of a campus-wide lighting retrofit, a system-wide approach was not desired (#4).

With the exception of the high scores given to objectives #8 and #9, most of the FM Group's judgements seemed appropriate for this case.

Discussion about Score Dispersion in the FM Group Survey

The score dispersion issue, as addressed in the discussion from Panel Questionnaire #2 Part B, can be also applied to the results from the FM Group Survey. Table IV-22 shows that even if a facility manager scored Objective #1 (to have a high economic benefit) as high as possible in a case study, the normalized score would only be 50%, with all other objectives capturing 5.6%.

Table IV-22 Potential Score Dispersion when Judging the Importance of Objectives

Obj. #	FM X Score	%
1	9	50.0%
2	1	5.6%
3	1	5.6%
4	1	5.6%
5	1	5.6%
6	1	5.6%
7	1	5.6%
8	1	5.6%
9	1	5.6%
10	1	5.6%
Sums	18	100%

The score dispersion issue from a nine-point Likert scale may represent a significant flaw in the model, if the FM Group had actually wanted Objective #1 to dominate. However, when looking at Tables IV-18 through IV-21, the facility mangers' judgements indicate that Objective #1 was not substantially more important than the other objectives. In the vast majority of judgements, when a facility manager scored Objective #1 high in a case, another objective was scored as high or higher. In fact, only three facility managers in Case A, one facility manager in Case B and three facility managers in Case D judged Objective #1 higher than any other objective. Thus, in only seven out of forty opportunities (17.5%) did a facility manager score objective #1 more important than any other objective.

It was thought that a greater emphasis would have been placed on economic benefit if the survey had encompassed more corporate financial officers, or other personnel that influence the financial arrangement selection. However, it should be noted that most facility managers in this study had substantial experience with selecting financial arrangements for large projects. Eight out of ten facility managers were responsible for selecting such arrangements in their current facility. The two government facility managers were the only exceptions.

When comparing the FM Group results to the panelists' judgements regarding objective importance, all six panelists did judge Objective #1 higher than any other objective. However, Table IV-6 shows that none of the panelists judged Objective #1 as extremely more important than the other objectives. These results seem to indicate that the importance of having a high economic benefit is not substantially dominant over the qualitative objectives.

4.4.7.1 Using the Results from the FM Group Survey

As mentioned earlier, the responses from Panel Questionnaire #2, part B were used to develop the priority weights for the bottom half of the E-FUND hierarchy. This section describes how the FM Group Survey provided the priority weights for the top half of the E-FUND hierarchy. Each facility manager's judgements were normalized and the FM Group's average weights were used as the local normalized priority weights from the primary goal to each objective, within each case study. The dashed lines in Figure IV-3 represent the priority weights that were generated when E-FUND was customized to a specific application.

The NPV of each arrangement was also entered (via direct data entry) to determine the priority weights from the NPV objective to the financial arrangements. Tables showing the annual cash flows and calculation of NPVs are presented in Appendix B. Table IV-23 shows the summary of the NPVs for the different financial arrangements in each case study. Note that Cases C and D involved government facilities, which could not sell stock, thus the NPVs for selling stock were $0.

Table IV-23 Net Present Values for Each Case Study

	Net Present Values for:			
Financial Arrangements	**Case A**	**Case B**	**Case C**	**Case D**
Cash (Ret. Earnings)	$ 7,325	$ 900,429	$ 1,941,699	$ 1,941,699
Sell Stock	$ 10,316	$ 1,952,411	$ -	$ -
Loan	$ 25,054	$ 2,191,179	$ 2,442,735	$ 2,904,945
Bond	$ 31,609	$ 2,466,713	$ 3,122,256	$ 3,507,982
Capital Lease	$ 18,474	$ 2,003,973	$ 2,355,824	$ 2,765,239
True Lease	$ 35,615	$ 1,587,487	$ 2,405,284	$ 2,405,284
Performance Contract	$ 3,059	$ 617,162	$ 935,095	$ 935,095

4.4.8 Synthesizing the Applied E-FUND Hierarchy

Once all priority weights were inserted into the E-FUND hierarchy, it was synthesized to determine the financial arrangement selection for each case study. If E-FUND was functioning properly, it would pick the logically expected financial arrangement for each case. The expected selections were:

Case A a true lease

Case B a host-managed arrangement

Case C a performance contract

Case D a host-managed arrangement (most likely a bond)

Unfortunately, the initial version of E-FUND was not very responsive to the different case studies. As Table IV-24 and Figure IV-20 show, the performance contract and true lease scored very high in all cases.

Table IV-24 Initial E-FUND Arrangement Selection by Case

	Score in Each Case Study			
Financial Arrangements	A	B	C	D
Cash (Ret. Earnings)	8.4%	9.3%	9.2%	10.0%
Sell Stock	5.2%	6.1%	4.2%	4.1%
Loan	13.3%	14.2%	13.2%	15.1%
Bond	12.6%	12.6%	12.0%	13.9%
Capital Lease	14.2%	16.1%	15.6%	16.8%
True Lease	23.7%	19.7%	20.8%	19.7%
Performance Contract	22.6%	22.1%	25.0%	20.4%
Sums	100%	100%	100%	100%

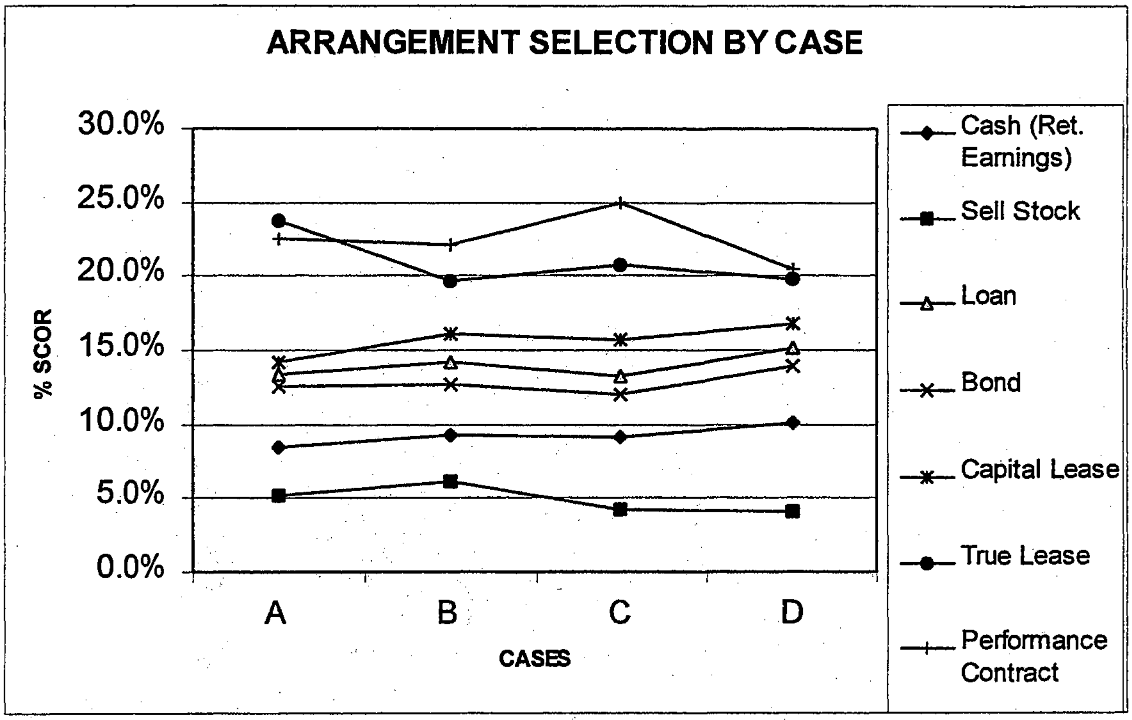

Figure IV-20 Initial E-FUND Arrangement Selection by Case

4.4.9 Model Analysis and Modification

4.4.9.1 Model Analysis

To determine why E-FUND was not selecting the logically expected financial arrangement for each case, a control experiment was conducted. All facility manager responses were made uniform to see if the performance contract remained dominant. As Table IV-25 and Figure IV-21 show, even when removing the influence of the facility manager, the initial E-FUND tended to favor the performance contract and true lease financial arrangements.

Table IV-25 Control Results

	Score in Each Case Study			
Financial Arrangements	**A**	**B**	**C**	**D**
Cash (Ret. Earnings)	8.7%	8.9%	9.6%	9.5%
Sell Stock	4.9%	5.8%	4.2%	4.2%
Loan	13.6%	13.6%	13.5%	13.7%
Bond	12.4%	12.1%	12.4%	12.4%
Capital Lease	15.1%	15.4%	15.4%	15.6%
True Lease	22.2%	20.9%	21.3%	21.2%
Performance Contract	23.1%	23.4%	23.6%	23.5%
Sums	100%	100%	100%	100%

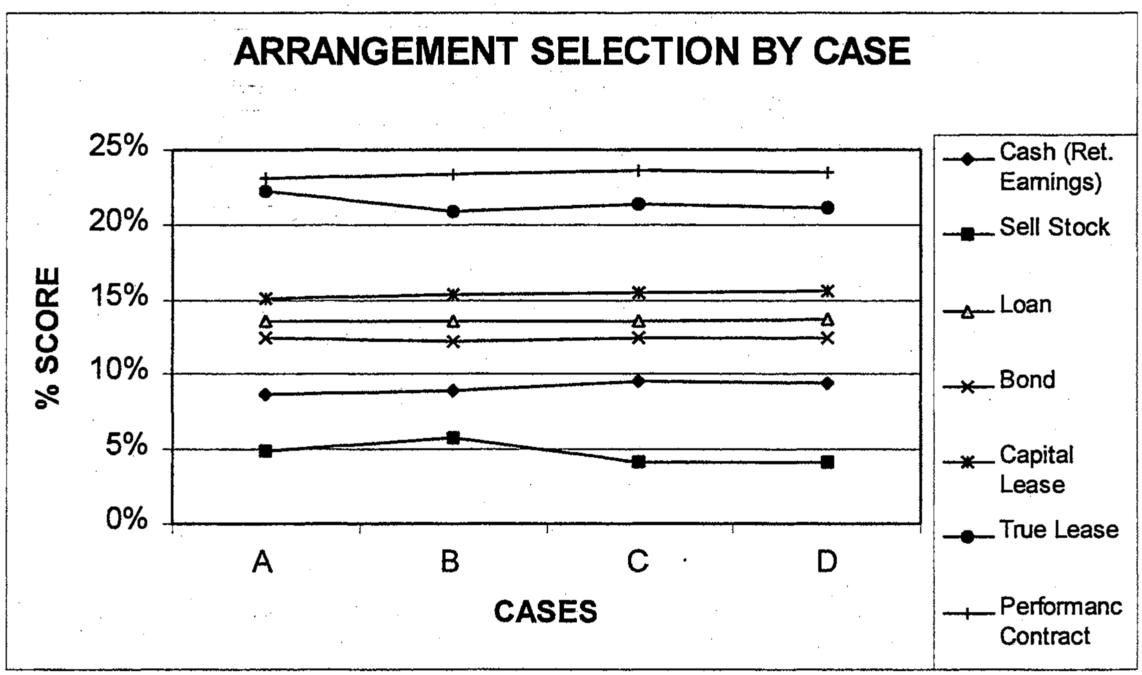

Figure IV-21 Control Results

From the results of the control experiment, it was clear that the initial E-FUND model would need to be modified to be useful. One reason why the initial version was not working properly was that there were too many objectives related to the performance contract and true lease financial arrangements. Logically, performance contracts or true leases best satisfied these objectives. The sheer number of objectives favoring the performance contract or true lease skewed the E-FUND model to select these arrangements.

It is interesting to discuss the score dispersion issue, which was raised in the discussion about the results from Panel Questionnaire #2, Part B (under Objective #2). In this study there were more performance contract-related objectives than host-managed-related objectives. Due to this imbalance, score dispersion actually helps the model (only slightly) by dispersing the performance contract's score into the host-managed scores. In other words, if an objective should be dominated by the performance contract, a portion of the performance contract's score would be dispersed into the other arrangements, which were mostly host-managed arrangements. A similar phenomenon occurred for the true lease, because it scored higher than host-managed arrangements in many of the objectives. However, score dispersion was a minor factor when compared to the impact of the number of objectives favoring the performance contract or true lease.

Sensitivity analysis of the E-FUND model would reveal the sensitivity of the arrangement selection (in each case study) to each of the ten objectives. A "critical" objective would be one that when its importance varies slightly, the model's arrangement selection would be significantly impacted. By conducting sensitivity analyses, the impact of the performance contract and true lease-related objectives could be determined. However, because sensitivity analysis can not be conducted until the models have been applied, the value of the sensitivity analysis is limited, because the "critical" objectives will change with every application. Thus, the sensitivity information would only be useful to these four case studies. In addition, conducting sensitivity analysis with ECPro would require at least 240 more graphs and supporting text of analysis.

An alternative indicator of sensitivity can be obtained by analyzing the fixed components of E-FUND (before application). In Panel Questionnaire #2 Part B, the panel judged how well the arrangements satisfied each objective, (except for Objective #1). The percent satisfaction that an arrangement achieves in an objective is an indication of the arrangement's impact in that portion of the model. By summing the percent weights that each arrangement achieved in satisfying all the objectives, an assessment can be made of the cumulative impact an arrangement has on the fixed component of model. Table IV-26 and Figure IV-22 show the normalized impact each arrangement has on the model before it is applied. From this information, it is clear that the performance contract and true lease arrangements had an advantage, even before E-FUND was applied. However, these results could indicate that these arrangements should be used more often for EMPs. This is discussed in greater detail at the end of Section 4.5.

Table IV-26 Normalized Cumulative Satisfaction Attained by each Arrangement

Net Satisfaction for each Financial Arrangement	Normalized Satisfaction
Cash (Ret. Earnings)	9%
Sell Stock	5%
Loan	13%
Bond	11%
Capital Lease	15%
True Lease	22%
Performance Contract	25%
Sum	100.0%

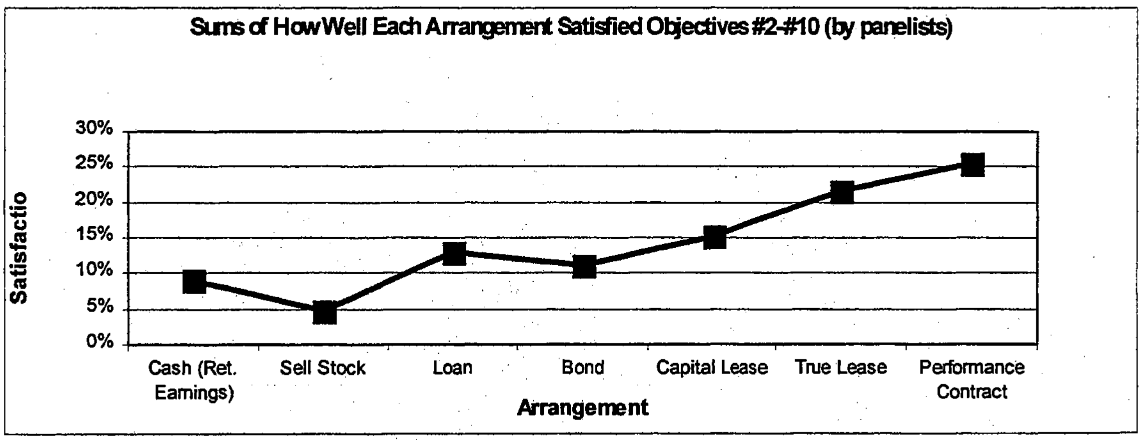

Figure IV-22 Normalized Cumulative Satisfaction Attained by each Arrangement

4.4.9.2 Model Modification

It was decided that for E-FUND to function properly, some of the performance contract and true lease-related objectives would need to be removed. Since the panel could not identify objectives that were insignificant (for most EMPs and facilities) the elimination of insignificant objectives needed to be done on a more site-specific basis: during application by facility managers. Eliminating insignificant objectives at the application phase made sense, because E-FUND included a broad range of objectives to handle many different types of EMPs and facilities. Obviously, with such a broad-based objective list, some objectives would not apply in each case study. Thus, in each case if the objectives ranked low by the FM Group were eliminated, the model would be more responsive to individual applications.

As Figure IV-23 shows, when objectives are ranked in order of importance (by facility managers in each case) there are diminishing gains in cumulative importance from the low-scoring objectives. The challenge was to determine how much cumulative importance should remain in the model. For example, in Figure IV-23, 70% of the cumulative importance can be maintained by including only the top six objectives in the model. Thus, the four lowest scoring objectives would be eliminated.

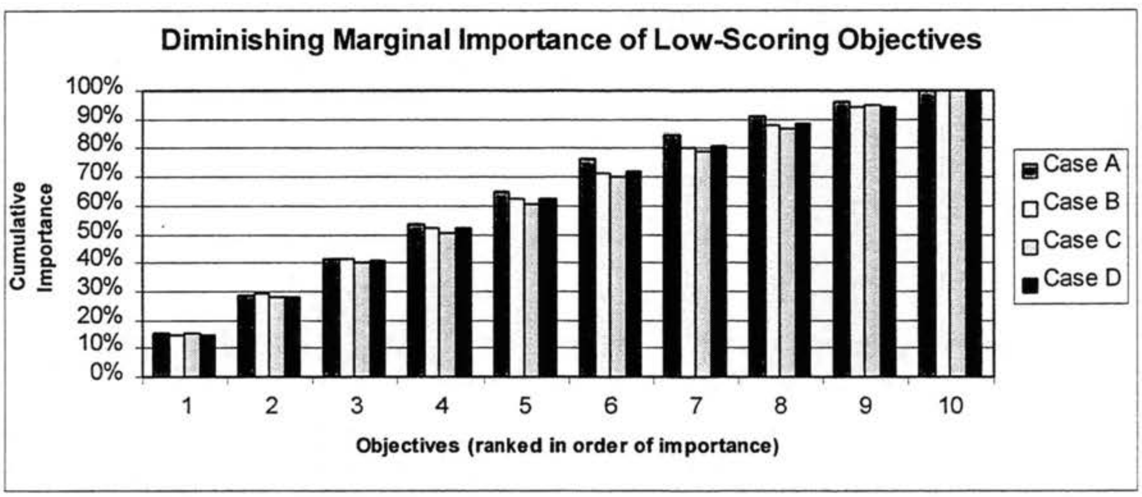

Figure IV-23 Diminishing Marginal Importance of Objectives

To determine how much cumulative importance to maintain, all possible configurations were evaluated. Table IV-27 shows the objectives that were eliminated as function of the cumulative importance maintained. Figures IV-24 through IV-27 show the arrangement selection in each case as a function of percent cumulative importance maintained. Similar analyses were conducted for maintaining 40%, 35%, 25%, 15% and 10% of the cumulative importance in each case. However these combinations did not significantly improve the accuracy of E-FUND.

Table IV-27 Objectives Eliminated as Function of Cumulative Importance Maintained

	OBJECTIVES ELIMINATED AS A FUNCTION OF CUMULATIVE IMPORTANCE MAINTAINED										
CASE	100%	95%	90%	85%	80%	75%	70%	65%	60%	55%	50%
A		4	10	9		6		5			2
B			2	7	3		8		5		9
C		7		6		9	1		5		10
D			7	2	3		4		10		5

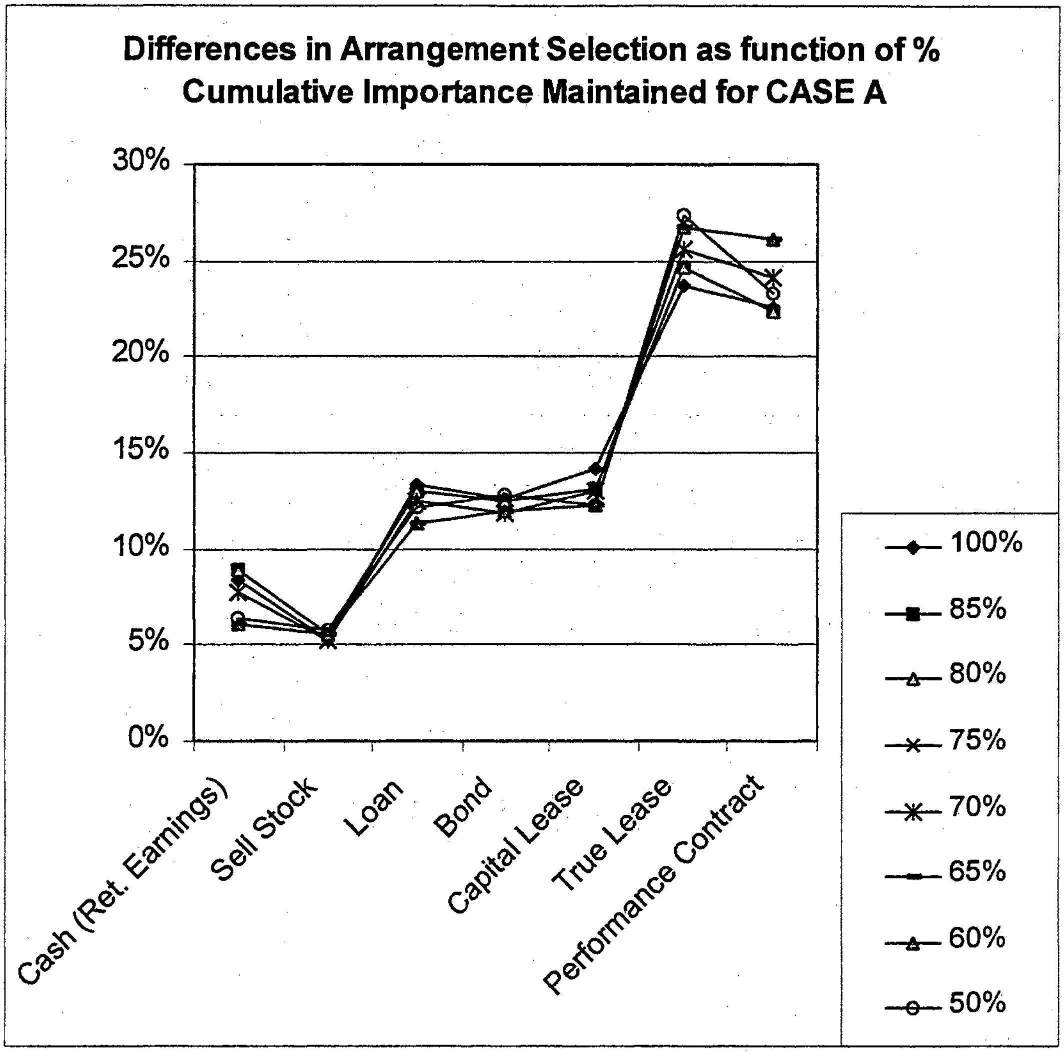

Figure IV-24 Case Arrangement Selection as a Function of Cumulative Importance Maintained

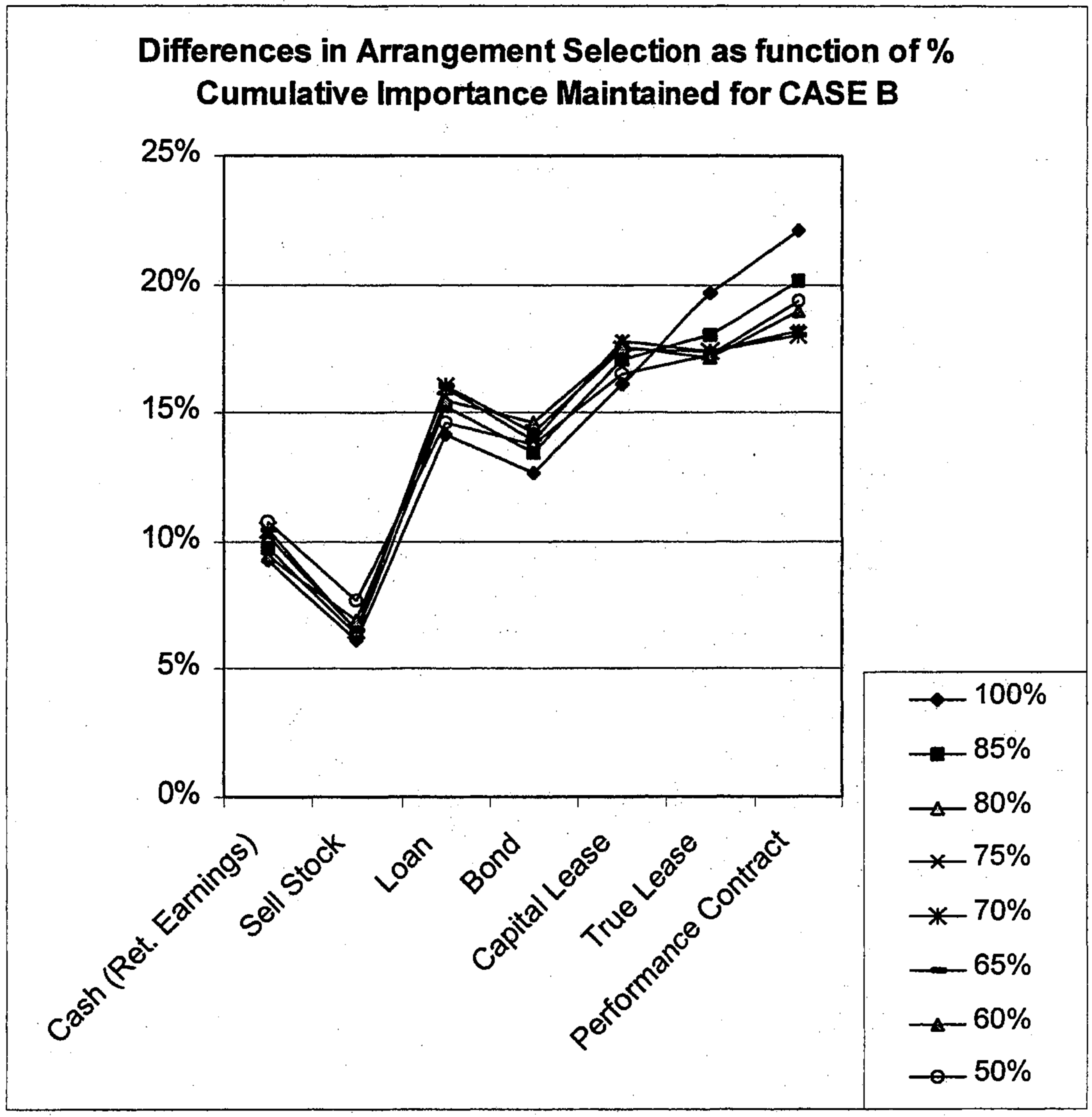

Figure IV-25 Case Arrangement Selection as a Function of Cumulative Importance Maintained

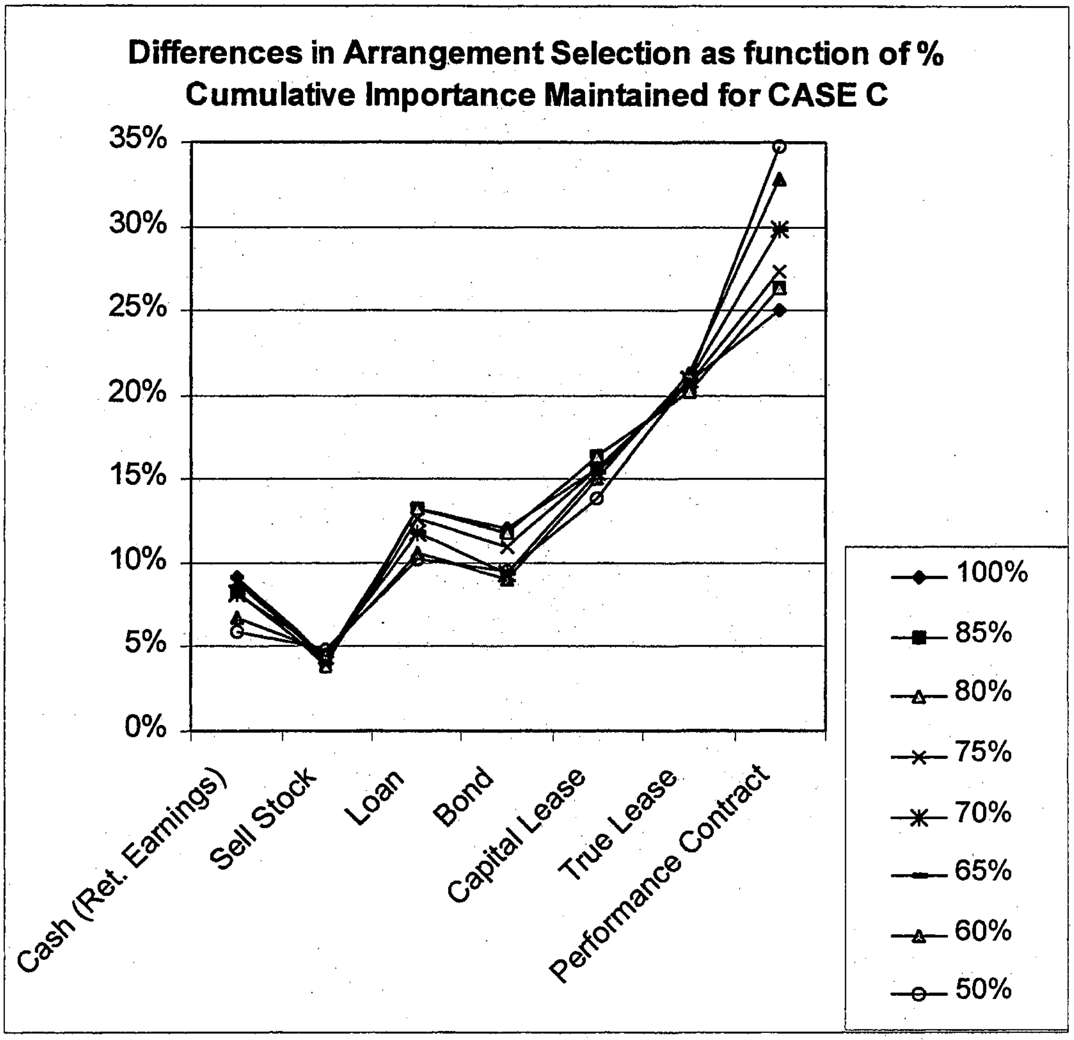

Figure IV-26 Case Arrangement Selection as a Function of Cumulative Importance Maintained

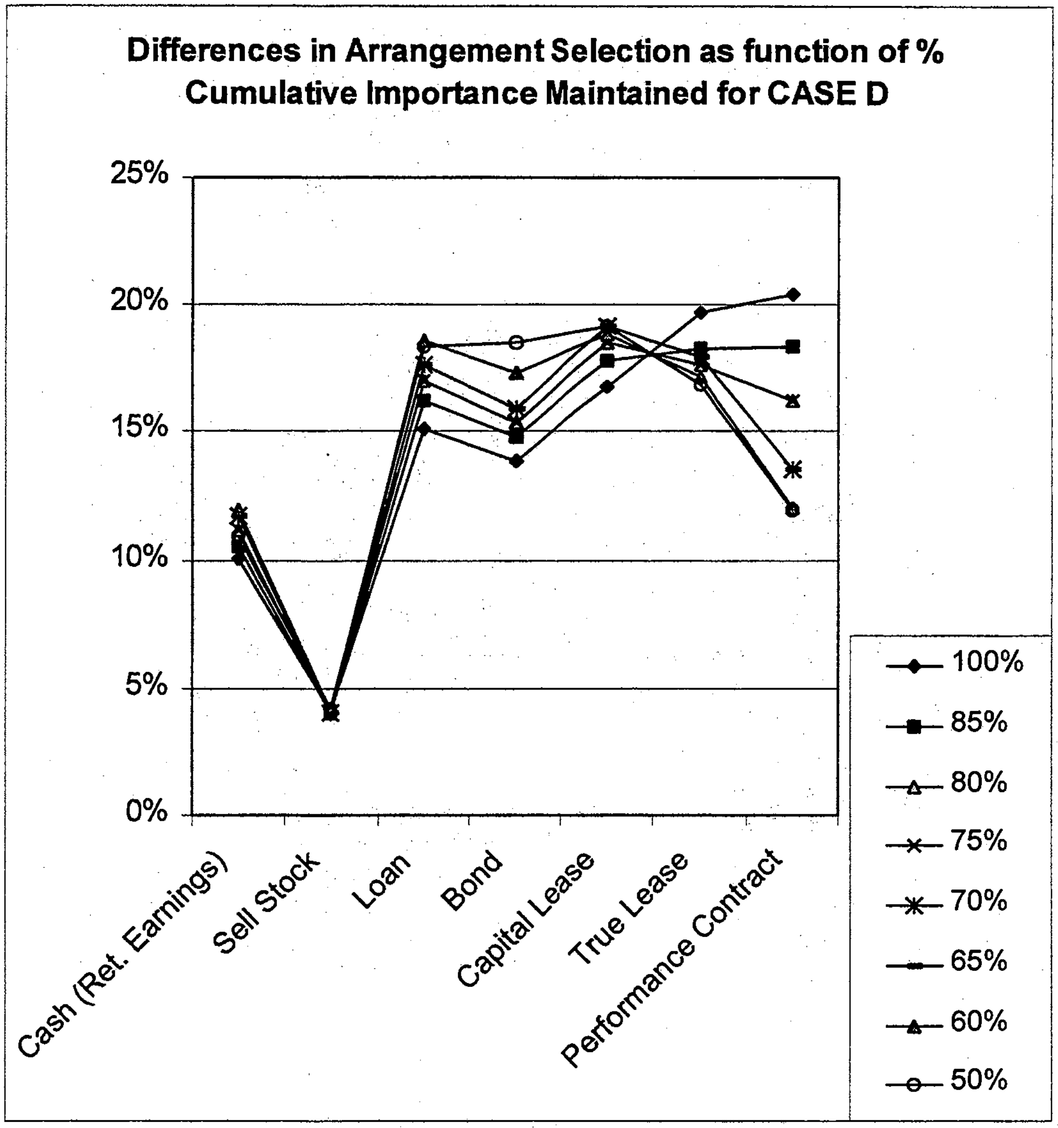

Figure IV-27 Case Arrangement Selection as a Function of Cumulative Importance Maintained

After examining all possible combinations, from maintaining 100% to 0% of the cumulative importance, it was found that maintaining 70% of the FM Group's cumulative importance produced a model that gave the closest arrangement selection to logically expected results. Maintaining 70% of the importance in all cases was chosen to become the final version of E-FUND. Table IV-28 shows arrangement selection with the final version of E-FUND.

Table IV-28 E-FUND Results (final version)

	Score in Each Case Study			
Financial Arrangements	**A**	**B**	**C**	**D**
Cash (Ret. Earnings)	7.7%	10.5%	8.2%	11.7%
Sell Stock	5.3%	6.5%	4.5%	4.0%
Loan	12.5%	16.0%	11.8%	17.7%
Bond	11.8%	14.2%	9.4%	15.9%
Capital Lease	13.0%	17.4%	15.4%	19.2%
True Lease	25.6%	17.3%	20.9%	18.0%
Performance Contract	24.1%	18.0%	29.8%	13.5%
Sums	100%	100%	100%	100%

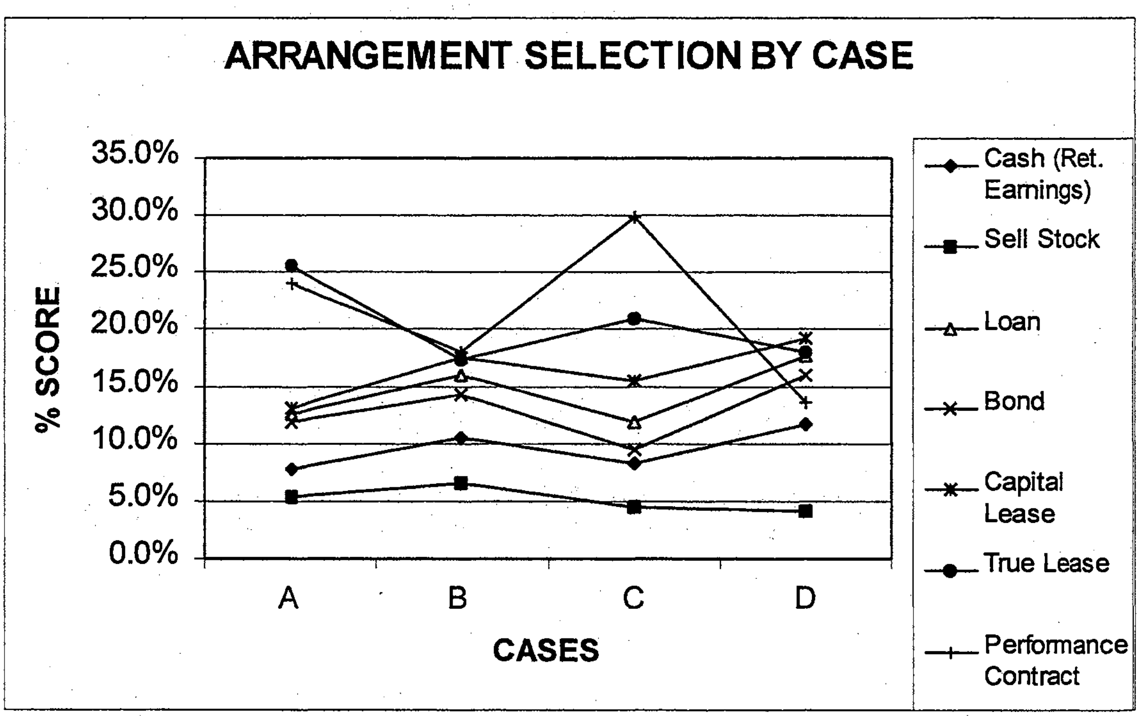

Figure IV-28 E-FUND Results (final version)

As Figure IV-28 shows, the model was much more responsive, increasing accuracy in Cases B and D, where host-managed arrangements should be selected. Thus, in Cases B and D, some of the performance contract-related objectives were scored low by the facility managers and eliminated. Although little improvement occurred in Case A, accuracy in Case C was improved because the performance contract arrangement had even greater dominance. Thus, in Case C, the facility managers ranked the non-performance contract-related objectives low, and they were eliminated.

4.4.9.3 The Alternative E-FUND Model

In an effort to further improve the final model, the importance of Objective #1 (NPV) was increased to 50% in all case studies. Although this study showed that both panelists and facility managers considered the importance of NPV to be much lower, 50% represents a more traditional evaluation and a possibility when avoiding the use of a nine-point Likert scale. The relative importance of the remaining objectives in each case were scaled down proportionately. Table IV-29 shows the before and after changes to the importance of objective #1 in each case study. In the table, the "importance" values are the local normalized priority weights from the primary goal to Objective #1.

Table IV-29 Objective #1 Importance in both Models

E-FUND		ALTERNATIVE E-FUND	
CASE A		CASE A	
Obj.	Importance	Obj.	Importance
1	19.9%	1	50.0%
2	15.2%	2	9.5%
3	16.5%	3	10.3%
4	0.0%	4	0.0%
5	14.7%	5	9.1%
6	0.0%	6	0.0%
7	17.8%	7	11.1%
8	16.0%	8	9.9%
9	0.0%	9	0.0%
10	0.0%	10	0.0%
CASE B		CASE B	
Obj.	Importance	Obj.	Importance
1	16.8%	1	50.0%
2	0.0%	2	0.0%
3	0.0%	3	0.0%
4	20.4%	4	12.2%
5	13.3%	5	8.0%
6	15.9%	6	9.5%
7	0.0%	7	0.0%
8	0.0%	8	0.0%
9	13.5%	9	8.0%
10	20.1%	10	12.2%
CASE C		CASE C	
Obj.	Importance	Obj.	Importance
1	0.0%	1	0.0%
2	21.9%	2	21.9%
3	17.9%	3	17.9%
4	14.4%	4	14.4%
5	14.3%	5	14.3%
6	0.0%	6	0.0%
7	0.0%	7	0.0%
8	17.1%	8	17.1%
9	0.0%	9	0.0%
10	14.4%	10	14.4%
CASE D		CASE D	
Obj.	Importance	Obj.	Importance
1	19.7%	1	50.0%
2	0.0%	2	0.0%
3	0.0%	3	0.0%
4	0.0%	4	0.0%
5	14.5%	5	8.7%
6	16.3%	6	9.8%
7	0.0%	7	0.0%
8	18.5%	8	12.0%
9	17.4%	9	11.1%
10	13.5%	10	8.4%

As Table IV-30 and Figure IV-29 show, the "Alternative E-FUND" model performed better at selecting the arrangement that was expected in each case.

Table IV-30 Alternative E-FUND Results (70% Importance Maintained with Adjusted Importance of Objective #1)

Financial Arrangements	Score in Each Case Study A	B	C	D
Cash (Ret. Earnings)	6.9%	9.4%	8.2%	12.3%
Sell Stock	6.3%	10.6%	4.5%	2.5%
Loan	15.0%	17.1%	11.8%	18.6%
Bond	16.4%	16.9%	9.4%	19.1%
Capital Lease	13.4%	17.3%	15.4%	19.2%
True Lease	26.2%	15.8%	20.9%	17.5%
Performance Contract	15.9%	12.9%	29.8%	10.9%
Sums	100%	100%	100%	100%

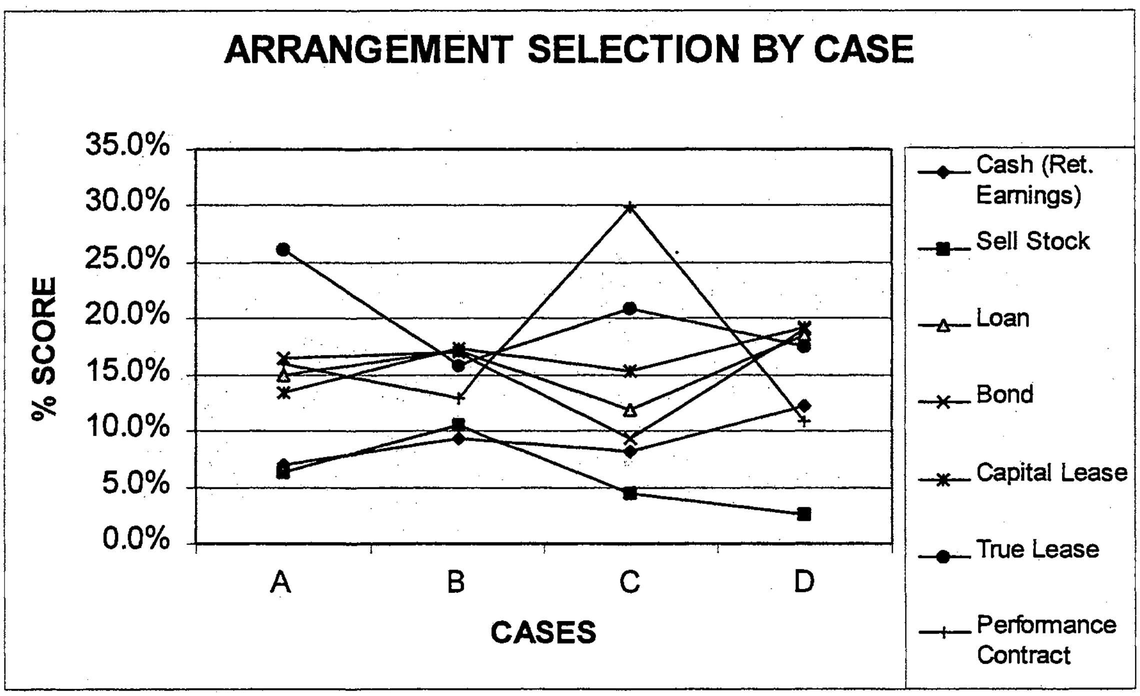

Figure IV-29 Alternative E-FUND Results (70% Importance Maintained with Adjusted Importance of Objective #1)

Although the true lease remained competitive in nearly all cases, the Alternative E-FUND model produced results that were closer to what was expected. In cases A and C, the logically expected arrangements clearly dominate.

Case C is especially interesting because the NPV for the bond was significantly higher than the other arrangements. Thus, when increasing the importance of the NPV, it is logical that the bond would obtain a higher score. However, because the facility managers scored the importance of NPV very low in this case study, objective #1 was eliminated when only 70% of the cumulative importance was maintained. Because the objective was eliminated, increasing its importance had no effect on the arrangement selection for Case C. This result is appropriate because in Case C, the government facility had no budget funds and limited maintenance staff; the only logically expected arrangement was the performance contract.

In cases B and D, where host-managed arrangements should be used, Alternative E-FUND did further reduce the dominance of the performance contract arrangement. However, arrangement selection was practically a "tie" between the loan, bond, capital lease and true lease. This could be due to the fact that the host-managed arrangements shared the participants' votes, which restrained any one arrangement from dominating. However, the fact that the true lease continued to score highly in all cases could indicate that it is an effective arrangement for a broad variety of applications.

E-FUND or Alternative E-FUND did not select selling stock in any of the case studies. This result is likely because all panelists and facility managers were unfamiliar and probably uncomfortable using that type of arrangement. In addition, no objectives were directly related to selling stock in the Cumulative List of Objectives. It could still be beneficial for companies that can manage a project internally, and can increase firm value by revising their capital structure.

Using cash (retained earnings) was not selected in any of the case studies by E-FUND or Alternative E-FUND. This result is likely because as a prerequisite for this model, the projects needed to be large enough such that the host needed financing. Also, the cash arrangement was disadvantaged because it did not allow tax-deductible payments. In addition, because the MARR was 20%, the opportunity cost of capital was much greater than the finance interest rates for most other arrangements.

4.4.10 Final Questionnaire

E-FUND's and Alternative E-FUND's arrangement selections for each case study were sent to the panel and the FM Group. The exact same case study descriptions used in the FM Group Survey (qualitative information) were also sent to both groups. Both groups were asked whether they felt the models selected the appropriate financial arrangement within each case study. Six panelists and five facility managers responded to the Final Questionnaire. The responses are summarized in Table IV-31.

Table IV-31 Participant Responses to the Final Questionnaire

	E-FUND's PERFORMANCE		ALTERNATIVE E-FUND's PERFORMANCE	
PARTICIPANT	Approved in these Cases	Disapproved in these Cases	Approved in these Cases	Disapproved in these Cases
P1	B,D	A,C	B,D	A,C
P2	A,B,C,D		A,B,C,D	
P3	A,B,C,D		A,C,D	B
P4	A,B,C,D		A,B,C,D	
P5	A,C,D	B	A,B,C,D	
P6	A,B,C,D		A,B,C,D	
FM2	A,B,C,D		A,B,C,D	
FM3	A,B,C,D		A,B,C,D	
FM7	A,B,C,D		A,B,C,D	
FM9	A,C,D	B	A,B,C,D	
FM10	A,B,C,D		A,B,C,D	

Although the majority of participants approved both E-FUND and the Alternative E-FUND models, the Alternative E-FUND model was more dynamic and responsive to the diverse test cases within this study.

Discussion about the Responses to the Final Questionnaire

Regarding performance with the case studies, both E-FUND and Alternative E-FUND received a high degree of approval from the participants. Some participants did have some comments regarding the performance of the models in specific case studies. These comments are discussed below.

In Case A, Panelist #2 (P2) and Facility Manager #10 (FM10) stated that the performance contract should not be chosen because the facility was not interested in outsourcing. FM10 also pointed this out in Case B. The participants' assessments were completely accurate. However, even with these comments, both participants approved E-FUND's performance, even though the performance contract had relatively high scores in Cases A and B.

In Case B, P5 and FM9 stated that the capital lease should have had a higher, more dominant score in the E-FUND model. Again, the participants' comments were accurate. Alternative E-FUND reduced the performance contract and true lease scores and increased the loan and bond scores. However the capital lease score remained constant. Despite this, both participants approved the Alternative E-FUND model. Perhaps they approved Alternative E-FUND because it scored the host-managed arrangements slightly higher.

In Case D, FM10 stated that E-FUND should have given the true lease a lower score, because it is unlikely that the lights would be returned to the lessor. This participant's assessment was completely accurate, however he still approved both models.

It is interesting that some participants made comments implying disapproval of a model's performance, yet still approved it. Perhaps the participants were too emotionally tied to the model to disapprove its performance. Another possibility is that the participants did not want to disappoint the research coordinator's expectations.

Identified Errors in the Research Design

There were a few additional participant comments from the Final Questionnaire that were used to identify errors in the design of the questionnaires.

In Case A, P3 stated, "the true lease should not be picked if the equipment was supposed to be sold at the end of year five." This is logical because equipment that is not purchased by the host can not be sold. The case description should have been worded "if the equipment is purchased, PizzaCo will sell it at the end of 5 years."

In Case A, P2 and FM10 stated that the performance contract should not be chosen because the facility was not interested in outsourcing. However, a similar argument could be made for the true lease, since it did contain a maintenance service agreement, which could be considered as "outsourcing". Although no participants made any comments, the case descriptions for cases A, B and D should have been worded, "PizzaCo is opposed to performance contracts". In addition, in Case A, the description should not have stated that "PizzaCo was opposed to using sub-contractors".

Discussion about Including Quantitative Information in the Case Descriptions

In Case A, P1 stated, "the case description does not say that the project will save energy." This panelist's comment was accurate because the case study descriptions did not include the annual cash flows for each arrangement. During the design of the FM Group Survey, the research coordinator did not include each arrangement's annual cash flows or NPV within the case descriptions. This was because this information was unrelated to the <u>importance</u> of the objectives, which is what the FM Group was asked to judge. In addition, if this quantitative information was included, the survey would have been about 30 pages longer, and there was concern whether increasing an already lengthy survey would decrease the response rate. However, if this quantitative information was supplied to the FM Group, their evaluation would have been more realistic, since they would have access to this information under normal conditions. Quantitative information could have helped the FM Group better evaluate which arrangements would satisfy a facility's requirements with respect to payback periods.

The lack of quantitative information may have influenced the facility manager's judgements with respect to the importance of Objective #1. *For example, a facility manager may have scored the importance of Objective # 1 higher if more information was provided about the facility's quantitative goals as well as the EMP's cash flows. Conversely, including this information might have reduced the score. To illustrate this point, consider that the facility managers were unaware that all EMPs within the case studies had positive NPVs, thus the facility managers were not sure if the EMP had exceeded the host's financial criteria. If they were supplied this information, it is likely that they would score Objective #1 lower due to the thought that the host's needs in this objective were already being met, and additional emphasis would have diminishing marginal returns.*

It should be noted that even if the arrangements' annual cash flows were included within each case study, the facility manager would not be able to effectively use this information until after E-FUND had scored each arrangement. *For example, in Case A, management was only interested in projects with a two-year simple payback period. Using the cash flow information, the facility manager could eliminate any arrangements that did not meet this* *qualification. However, if the facility manager wanted to score only the surviving arrangements, he/she would need to make modifications in the fixed components of E-FUND, (which includes priority weights for all arrangements). It would be much faster to the use E-FUND to score the arrangements, then eliminate any arrangements that do not meet management's qualifications.*

For an instant, it was thought that revealing annual cash flow information to the panelists would help them better assess how well each arrangement satisfied objectives #8 and #9. However the arrangements' annual cash flows were not included within Panel Questionnaire #2 Part B, because the panelists were making general judgements about how well each arrangement satisfied the objectives. These generalized judgements would become site-specific once cash flows from a particular project were considered. However, to ensure the panelists understood the basic features behind each arrangement type, the assumptions about the different arrangements were included in the questionnaire. These assumptions described the general features about the arrangements without addressing application to any specific case study. This information was intended to help the panelists evaluate how well each arrangement satisfied the objectives.

4.4.11 Producing a Users Guide to E-FUND

A complete E-FUND user's guide was developed based on the E-FUND model, and is included within Appendix C. The guide contains instructions on how to apply E-FUND, and how to alter the model to obtain the Alternative E-FUND model. The guide also explains the cumulative objective list as well as a short description of the financial arrangements.

4.4.12 The Development and Refinement of this Methodology Approach.

The methodology approach described in this chapter evolved through several refinements to an original idea. This section describes the major revisions to develop the final methodology.

Originally, the panel was going to develop priority weights from the primary goal to the default objectives. During application, the facility manager would judge the relationship between the default objectives and the financial arrangements. However, by having the panel judge the importance of the default objectives, the facility manager's influence on the outcome was significantly reduced. Under this scenario, the facility manager might not support the results from E-FUND. In addition, facility and project information would be best utilized to determine the importance of the default objectives to the primary goal, not the relation between the default objectives and alternatives.

The first major revision was to use the panel to develop the default objectives, but not to determine priority weights for these objectives. Since the facility manager is the expert on the facility, he/she is well suited to assess the impact of the particular EMP being installed. Thus, in the application phase, the facility manager would be given a set of default objectives, which he/she would weight. Thus, this revision would allow the facility manager to weight the entire hierarchy. However, this process represented a significant burden on the facility manager, and also made the model somewhat "generic".

A second revision was made to utilize the panel's expertise at identifying the relationships between the default objectives and the arrangements. This was logical because these experts understand the characteristics of each arrangement and how they would impact default objectives such as: "the desire to minimize the additional impact on maintenance as a result of implementing this EMP within this facility". Thus, the bottom half of the hierarchy (priority weights from the objectives to the arrangements) would be generalized and weighted by the panel. This revision resulted in the final version of this proposed methodology.

4.5 SUMMARY OF DATA ANALYSIS

The data collected in this study represent a significant contribution by the volunteer participants. There were three survey phases for the panelists and two survey phases for the FM Group. Out of the 43 separate surveys that were distributed to the combined pool of participants, 35 responses were recovered. Thus, this participant group attained an 81% response rate overall. Without their effort, none of the analysis in this chapter would have been possible.

Identification of Default Objectives for E-FUND

In Panel Questionnaire #1, the panelists edited the Trial List of Objectives and added three new objectives, which produced a Cumulative List of Objectives. In Panel Questionnaire #2 Part A, the panel ranked the importance of the objectives on the cumulative list. The goal was to identify and eliminate insignificant objectives, however the panelists had substantial differences of opinion regarding objective importance. Therefore, a Delphi procedure was used to help the panel reach consensus. After consensus was reached, the data indicated that all ten objectives were relatively important and needed to be included in the E-FUND model.

Panel Questionnaire #2 Part A also contained some interesting data. Surprisingly, as Table IV-6 shows, the panel's average weight regarding the importance of having a high economic benefit (at 15.1%) was not overwhelmingly dominant over the other objectives, which ranged from 7.3% to 11.5%. These results indicate that economic benefit may not be as important as traditionally thought.

The panelists' opinions also indirectly represent the opinions of the hosts that enter financing agreements with the panelists' companies. During conversations with several panelists, several panelists described, "their success was dependent on meeting the host's needs, and the distribution of importance between these objectives represents (in general) what the host wants." Although it should be noted that hosts are drawn to these panelists because they are experts in financing performance contracts and leases. Thus, the panelists may interact with hosts that represent only part of the population. As mentioned in Chapter II, most financiers are not attracted to small projects, (where host-managed arrangements are likely to dominate). Because most panelists structured financing for performance contracts and true leases, it was not surprising that most of the objectives were related to these two financial arrangements.

Determining the Relationship between the Default Objectives and the Financial Arrangements

Panel Questionnaire #2 Part B was used to determine the relationship between the default objectives and the financial arrangements. Specifically, the panelists were asked how well the arrangements satisfied the objectives. When compared to the responses from the previous questionnaire, the panelists had a greater degree of consensus on the original responses. Because most of the objectives were related to the performance contract or lease arrangements, these scored highly in nearly all responses. The responses from this questionnaire were used to develop the fixed components of E-FUND.

Testing E-FUND: The FM GROUP SURVEY

The population of facility managers (FM Group) applied E-FUND to four different case studies. Based on site specific EMP and facility information, each facility manager judged the relative importance of the default objectives in each case study.

The responses showed that facility managers did have a high degree of consensus on the importance of the objectives. The most important and least important objectives varied from case to case, which shows that the facility managers did understand and react to the priorities and needs of each case study.

Similar to the panelists, the facility managers did not score the importance of economic benefit substantially dominant over the other objectives. In fact, in only seven out of forty opportunities (17.5%) did a facility manager score objective #1 more important than any other objective. The FM Group's average response (regarding the importance of economic benefit) varied from 9% to 15%, depending on the case study. Combined with the responses from the panel (Panel Questionnaire #2, Part A) this data suggests that the importance of attaining a high economic benefit is not as important as traditionally believed.

E-FUND's Results

The responses from the facility manager survey were inserted into four E-FUND models, one for each case study. The NPV of each arrangement was also entered (via direct data entry) to determine the priority weights from Objective #1 to the financial arrangements in each model. The E-FUND models were synthesized, producing a score for each arrangement in the cases. Unfortunately, the initial version of E-FUND did not select the logically expected arrangement within each case; the performance contract and true lease scored abnormally high in all cases.

Model Analysis and Modification

The model was analyzed to identify why it was not performing as expected. A control experiment confirmed that the model (before application) naturally favored a performance contract in all cases, regardless of facility manager input.

Although score dispersion may have had a correcting effect on the model, it was slight when compared to the impact from the number of objectives related to the performance contract or true lease. Because there were so many of these objectives, the model was skewed. To improve the model's responsiveness, it was decided that some of the objectives would need to be removed.

Originally, the panel was supposed to identify and eliminate insignificant objectives via Panel Questionnaire #2 Part A. However, no objectives were determined insignificant (in general). Deviating from the original plan, it was decided that the facility managers' response would identify and eliminate objectives that were insignificant within each case study. Eliminating insignificant objectives at the application phase made sense, because E-FUND included a broad range of objectives to handle many different types of EMPs and facilities. Obviously, with such a broad-based objective list, some objectives would not apply in each case study. Thus, in each case, the objectives ranked low by the FM Group were eliminated, and the model was more responsive to the case studies. This modified model became the final version of E-FUND.

The final version of E-FUND did perform better at selecting the logically expected arrangement for each case. However, because it barely selected the logically expected arrangement in three out of the four case studies, further refinements are necessary before E-FUND could become commercially applicable.

Development of the Alternative E-FUND Model

In the interests of developing a more responsive model, the Alternative E-FUND model was developed. In Alternative E-FUND, the importance of the economic benefit was increased to 50%.

Alternative E-FUND did select the logically expected arrangement in all four cases, with clear arrangement domination in cases A and C. However, in cases B and D, arrangement selection was practically a "tie" between the loan, bond, capital lease and the true lease. As with E-FUND, this effect could be due to the fact that the host-managed arrangements shared the participants' votes, which restrained any one arrangement from dominating.

Validation of Performance for E-FUND and Alternative E-FUND

The panel and FM Group were asked whether they felt E-FUND and Alternative E-FUND selected the appropriate financial arrangement within each case study. The majority of respondents approved both models' performance.

Conclusion on E-FUND and Alternative E-FUND

The results indicate that E-FUND did select the logically expected arrangement for cases A, C and D. The Alternative E-FUND model increased the winning arrangement's dominance in cases A, C and D, and also selected the logically expected arrangement for case B. However, the data in this research clearly show that the true lease and performance contract were favored in most arrangements. This effect could indicate that the model development was biased because:

1. there were too many host-managed arrangements, which shared the participant's votes, making it difficult for one to dominate.

2. there were too many objectives related to the performance contract or true lease. *Although this impact was partly mitigated by maintaining only 70% of the cumulative importance.*

Conversely, the results could indicate that the true lease and performance contract best satisfied the needs of the facility manager. Supporting this theory is the surprising fact that both participant groups in this study did not score the importance of objective #1 (the importance of having a high economic benefit) as overwhelmingly dominant. Thus, the other objectives (which relate to performance contracts and leases) may represent significant desires for the facility manager. Although it should be noted that the limited amount of quantitative information may have influenced the participants' scores with respect to Objective #1.

In conclusion, there are numerous site-specific factors that affect the selection of financial arrangements for energy management projects. These factors include facility, project and financial arrangement characteristics. Perhaps the numerous combinations cannot be generalized within a model, and this is why experts are needed to assess and satisfy the needs of individual facilities. However, this research represents a "first step" to a better understanding of how these complex relationships interact. E-FUND and Alternative E-FUND are evidence of progress.

The research coordinator learned a great deal about financing for EMPs through this research effort. In general, this research yielded many interesting points. Although a few errors in research design were identified, these were unpredictable and unavoidable. Chapter VI contains recommendations that would be helpful for future research efforts.

V. CONCLUSION

This research process as described in Chapter IV, has helped the author better understand financial arrangement selection for EMPs. The data collected represent a significant contribution by the volunteer participants, and their efforts are extremely appreciated. From their responses and performance of the models, a discussion of the possible implications is presented below.

Perhaps the most surprising finding from this research was that both participant groups scored the importance of Objective #1 (having a high economic benefit) as not overwhelmingly dominant over the other (qualitative) objectives. This fact significantly contradicts traditional engineering economic theory; that quantitative evaluation is most important. Although the exact reason for the participants' judgements is unknown, a few possible theories are presented below.

Recall that during the FM Group Survey, only 17.5% of the time did a facility manager score Objective #1 more important than any other objective. In addition, when

Objective #1 was scored higher, most facility managers did not indicate that it was overwhelmingly higher. If these judgements are accurate and truly represent the beliefs of facility managers, then perhaps economic benefits are not as important as traditionally believed and taught. This would be a startling fact if proven true.

Another implication could be that EMPs are not seen as typical profit-enhancing projects; which are evaluated based on their NPV, return on investment or simple payback period. Perhaps the facility manager's perspective is that EMPs are necessary projects (like overhead expenses) that should be implemented with minimal effort, investment and distraction from a company's core business goals. This is interesting since recent research has shown that stockholders consider EMPs as profit-enhancing projects, and after such projects are announced, a host's stock price can increase abnormally [Wingender and Woodroof, 1997]. Thus, additional research could provide greater insight on how EMPs are perceived, either as profit-enhancing projects or as overhead expenses, (or other perspectives). Perhaps additional research will identify how EMPs should be perceived to maximize value to the host.

If facility managers desire to reduce investment and attention towards EMPs, the true lease and performance contract may best satisfy the facility manager's needs because these arrangements usually offer maintenance agreements and/or minimal investment and/or project management. In essence, the true lease and performance contract embody the basic elements of "outsourcing" or "sub-contracting", which appear to be attractive to facility managers at this time. The panelists also established the performance contract and true lease as the arrangements that satisfy the greatest percent of the objectives. *Recall that the panelists indirectly represent many facility managers.* These finding could indicate an industry mega-trend to outsource any non-core-related business function.

Based on the judgements from both participant groups, the true lease and performance contract scored relatively high when the E-FUND model was applied to the case studies in this research. However, it should be noted that the results of this research could be biased due to model development and survey design. These issues and mitigation efforts are described in Chapter IV.

Although the meaning of the results is not completely clear, the implications are interesting, and worth further investigation. Recommendations on such future endeavors are discussed in Chapter VI. In addition to the results from Chapter IV, this dissertation produced many contributions to the energy management field.

First, Chapter II introduced and explained the primary financial arrangements available for EMPs. Woodroof [1998] published chapter II and presented it at an international conference on energy management [1997a]. Presentations of this chapter have also been made to graduate students at Oklahoma State University and to local professional organizations in Oklahoma.

Second, a panel of financiers from the energy management field helped develop a list of key objectives that a facility manager should consider when selecting a financial arrangement for an EMP. This list of objectives is broad-based, allowing it to be applied to many different EMPs and facility types. Because the facility managers informed the research coordinator that the list of objectives helped them better understand the financial arrangements, the list has already proven to be an educational asset. The variance in judgements from participants' provided some insight about how strongly certain objectives are perceived as "important".

Third, an EMP financing decision support system (E-FUND) was developed to assist the facility manager in identifying the most appropriate arrangement(s) to use for a particular EMP within a specific facility. E-FUND represents a new application of the Analytic Hierarchy Process, which is used for multiple criteria decision making. E-FUND lets the facility manager customize the list of objectives to account for site-specific conditions in order to match the needs of the facility.

E-FUND offers unique benefits that exceed the services offered by existing government programs. Specifically, E-FUND helps the facility manager select the best arrangement based on quantitative and qualitative information, rather than simply evaluating the monetary value of different financial arrangements. E-FUND expands the traditional lease/buy analysis by incorporating arrangements common to energy management projects, such as performance contracting. For additional discussion of E-FUND's performance, refer to Chapter IV.

The development of the list of objectives and E-FUND will help educate facility managers about financial arrangements for EMPs. Hopefully this result will lead to greater application of such arrangements to implement EMPs that would not have been implemented.

VI. RECOMMENDATIONS FOR FURTHER RESEARCH

The final objective for this research was to identify potential areas for future research on this topic and on modeling the selection of financial arrangements for energy management projects. These recommendations are presented below.

As described in Chapter IV, the importance of Objective #1 (having a high economic benefit) was not considered overwhelmingly dominant by both participant groups. It would be of great value if future research could verify these results and identify why Objective #1 was not considered extremely important, (as has been traditionally believed). In addition, it would be interesting to explore how facility managers perceive EMPs; as profit-enhancing opportunities, or as overhead expenses.

Due to the fact that the true lease and performance contract attained relatively high scores in the E-FUND model, it would be interesting to determine whether these arrangements better satisfy the facility manager's needs. Additional research could verify whether these arrangements are the best for most EMPs, or any non-core-related business process. In addition, testing in more case studies would also help determine if the true lease and performance contract truly dominate the EMP market.

To verify the results of this research, a future model could incorporate the following improvements to E-FUND. These improvements may reduce bias and/or produce results that have a dominant winning arrangement within each case study.

- From E-FUND and Alternative E-FUNDs' arrangement selection it is clear that there were too many "host-managed" arrangements. These arrangements shared participant votes, which kept any from achieving dominance in objectives. In future models, it may be more effective to group these arrangements under one title: "host-managed arrangements". With this approach, the facility manager would embark on a two-step decision process. First, E-FUND could be used to score the host-managed arrangements along with the true lease and the performance contract. Then, if the "host-managed arrangements" were selected, the facility manager would then determine which particular arrangement (cash, loan, bond, selling stock, or capital lease) is best for the specific application.

- A future model could utilize a different decision support system, or an artificial intelligence system, or an expert system. However, such systems should incorporate site-specific EMP and facility factors. In addition, the facility manager should be able to provide input into the model. As was evident in the case studies, site-specific conditions can have a substantial impact on the results.

- If future studies utilize a panel of experts, it would be beneficial to obtain an equal number of panelists that specialize in financing for a specific arrangement. It is hoped that this practice would result in a better-balanced list of objectives, reducing the pre-application advantage that the performance contract and true lease had with E-FUND. It may also be helpful to use a larger pool of panelists. Responses from the panelists could be stratified to determine if industry preferences exist. A similar research approach and analyses would be useful for the facility manager group.

- In the facility manager survey, it would be more realistic to include annual cash flow and NPV information for each arrangement within the case study descriptions.

If possible, testing a model in additional case studies could provide more conclusive results.

- Perhaps the score dispersion issue can be minimized by using a Likert scale with a larger range, or one that includes "0" as a potential judgement. This would allow the participants to eliminate relationships or criteria by putting a "0" as a judgement. This would allow objectives or alternatives to achieve a higher dominance.

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Wood, G. (1994) "Funding Options help Facility Managers Launch New Energy Projects", *Energy User News*, 19(4), Special Report: Project Finance, p.21.

Saaty, T. and Alexander, J., (1981), Thinking with Models, Pergamon Press, New York, p. 152.

APPENDIX A

QUESTIONNAIRES FOR PARTICIPANTS

PANEL QUESTIONNAIRE #1

To: Expert Panelists

From: Eric A. Woodroof

Date: March 12, 1998

Re: Overview and Questionnaire #1

I sincerely appreciate your willingness to serve as a panelist in this research effort. My goal is to develop E-FUND/s, a decision support system that will help facility managers select the best financial arrangements for energy management projects (EMPs). For your contribution, you will receive a plaque acknowledging your participation as an expert panelist. If you wish, I will also list you as a co-author, if I can publish this research with the Association of Energy Engineers. Your total time commitment should be about 3 hours, spread out over a one-month period.

OVERVIEW OF PANELIST DUTIES

The panel will determine which financial arrangements best satisfy a set of objectives relating to financing energy management projects. As a panelist, you will be asked to answer four questionnaires. The goal of the first questionnaire is to compile a list of *qualitative* objectives that a facility manager should consider when selecting a financial arrangement for an energy management project. The second questionnaire will ask you to prioritize the importance of these objectives. In the third questionnaire, you will determine how well each financial arrangement (loan, bond, lease, performance contract, etc.), satisfies the most important objectives.

I am hoping that questionnaires #1 and #2 are completed quickly, so that the panel can spend most of its time on questionnaire #3. Once we have defined which financial arrangements best satisfy each objective, E-FUND/s will be ready for application. To apply E-FUND/s, a facility manager will simply weight the importance of the objectives as they relate to a particular project in a particular facility. Based on the facility manager's input as well as the panel's work, E-FUND/s will indicate which financial arrangement is best.

A separate population of facility managers will test E-FUND/s in four case studies. After E-FUND/s has been tested, I will send the results to the panel. In a final questionnaire, each panelist will vote on whether E-FUND/s selected the appropriate arrangement for each case study type.

Thanks again for agreeing to be a panelist. This will require some of your time, but your input will have a positive effect on the energy management industry. When we are finished, I will send you the results and show you how you can use E-FUND/s to help your clients pick the best financial arrangements for their energy management projects.

Questionnaire #1 is on the following page. It may look long, but I am only asking you to add some objectives if you feel necessary. Please return your responses within seven days.

E-mail: eaw@okstate.edu
or
Via Fax: 405-744-4654 *Please use the attached cover sheet*

PANEL QUESTIONNAIRE #1

Please answer the following question and return this form to me. You may answer electronically, or simply "fill in the blanks" with a pen and fax back to me. *Note that all panelists' responses will be associated with a panelist number, to maintain anonymity.*

QUESTION # 1: Please read the Trial List of Objectives (from the host facility's perspective). This list is supposed to encompass the objectives that a facility manager should consider when selecting a financial arrangement to implement an EMP in a typical facility. If you feel this list is incomplete, please add any objectives you think are missing. Please also include a brief explanation of each objective you add. *Note that all economic considerations are included in the "Net Present Value" objective.* If you have any questions regarding the objectives, please call me at (405) 744-9146.

TRIAL LIST OF OBJECTIVES	EXPLANATION / EXAMPLE
To have a high economic benefit (high Net Present Value, or short Payback Period)	Facility managers often select projects with a short Payback Period, or projects with a high Net Present Value. *The NPV of each arrangement incorporates all quantitative factors; such as the finance rate assigned by the lender, the timing and amount of the cash flows, as well as the additional costs (administrative, maintenance, legal) required by a certain EMP under a particular arrangement.* Thus, the NPV of each arrangement is the cumulative assessment of all quantitative objectives relating to installing the EMP in a particular facility, using a particular financial arrangement.
To have a guaranteed savings contract, where the project's costs are "paid from savings"	A guaranteed amount of savings (as offered by a performance contract) can reduce the host's risk if the EMP is technically or financially challenging. "Paid from Savings" contracts require no up-front investment, allowing the host to preserve in-house funds for other company purposes.
To minimize the additional impact on the maintenance and energy management teams	Based on the EMP's complexity and the host's in-house resources, the maintenance and energy management teams may need to devote attention that should be focused elsewhere (i.e. implementing other profit improvement measures). However, if the financial arrangement provides maintenance and technical services, the in-house resources can focus their attention on other tasks.
To minimize the additional impact on the administration or upper-level management	Based on the complexity of contracts and interaction with external parties (lawyers, lenders, etc.), the host's administrative and upper-level personnel may need to devote attention that should be focused elsewhere, such as on core business goals.

To minimize contractual restraints, in case operations change significantly	A performance contract can require the host to operate a minimum number of hours per year, thereby restricting the host's ability to change operations and react to unforeseen circumstances.
To increase equity capital	This criterion relates to the host's desire to sell stock to finance the EMP. Selling stock can help the host achieve its target capital structure, thereby maximizing firm value.
The strategic desire to use off-balance sheet financing	Off-balance sheet financing (as with a True Lease) allows the host to keep project liabilities off the balance sheet to retain a stronger financial image.

ADDITIONAL OBJECTIVES	EXPLANATION / EXAMPLE

acsimile Transmittal

To: Eric A. Woodroof
Industrial Engineering and Management
322 Engineering North
Stillwater, OK 74078

Fax: (405) 744-4654

From:

Date:

Re: SURVEY RESPONSE

Pages:

PANEL QUESTIONNAIRE #2

To: Expert Panelists

From: Eric A. Woodroof

Date: April 1st, 1998

Re: Questionnaire #2

Thanks for your feedback on Questionnaire #1. There were many excellent comments and I have refined my list of objectives to incorporate the panel's input. In this questionnaire, we will prioritize the Cumulative List of Objectives and determine how well each financial arrangement satisfies them.

PLEASE RESPOND BY APRIL 9TH. It will probably be easiest for you to print this questionnaire, "fill in the blanks" with a pen, and fax the Score Sheets back to me. If all goes well, E-FUND will then be complete and will be tested by a group of facility managers. You will only be asked to respond to one more questionnaire; I will show you the test results, and ask you to vote on whether E-FUND selected the most appropriate arrangement.

The Cumulative List of Objectives is on the next page. You will need to refer to it throughout this questionnaire.
Thanks for all your efforts. After this questionnaire, we are almost done!

Sincerely,

Eric A. Woodroof
Project Coordinator
Industrial Assessment Center
phone: (405) 744-9146

#	CUMULATIVE LIST OF OBJECTIVES	EXPLANATIONS/ EXAMPLES
1	To have a high economic benefit (High Net Present Value, or Short Payback Period).	Facility managers often select projects with a short Payback Period, or projects with a high Net Present Value. *The NPV of each arrangement incorporates all quantitative factors; such as the finance rate assigned by the lender, the timing and amount of the cash flows, as well as the additional costs (administrative, maintenance, legal) required by a certain EMP under a particular arrangement.* Thus, the NPV of each arrangement is the cumulative assessment of all quantitative objectives relating to installing the EMP in a particular facility, using a particular financial arrangement.
2	To reduce the host's risk by using a guaranteed savings performance contract, where the host makes no initial investment, and the project's costs are "paid from savings".	In this case, an Energy Service Company installs and operates the equipment. The ESCO shares the savings with the host, which encourages both parties to maximize savings, and look out for each other. A guaranteed amount of savings (as offered by a performance contract) can reduce the host's risk if the EMP is technically or financially challenging. "Paid from savings" contracts require no up-front investment, allowing the host to preserve in-house funds for other company purposes.
3	To minimize the additional impact on the maintenance and energy management teams. or To compliment maintenance goals and improve effectiveness.	Based on the EMP's complexity and the host's in-house expertise, the host's maintenance and energy management teams may need to devote attention that should be focused elsewhere (i.e. implementing other profit improvement measures). However, if the financial arrangement (such as a performance contract) provides maintenance and technical services or improves maintenance effectiveness, the in-house resources can focus their attention on core business goals.
4	To use a comprehensive, "system-wide" approach to maximize the replacement of outdated equipment.	Performance Contracts can be "bundled" to include other services and projects, creating a larger, more comprehensive package. This is the opposite of "cream skimming." For example, a lighting retrofit may be "bundled" with a chiller retrofit to obtain additional "system-wide" benefits.
5	To have an "easy to understand" agreement that minimizes the impact on the host's administrative personnel.	A simple agreement can "stand by itself" (no matter who is interpreting it) and minimize the potential for litigation in the future. Complex contracts may require the host's administrative personnel to devote attention that should be focused on achieving core business goals.
6	To minimize contractual restraints, so the facility manager has greater flexibility and control over the project.	A performance contract can require the host to operate a minimum number of hours per year, thereby restricting the host's ability to change operations and react to unforeseen circumstances. In addition, contracts may restrict the facility manager's ability to specify equipment, use specific vendors or obtain other preferences.

7	To protect the host's financial image by using off-balance sheet financing and avoid using collateral that could be spared to support future financing.	If available, "off-balance sheet" financing, as with a True Lease (a rental agreement), allows the host to use the equipment without purchasing it. This keeps project liabilities off the balance sheet, allowing the host to retain a stronger financial image. Minimizing the amount of collateral (on Uniform Commercial Code filings) improves the host's ability to obtain future financing.
8	To structure an arrangement such that annual savings are always greater than annual payments. Thus, the project only has positive cash flows.	If the maximum payment is set equal to the minimum savings estimate, the project should have only positive cash flows, (provided the equipment will last long enough to pay itself off). In the event of unforeseen or periodic project expenses, an agreement with adjustable payments can be used to eliminate annual profit shortfalls. In such a case, the agreement could be changed so the host makes smaller payments for a longer time period.
9	To secure fixed interest rate financing for the length of the project.	If possible, securing fixed interest rate financing would reduce risk relating to interest rate fluctuation. This can be helpful when financing the construction and operational phases of the project.
10	To be able to easily expand the scope of the arrangement.	Certain arrangements permit either party to suggest improvements that can be added easily to the scope of work. Also in certain financial arrangements, it is easy to acquire additional financing with minimal paperwork.

PART A: PRIORITIZING THE OBJECTIVES

The goal is to identify which objectives are most important. With your experience in financing energy management projects (EMPs), please answer the following questions.

Question: On a scale of 1 to 9, score the importance of each objective (as applied to most EMPs in most facilities). A rating of 9 indicates that the objective is very important. Please refer to the Cumulative List of Objectives and enter your answers beneath the "Scores of Importance" column. Remember that these are the objectives a facility manager should consider when selecting a financial arrangement for an EMP.

EXAMPLE

The example scores are provided only to show you where to put your answers.
Please think carefully about your own answer to each objective.

Unimportant : 1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : Very Important

EXAMPLE SCORE SHEET

Objective #	*Score of Importance*
1	*9*
2	*6*
3	*3*
4	*4*
5	*3*
6	*1*
7	*3*
8	*4*
9	*2*
10	*3*

ACTUAL SCORE SHEET FOR PART A

Question: On a scale of 1 to 9, score the importance of each objective (as applied to most EMPs in most facilities). A rating of 9 indicates that the objective is very important. Please refer to the Cumulative List of Objectives. Remember that these are the objectives a facility manager should consider when selecting a financial arrangement for an EMP.

Unimportant : 1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : Very Important

Objective #	Score of Importance
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

PART B: DETERMINING HOW WELL EACH FINANCIAL ARRANGEMENT SATISFIES EACH OBJECTIVE

The goal is to identify how well each financial arrangement satisfies each objective.

To allow this model to work, I have made some assumptions. First, we are assuming the facility manager already wants to implement the project, and is seeking the best financing arrangement to do so. Obviously, any assumption will not always be true, but the assumptions below allow us to distinguish the different financial arrangements. In the complete E-FUND model, the facility manager will be able to insert his/her own financial arrangements. Please "bear with me" on these assumptions, so we can test the model.

Assumptions to Differentiate the Basic Financial Arrangements

<u>Purchase with Cash, Loan, Bond, Selling Stock or a Capital lease</u>

- All of these arrangements assume that the host manages the EMP.
- The Net Present Value of each arrangement will be different due to differences in the cost of capital, tax treatment, and cash flow timing. The differences in NPV will distinguish these arrangements.
- The Capital Lease is treated as an installment loan.
- With Selling Stock, the host is expected to pay periodic dividends to shareholders.

<u>True Lease or Operating Lease</u>

- This is an "off-balance sheet" arrangement, and the host avoids adding liabilities or putting up collateral.
- This lease is essentially a rental agreement. The host is "lessee" and although unlikely for large EMPs, does not automatically take ownership of the equipment at the end of the contract. However, the host can purchase the equipment for fair market value at the end of the contract.
- Assume that a maintenance service agreement is included in the lease so that the impact on the host's maintenance team is minimal.

<u>Performance Contract</u>

- An Energy Service Company manages the EMP. The ESCO supplies installation, management and maintenance services for the project, thereby minimizing impact on the host's maintenance and energy management teams.
- Assumes the ESCO offers a guaranteed savings performance contract. The ESCO and the facility share any savings that exceed the guaranteed amount. The contract requires the host to operate a minimum number of operating hours per year.
- The host makes no initial investment (the project is "paid from savings")
- The performance contract will require the host's administrative personnel to become more involved (due to more extensive contracts) than with the other agreements.
- The host takes ownership of the equipment at the end of the contract.
- The contract may provide a more comprehensive system-wide approach, which could obtain greater savings with additional equipment installation, or complimentary improvements.
- Assume the ESCO has an excellent reputation and is financially strong.

OK, now lets get started! I've included some examples to help you get started.
Question: On a scale of 1 to 9, score how well each financial arrangement satisfies each objective. If you think a financial arrangement does not at all satisfy the objective, a score of "1" would be appropriate. If you think a financial arrangement completely satisfies the objective, a score of "9" would be appropriate. If you are unsure about how well a financial arrangement satisfies an objective, refer to the assumptions for each financial arrangement. If you are still unsure, leave that space blank.

EXAMPLE # 1
The example scores are provided only to show you where to put your answers.
Please think carefully about your own answers.

OBJECTIVE # 2

Arrangement does not satisfy Objective:1:2:3:4:5:6:7:8:9:Arrangement strongly satisfies Objective

__1__ *Use Cash on Hand (Retained Earnings)*

__1__ *Sell Stock*

__1__ *Loan*

__1__ *Bond*

__1__ *Capital Lease*

__1__ *True Lease*

__9__ *Performance Contract*

EXAMPLE # 2
The example scores are provided only to show you where to put your answers.
Please think carefully about your own answers.

OBJECTIVE # 5

Arrangement does not satisfy Objective:1:2:3:4:5:6:7:8:9:Arrangement strongly satisfies Objective

__9__ *Use Cash on Hand (Retained Earnings)*

__1__ *Sell Stock*

__6__ *Loan*

__6__ *Bond*

__6__ *Capital Lease*

__7__ *True Lease*

__2__ *Performance Contract*

ACTUAL SCORE SHEET FOR PART B

OBJECTIVE # 1:

The NPV of each arrangement will determine how well it satisfies this objective. Thus, proceed to Objective #2.

OBJECTIVE # 2

Arrangement does not satisfy Objective:1:2:3:4:5:6:7:8:9:Arrangement strongly satisfies Objective

_____*Use Cash on Hand (Retained Earnings)*
_____*Sell Stock*
_____*Loan*
_____*Bond*
_____*Capital Lease*
_____*True Lease*
_____*Performance Contract*

OBJECTIVE # 3

Arrangement does not satisfy Objective:1:2:3:4:5:6:7:8:9:Arrangement strongly satisfies Objective

_____*Use Cash on Hand (Retained Earnings)*
_____*Sell Stock*
_____*Loan*
_____*Bond*
_____*Capital Lease*
_____*True Lease*
_____*Performance Contract*

ACTUAL SCORE SHEET FOR PART B

OBJECTIVE # 4

Arrangement does not satisfy Objective:1:2:3:4:5:6:7:8:9:Arrangement strongly satisfies Objective

_____*Use Cash on Hand (Retained Earnings)*
_____*Sell Stock*
_____*Loan*
_____*Bond*
_____*Capital Lease*
_____*True Lease*
_____*Performance Contract*

OBJECTIVE # 5

Arrangement does not satisfy Objective:1:2:3:4:5:6:7:8:9:Arrangement strongly satisfies Objective

_____*Use Cash on Hand (Retained Earnings)*
_____*Sell Stock*
_____*Loan*
_____*Bond*
_____*Capital Lease*
_____*True Lease*
_____*Performance Contract*

ACTUAL SCORE SHEET FOR PART B

OBJECTIVE # 6

Arrangement does not satisfy Objective:1:2:3:4:5:6:7:8:9:Arrangement strongly satisfies Objective

_____*Use Cash on Hand (Retained Earnings)*
_____*Sell Stock*
_____*Loan*
_____*Bond*
_____*Capital Lease*
_____*True Lease*
_____*Performance Contract*

OBJECTIVE # 7

Arrangement does not satisfy Objective:1:2:3:4:5:6:7:8:9:Arrangement strongly satisfies Objective

_____*Use Cash on Hand (Retained Earnings)*
_____*Sell Stock*
_____*Loan*
_____*Bond*
_____*Capital Lease*
_____*True Lease*
_____*Performance Contract*

ACTUAL SCORE SHEET FOR PART B

OBJECTIVE # 8

Arrangement does not satisfy Objective:1:2:3:4:5:6:7:8:9:Arrangement strongly satisfies Objective

_____*Use Cash on Hand (Retained Earnings)*
_____*Sell Stock*
_____*Loan*
_____*Bond*
_____*Capital Lease*
_____*True Lease*
_____*Performance Contract*

OBJECTIVE # 9

Arrangement does not satisfy Objective:1:2:3:4:5:6:7:8:9:Arrangement strongly satisfies Objective

_____*Use Cash on Hand (Retained Earnings)*
_____*Sell Stock*
_____*Loan*
_____*Bond*
_____*Capital Lease*
_____*True Lease*
_____*Performance Contract*

ACTUAL SCORE SHEET FOR PART B

OBJECTIVE # 10

Arrangement does not satisfy Objective:1:2:3:4:5:6:7:8:9:Arrangement strongly satisfies Objective

_____*Use Cash on Hand (Retained Earnings)*
_____*Sell Stock*
_____*Loan*
_____*Bond*
_____*Capital Lease*
_____*True Lease*
_____*Performance Contract*

Facsimile Transmittal

To: Eric A. Woodroof
Industrial Engineering and Management
322 Engineering North
Stillwater, OK 74078

Fax: (405) 744-4654

From:

Date:

Phone:

Re: SURVEY RESPONSE

Pages

THE FM GROUP SURVEY

To: Facility Management Experts

From: Eric A. Woodroof

Date: 4/1/98

Re: OSU Research Survey

Thank you for participating in this OSU research survey. As you know, there are many ways to finance energy management projects, (loans, bonds, leases, performance contracts, etc.). Each financial arrangement has its own set of "pros" and "cons" that effect the true value added to the company. Through your responses in this survey, we will determine which financial arrangements best meet the needs of particular projects in specific facilities. Ultimately, your input will be used to test E-FUND/s, a decision support system that helps facility managers select the best financial arrangements for energy management projects. All correspondence will be done via e-mail and/or facsimile. Your total time commitment should be less than 2 hours.

The Cumulative List of Objectives is on the next page. You will need to refer to it throughout this survey. You may also want to look at Appendix A on page 11, which contains a description and list of assumptions for the different types of financial arrangements used in this model. The actual survey starts on page 4.

PLEASE FAX YOUR RESPONSE TO ME BY APRIL 9, 1998. It will probably be easiest for you to "fill in the blanks" with a pen, and fax the Score Sheets and Final Question back to me. THANKS!!!

After you send your response to me, I will send you the results, which will indicate which arrangement E-FUND/s picked based on your input. I will also show you how to use this information to pick the best financial arrangements for your future energy management projects. In addition, I will present a certificate to you, recognizing your contribution to this research.

Thanks for all your help,

Eric A. Woodroof
Project Coordinator
Oklahoma Industrial Assessment Center
phone: (405) 744-9146

The Cumulative List of Objectives below is supposed to encompass the objectives that a facility manager should consider when selecting a financial arrangement for an energy management project (EMP) in a typical facility. *Note that all economic considerations are included in the "Net Present Value" objective.*

#	CUMULATIVE LIST OF OBJECTIVES	EXPLANATIONS/ EXAMPLES
1	To have a high economic benefit (High Net Present Value, or Short Payback Period).	Facility managers often select projects with a short Payback Period, or projects with a high Net Present Value. *The NPV of each arrangement incorporates all quantitative factors; such as the finance rate assigned by the lender, the timing and amount of the cash flows, as well as the additional costs (administrative, maintenance, legal) required by a certain EMP under a particular arrangement.* Thus, the NPV of each arrangement is the cumulative assessment of all quantitative objectives relating to installing the EMP in a particular facility, using a particular financial arrangement.
2	To reduce the host's risk by using a guaranteed savings performance contract, where the host makes no initial investment, and the project's costs are "paid from savings".	In this case, an Energy Service Company installs and operates the equipment. The ESCO shares the savings with the host, which encourages both parties to maximize savings, and look out for each other. A guaranteed amount of savings (as offered by a performance contract) can reduce the host's risk if the EMP is technically or financially challenging. "Paid from savings" contracts require no up-front investment, allowing the host to preserve in-house funds for other company purposes.
3	To minimize the additional impact on the maintenance and energy management teams. or To compliment maintenance goals and improve effectiveness.	Based on the EMP's complexity and the host's in-house expertise, the host's maintenance and energy management teams may need to devote attention that should be focused elsewhere (i.e. implementing other profit improvement measures). However, if the financial arrangement (such as a performance contract) provides maintenance and technical services or improves maintenance effectiveness, the in-house resources can focus their attention on core business goals.
4	To use a comprehensive, "system-wide" approach to maximize the replacement of outdated equipment.	Performance Contracts can be "bundled" to include other services and projects, creating a larger, more comprehensive package. This is the opposite of "cream skimming." For example, a lighting retrofit may be "bundled" with a chiller retrofit to obtain additional "system-wide" benefits.
5	To have an "easy to understand" agreement that minimizes the impact on the host's administrative personnel.	A simple agreement can "stand by itself" (no matter who is interpreting it) and minimize the potential for litigation in the future. Complex contracts may require the host's administrative personnel to devote attention that should be focused on achieving core business goals.

6	To minimize contractual restraints, so the facility manager has greater flexibility and control over the project.	A performance contract can require the host to operate a minimum number of hours per year, thereby restricting the host's ability to change operations and react to unforeseen circumstances. In addition, contracts may restrict the facility manager's ability to specify equipment, use specific vendors or obtain other preferences.
7	To protect the host's financial image by using off-balance sheet financing and avoid using collateral that could be spared to support future financing.	If available, "off-balance sheet" financing, as with a True Lease (a rental agreement), allows the host to use the equipment without purchasing it. This keeps project liabilities off the balance sheet, allowing the host to retain a stronger financial image. Minimizing the amount of collateral (on Uniform Commercial Code filings) improves the host's ability to obtain future financing.
8	To structure an arrangement such that annual savings are always greater than annual payments. Thus, the project only has positive cash flows.	If the maximum payment is set equal to the minimum savings estimate, the project should have only positive cash flows, (provided the equipment will last long enough to pay itself off). In the event of unforeseen or periodic project expenses, an agreement with adjustable payments can be used to eliminate annual profit shortfalls. In such a case, the agreement could be changed so the host makes smaller payments for a longer time period.
9	To secure fixed interest rate financing for the length of the project.	If possible, securing fixed interest rate financing would reduce risk relating to interest rate fluctuation. This can be helpful when financing the construction and operational phases of the project.
10	To be able to easily expand the scope of the arrangement.	Certain arrangements permit either party to suggest improvements that can be added easily to the scope of work. Also in certain financial arrangements, it is easy to acquire additional financing with minimal paperwork.

Expert Facility Manager's Survey

In each of the attached four case studies, I would like you to pretend you are going to install an energy management project in the facility described. Thus, you are the "host facility manager". In your desire to select the best arrangement for each case study, please score the importance of each objective in the Cumulative List of Objectives. In other words, read each case study, then ask yourself "if I were the facility manager in this situation, how important would each objective be to me?" Use the Case Study description and your instincts. For each case study, write your answers on the Score Sheets beneath each case study description. If you are unsure about the importance of an objective, refer to Appendix A, where the assumptions for each financial arrangement are listed. If you are still unsure about the importance of a particular objective, leave that space blank.

Please treat each case study carefully and individually; they are different with respect to project and facility characteristics. Please remember that all economic benefits are represented by Objective #1.

EXAMPLE CASE STUDY

Consider a government facility with an under-staffed maintenance crew and a small budget to invest in projects. Tremendous savings are possible if a complex energy management control system is installed. The facility manager would like to use a specific brand that functions well with existing equipment. The energy manager is a volunteer employee, and it would be risky to have him manage such a complex project. The facility needs many other equipment retrofits, but is lacking energy management and maintenance expertise. Since this is a government facility, management is not as concerned about its "financial image" with respect to obtaining strong credit ratings. However, the facility manager must use his budget wisely. Thus, having an economically beneficial project is important, especially if the project only generates funds.

In this scenario, the "scores of importance" on the right side of the Example Score Sheet below could represent a facility manager's response.

Question: If you were the facility manager implementing this project in this facility, please rate how important each objective would be on a scale of 1 to 9. A rating of 9 indicates that the objective is very important.

Unimportant : 1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : Very Important

EXAMPLE SCORE SHEET

Objective #	*Score of Importance*
1	8
2	7
3	5
4	3
5	4
6	5
7	1
8	7
9	1
10	3

CASE STUDY A

A small manufacturing plant (PizzaCo) needs a chiller for a new manufacturing process. After five years, PizzaCo plans on moving to a new facility and the chiller will be sold. This project will be the final improvement project for this facility. Management has already downsized the maintenance department and energy management teams, and they are now over-loaded with work. PizzaCo is struggling to maintain its current customers, and production schedules vary widely. PizzaCo needs maximum flexibility and does not want to enter contracts that bind operations. PizzaCo also wants to protect trade secrets and is opposed to outsourcing and using sub-contractors. Cash on hand is limited and short-term cost reduction is a major priority for PizzaCo at this time. Due to a poor credit rating, PizzaCo wants to improve its financial image and does not want to add liabilities to its balance sheet. Adding economic value to PizzaCo is extremely important at this time, and management is only interested in investments that have less than a two-year payback.

Question: If you were the facility manager implementing this project in this facility, please rate how important each objective would be on a scale of 1 to 9. A rating of 9 indicates that the objective is very important.

Unimportant : 1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : Very Important

ACTUAL SCORE SHEET

Objective #	Score of Importance
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

CASE STUDY B

Consider the same project as in Case Study A, except an entire chilled water system will be installed. There are also differences with the facility. In this case study, PizzaCo is very profitable and expanding. Production hours are expected to continue to increase. PizzaCo is increasing the capabilities of its in-house maintenance and energy management teams. The company is not re-locating, and plans to use the chilled water system indefinitely. Upper-level management has publicly engaged in an employee empowerment program, and is training employees to manage technically challenging projects. By delegating major responsibilities, upper-level management has been able to spend more time on generating new sales, which has been the reason for PizzaCo's success. However, PizzaCo wants to protect trade secrets and is opposed to outsourcing. Upper-level management desires "long-term" benefits and is willing to take on risks as well as add liabilities to the balance sheet (as long as all projects have a payback period less than five years). If this project is successfully implemented, additional budget funds will be allocated for energy management projects, which would allow additional equipment to be upgraded.

<u>Question</u>: If you were the facility manager implementing this project in this facility, please rate how important each objective would be on a scale of 1 to 9. A rating of 9 indicates that the objective is very important.

Unimportant : 1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : Very Important

ACTUAL SCORE SHEET

Objective #	Score of Importance
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

CASE STUDY C

A large federal government building desperately needs to upgrade its 40 year-old HVAC system. The current equipment is extremely inefficient and falling apart. Maintenance has been deferred for many years due to decreasing budgets, minimal maintenance staff and lack of experience. The budgets for utility expenses and maintenance are expected to decline further in the future and the facility manager must upgrade or replace equipment to meet energy conservation goals established by Presidential Executive Orders. However, there are no budget funds available for major capital improvements. The building is needed for at least 30 more years, and operational hours are very predictable. If the HVAC system can be successfully upgraded, additional equipment retrofits are possible. Since this is a government facility, management is not as concerned about its "financial image" with respect to obtaining strong credit ratings. The facility manager is willing to invest time and structure an agreement to get the equipment installed. He is also willing to cooperate and outsource projects as long as they pay for themselves with savings and reduce technical and financial risks.

<u>Question</u>: If you were the facility manager implementing this project in this facility, please rate how important each objective would be on a scale of 1 to 9. A rating of 9 indicates that the objective is very important.

Unimportant : 1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : Very Important

ACTUAL SCORE SHEET

Objective #	Score of Importance
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

CASE STUDY D

A State University (that has access to low bond rates) is entering the final phase of a campus-wide energy efficiency retrofit. The last facility to be retrofitted is the main library. The lighting system is old and needs to be replaced. Maintenance and utility budgets have remained constant for the past five years, and the university has an experienced maintenance team and in-house lighting experts, who are presently under-utilized. The university does not wish to outsource the project. The facility manager is very busy, but has had success working with his in-house staff to accomplish university growth and renovation objectives. He feels comfortable with his staff and is willing to assume technical and financial risks in order to implement an economically attractive project. This library is expected to be used for another 30 years, and the lighting retrofit needs to be completed quickly. The university is not desperate for capital, yet would like to evaluate its financing options carefully to get the most value per dollar spent. The facility manager is responsible for keeping costs below the budget limit. However, he is not as concerned about financial image with respect to obtaining strong credit ratings.

<u>Question</u>: If you were the facility manager implementing this project in this facility, please rate how important each objective would be on a scale of 1 to 9. A rating of 9 indicates that the objective is very important.

Unimportant : 1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : Very Important

ACTUAL SCORE SHEET

Objective #	Score of Importance
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

FINAL QUESTION

Now that you are familiar with the objectives in this model, do you wish other objectives would have been listed? If yes, please list the objectives you would like to have seen incorporated into this model. Please also list an explanation for each objective you add. Perhaps we can further improve this model.

ADDITIONAL OBJECTIVES	EXPLANATION/EXAMPLE

To allow this model to work, I have made some assumptions. First, we are assuming the facility manager already wants to implement the project, and is seeking the best financing arrangement to do so. Obviously, any assumption will not always be true, but the assumptions below allow us to distinguish the different financial arrangements. In the complete E-FUND model, the facility manager will be able to insert his/her own financial arrangements. Please "bear with me" on these assumptions, so we can test the model.

Assumptions to Differentiate the Basic Financial Arrangements

Purchase with cash, loan, bond, selling stock or a capital lease

- All of these arrangements assume that the host manages the EMP.
- The Net Present Value of each arrangement will be different due to differences in the cost of capital, tax treatment, and cash flow timing. The differences in NPV will distinguish these arrangements.
- The capital lease is treated as an installment loan.
- With selling stock, the host is expected to pay periodic dividends to shareholders.

True lease or operating lease

- This is an "off-balance sheet" arrangement, and the host avoids adding liabilities or putting up collateral.
- This lease is essentially a rental agreement. The host is "lessee" and although unlikely for large EMPs, does not automatically take ownership of the equipment at the end of the contract. However, the host can purchase the equipment for fair market value at the end of the contract.
- Assume that a maintenance service agreement is included in the lease so that the impact on the host's maintenance team is minimal.

Performance contract

- An Energy Service Company manages the EMP. The ESCO supplies installation, management and maintenance services for the project, thereby minimizing impact on the host's maintenance and energy management teams.
- Assumes the ESCO offers a guaranteed savings performance contract. The ESCO and the facility share any savings that exceed the guaranteed amount. The contract requires the host to operate a minimum number of operating hours per year.
- The host makes no initial investment (the project is "paid from savings")
- The performance contract will require the host's administrative personnel to become more involved (due to more extensive contracts) than with the other agreements.
- The host takes ownership of the equipment at the end of the contract.
- The contract may provide a more comprehensive system-wide approach, which could obtain greater savings with additional equipment installation, or complimentary improvements.
- Assume the ESCO has an excellent reputation and is financially strong.

Facsimile Transmittal

To: **Eric A. Woodroof**
Industrial Engineering and Management
322 Engineering North
Stillwater, OK 74078

Fax: **(405) 744-4654**

From:

Date:

Phone:

Re: SURVEY RESPONSE

Pages

THE FINAL QUESTIONNAIRE

To: Expert Panelists and Facility Manager Groups

From: Eric A. Woodroof

Date: April 27, 1998

Re: The Final Questionnaire

Thanks for your feedback on the last questionnaire. I have inserted your responses into the E-FUND model and tested it in four different case studies (A, B, C, and D), the results of which are presented on page 2. The results show the relative score of each arrangement in each case study. The highest scoring arrangement represents E-FUND's selection for each case study. If there was a "tie" (arrangements with approximately the same score), then both arrangements deserve further consideration. For example, based on the project and facility in Case A, the True Lease was selected by E-FUND, however the Performance Contract also had a high score and should also be considered as a financing option.

This questionnaire's purpose is to validate or invalidate E-FUND's performance. Please read each case study and indicate if you think E-FUND selected the most appropriate financial arrangement.

On page 3 is another set of results from a modified model, "Alternative E-FUND", which placed a higher weight on economic considerations. Please also indicate whether this alternative model selected the most appropriate arrangement.

PLEASE RESPOND BY MAY 1ST. **This questionnaire should only require 20 minutes of your time. Please let me know if you cannot make the deadline.** It will probably be easiest for you to print this questionnaire, "fill in the blanks" with a pen, and fax the Case Study Sheets (pages 4-7) back to me. **Pages 8-16 are the survey feedback charts, which show your judgements relative to the other participants. You do not need to read pages 8-16 to complete this questionnaire.**

Thanks for all your efforts. I will be sending you the user's guide to E-FUND as soon as I can complete it.

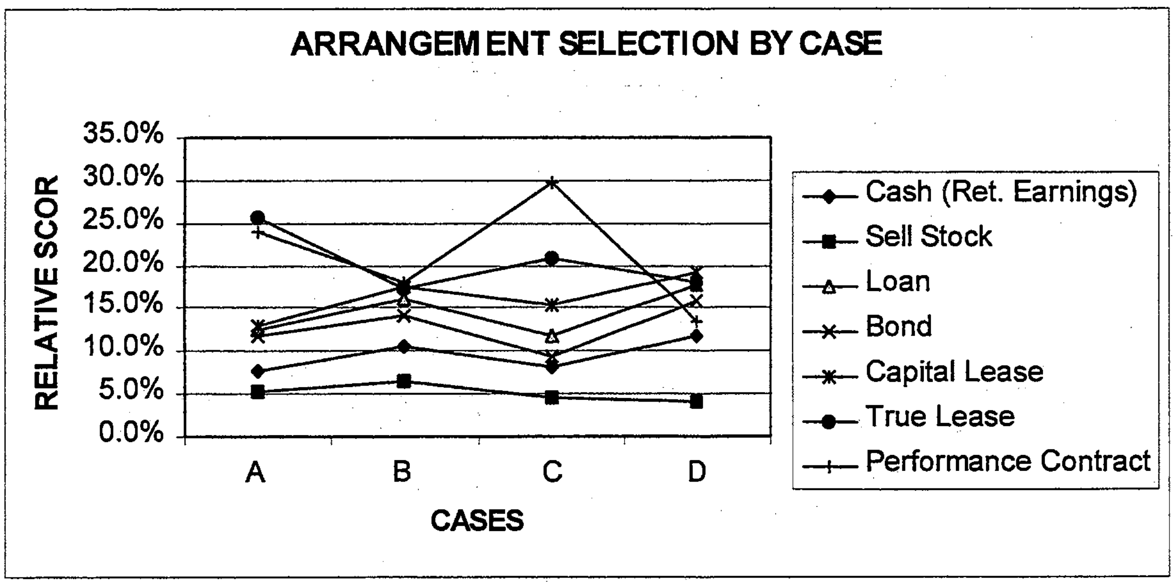
Sincerely,

Eric A. Woodroof
Project Coordinator
Industrial Assessment Center
phone: (405) 744-9146

E-FUND's

FINANCIAL ARRANGEMENT SELECTION IN EACH CASE STUDY

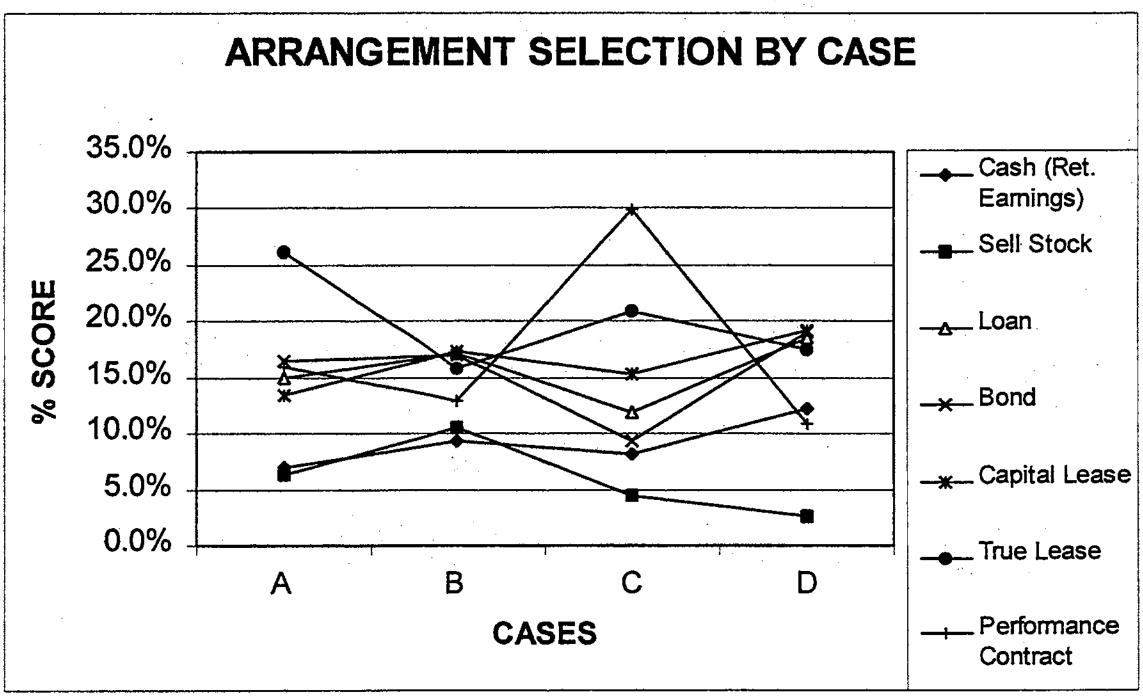
	Score in Each Case Study			
Financial Arrangements	**A**	**B**	**C**	**D**
Cash (Ret. Earnings)	7.7%	10.5%	8.2%	11.7%
Sell Stock	5.3%	6.5%	4.5%	4.0%
Loan	12.5%	16.0%	11.8%	17.7%
Bond	11.8%	14.2%	9.4%	15.9%
Capital Lease	13.0%	17.4%	15.4%	19.2%
True Lease	25.6%	17.3%	20.9%	18.0%
Performance Contract	24.1%	18.0%	29.8%	13.5%



ALTERNATIVE E-FUND

FINANCIAL ARRANGEMENT SELECTION IN EACH CASE STUDY

	Score in Each Case Study			
Financial Arrangements	**A**	**B**	**C**	**D**
Cash (Ret. Earnings)	6.9%	9.4%	8.2%	12.3%
Sell Stock	6.3%	10.6%	4.5%	2.5%
Loan	15.0%	17.1%	11.8%	18.6%
Bond	16.4%	16.9%	9.4%	19.1%
Capital Lease	13.4%	17.3%	15.4%	19.2%
True Lease	26.2%	15.8%	20.9%	17.5%
Performance Contract	15.9%	12.9%	29.8%	10.9%



CASE STUDY A

A small manufacturing plant (PizzaCo) needs a chiller for a new manufacturing process. After five years, PizzaCo plans on moving to a new facility and the chiller will be sold. This project will be the final improvement project for this facility. Management has already downsized the maintenance department and energy management teams, and they are now over-loaded with work. PizzaCo is struggling to maintain its current customers, and production schedules vary widely. PizzaCo needs maximum flexibility and does not want to enter contracts that bind operations. PizzaCo also wants to protect trade secrets and is opposed to outsourcing and using sub-contractors. Cash on hand is limited and short-term cost reduction is a major priority for PizzaCo at this time. Due to a poor credit rating, PizzaCo wants to improve its financial image and does not want to add liabilities to its balance sheet. Adding economic value to PizzaCo is extremely important at this time, and management is only interested in investments that have less than a two-year payback.

Question A1: *Based on this case study and the results, did* ***E-FUND*** *select the most appropriate financial arrangement?*

____*YES,* ***E-FUND*** *selected the most appropriate financial arrangement*

____*NO,* ***E-FUND*** *did not select the most appropriate financial arrangement*

If NO, please explain what would be the most appropriate financial arrangement for this Case?

Question A2: *Based on this case study and the results, did "****Alternative E-FUND****" select the most appropriate financial arrangement?*

____*YES,* ***Alternative E-FUND*** *selected the most appropriate financial arrangement*

____*NO,* ***Alternative E-FUND*** *did not select an appropriate financial arrangement*

If NO, please explain what would be the most appropriate financial arrangement for this Case?

CASE STUDY B

Consider the same project as in Case Study A, except an entire chilled water system will be installed. There are also differences with the facility. In this case study, PizzaCo is very profitable and expanding. Production hours are expected to continue to increase. PizzaCo is increasing the capabilities of its in-house maintenance and energy management teams. The company is not re-locating, and plans to use the chilled water system indefinitely. Upper-level management has publicly engaged in an employee empowerment program, and is training employees to manage technically challenging projects. By delegating major responsibilities, upper-level management has been able to spend more time on generating new sales, which has been the reason for PizzaCo's success. However, PizzaCo wants to protect trade secrets and is opposed to outsourcing. Upper-level management desires "long-term" benefits and is willing to take on risks as well as add liabilities to the balance sheet (as long as all projects have a payback period less than five years). If this project is successfully implemented, additional budget funds will be allocated for energy management projects, which would allow additional equipment to be upgraded.

Question B1: *Based on this case study and the results, did* ***E-FUND*** *select the most appropriate financial arrangement?*

____*YES,* ***E-FUND*** *selected the most appropriate financial arrangement*

____*NO,* ***E-FUND*** *did not select the most appropriate financial arrangement*

If NO, please explain what would be the most appropriate financial arrangement for this Case?

____

____

Question B2: *Based on this case study and the results, did "****Alternative E-FUND****" select the most appropriate financial arrangement?*

____*YES,* ***Alternative E-FUND*** *selected the most appropriate financial arrangement*

____*NO,* ***Alternative E-FUND*** *did not select an appropriate financial arrangement*

If NO, please explain what would be the most appropriate financial arrangement for this Case?

____

____

CASE STUDY C

A large federal government building desperately needs to upgrade its 40 year-old HVAC system. The current equipment is extremely inefficient and falling apart. Maintenance has been deferred for many years due to decreasing budgets, minimal maintenance staff and lack of experience. The budgets for utility expenses and maintenance are expected to decline further in the future and the facility manager must upgrade or replace equipment to meet energy conservation goals established by Presidential Executive Orders. However, there are no budget funds available for major capital improvements. The building is needed for at least 30 more years, and operational hours are very predictable. If the HVAC system can be successfully upgraded, additional equipment retrofits are possible. Since this is a government facility, management is not as concerned about its "financial image" with respect to obtaining strong credit ratings. The facility manager is willing to invest time and structure an agreement to get the equipment installed. He is also willing to cooperate and outsource projects as long as they pay for themselves with savings and reduce technical and financial risks.

Question C1: *Based on this case study and the results, did* ***E-FUND*** *select the most appropriate financial arrangement?*

____*YES,* ***E-FUND*** *selected the most appropriate financial arrangement*

____*NO,* ***E-FUND*** *did not select the most appropriate financial arrangement*

If NO, please explain what would be the most appropriate financial arrangement for this Case?

____

____

Question C2: *Based on this case study and the results, did "****Alternative E-FUND****" select the most appropriate financial arrangement?*

____*YES,* ***Alternative E-FUND*** *selected the most appropriate financial arrangement*

____*NO,* ***Alternative E-FUND*** *did not select an appropriate financial arrangement*

If NO, please explain what would be the most appropriate financial arrangement for this Case?

____

____

CASE STUDY D

A State University (that has access to low bond rates) is entering the final phase of a campus-wide energy efficiency retrofit. The last facility to be retrofitted is the main library. The lighting system is old and needs to be replaced. Maintenance and utility budgets have remained constant for the past five years, and the university has an experienced maintenance team and in-house lighting experts, who are presently under-utilized. The university does not wish to outsource the project. The facility manager is very busy, but has had success working with his in-house staff to accomplish university growth and renovation objectives. He feels comfortable with his staff and is willing to assume technical and financial risks in order to implement an economically attractive project. This library is expected to be used for another 30 years, and the lighting retrofit needs to be completed quickly. The university is not desperate for capital, yet would like to evaluate its financing options carefully to get the most value per dollar spent. The facility manager is responsible for keeping costs below the budget limit. However, he is not as concerned about financial image with respect to obtaining strong credit ratings.

<u>Question D1</u>: *Based on this case study and the results, did **E-FUND** select the most appropriate financial arrangement?*

____*YES, **E-FUND** selected the most appropriate financial arrangement*

____*NO, **E-FUND** did not select the most appropriate financial arrangement*

If NO, please explain what would be the most appropriate financial arrangement for this Case?

____

____

<u>Question D2:</u> *Based on this case study and the results, did "**Alternative E-FUND**" select the most appropriate financial arrangement?*

____*YES, **Alternative E-FUND** selected the most appropriate financial arrangement*

____*NO, **Alternative E-FUND** did not select an appropriate financial arrangement*

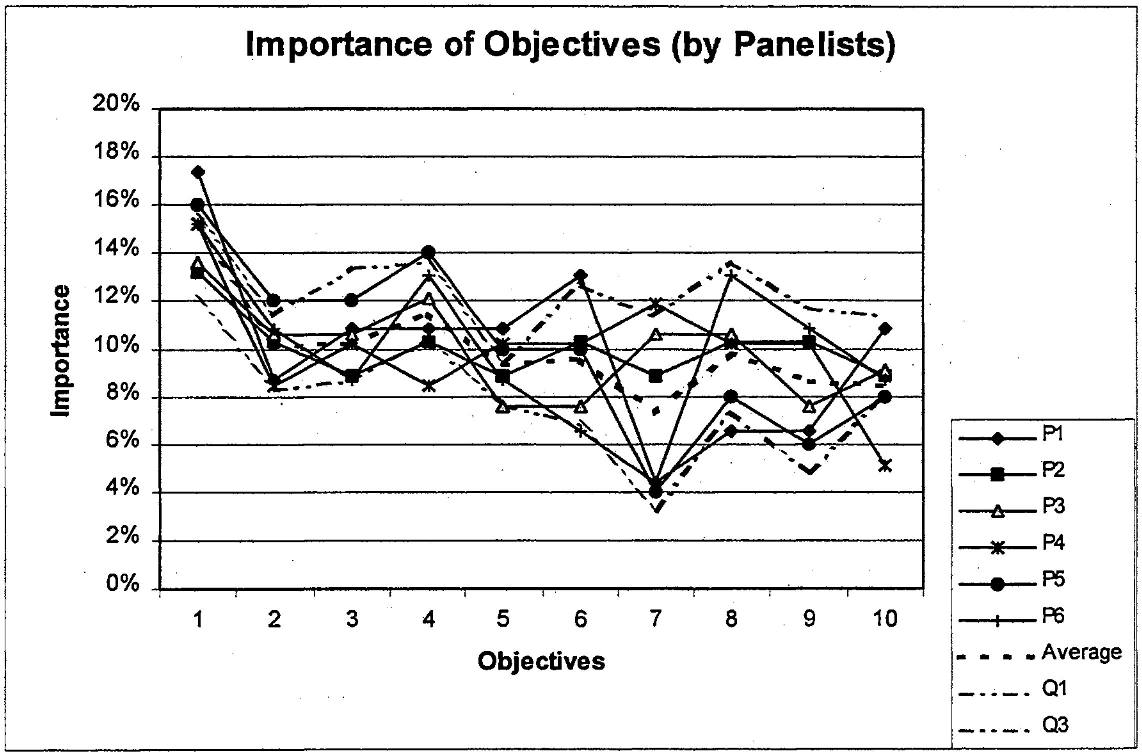
If NO, please explain what would be the most appropriate financial arrangement for this Case?

____

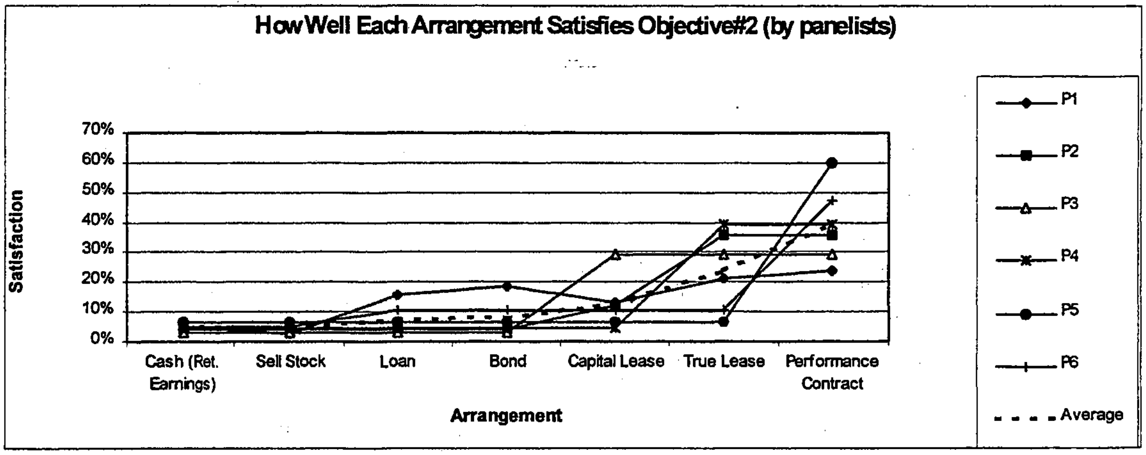
____

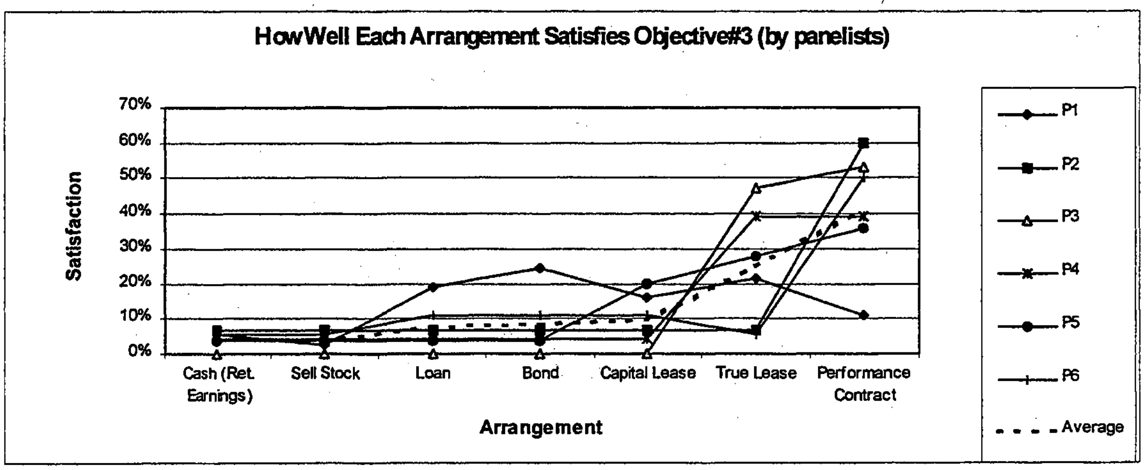
PANELIST SURVEY FEEDBACK

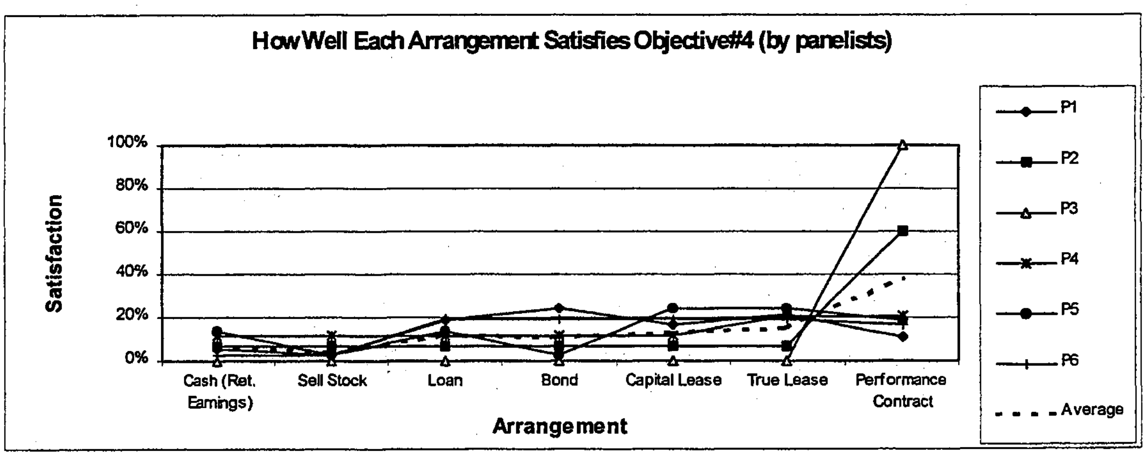
PART A

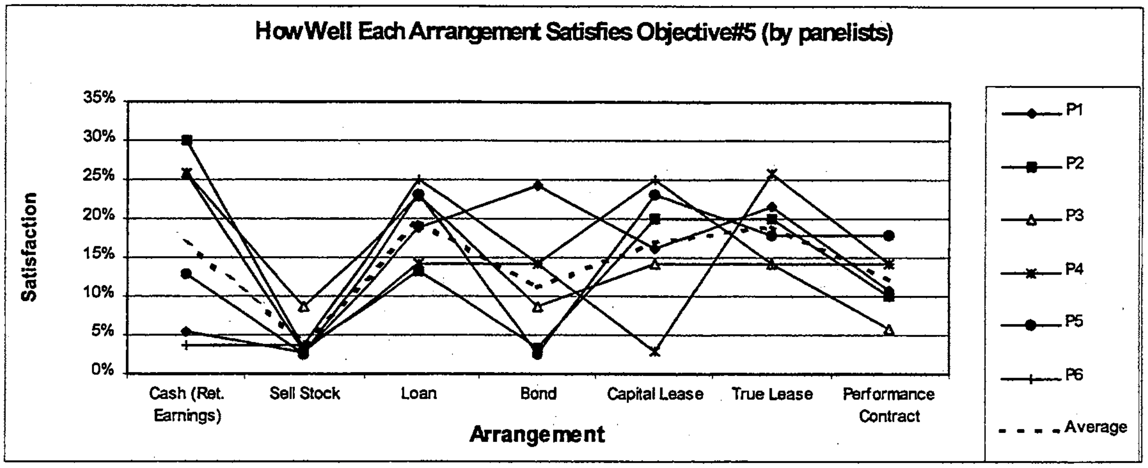


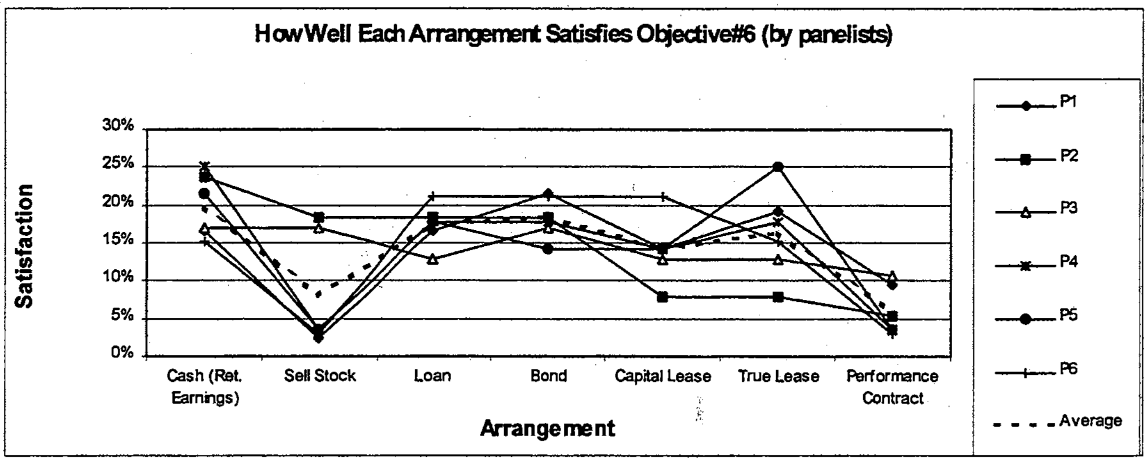
PART B

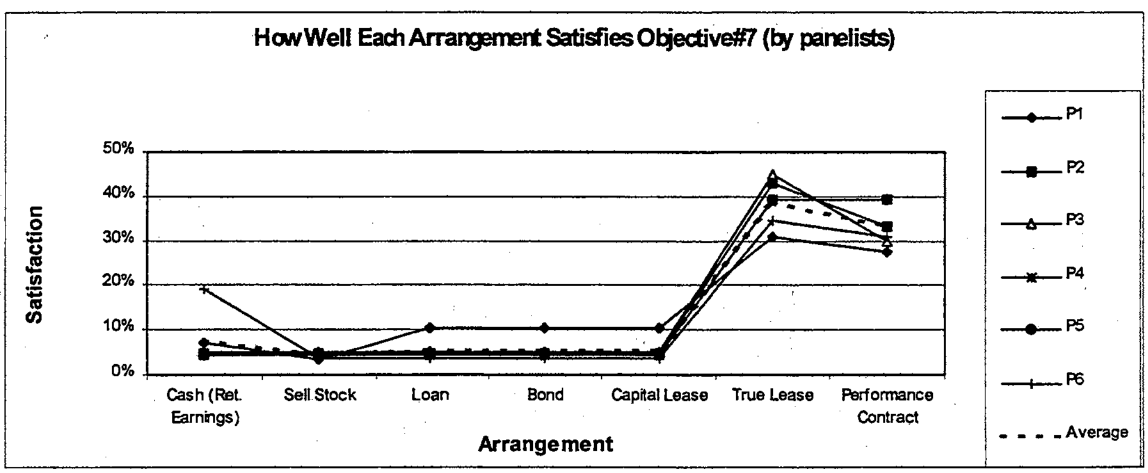

How Well Each Arrangement Satisfies Objective#2 (by panelists)
Satisfaction
70%
60%
50%
40%
30%
20%
10%
0%
Cash (Ret. Earnings)
Sell Stock
Loan
Bond
Capital Lease
True Lease
Performance Contract
Arrangement
P1
P2
P3
P4
P5
P6
Average

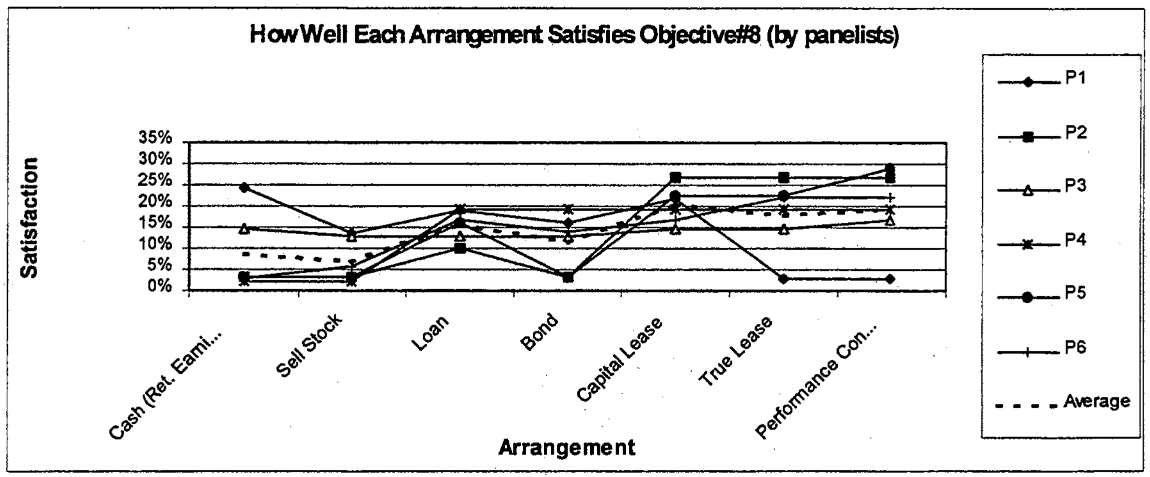

How Well Each Arrangement Satisfies Objective#3 (by panelists)
Satisfaction
70%
60%
50%
40%
30%
20%
10%
0%
Cash (Ret. Earnings)
Sell Stock
Loan
Bond
Capital Lease
True Lease
Performance Contract
Arrangement
P1
P2
P3
P4
P5
P6
Average

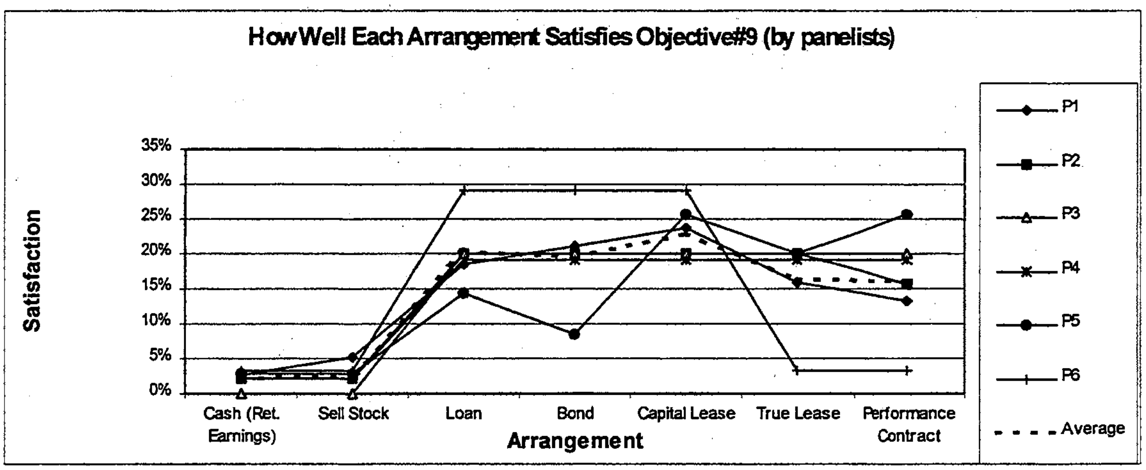

How Well Each Arrangement Satisfies Objective#4 (by panelists)
Satisfaction
100%
80%
60%
40%
20%
0%
Cash (Ret. Earnings)
Sell Stock
Loan
Bond
Capital Lease
True Lease
Performance Contract
Arrangement
P1
P2
P3
P4
P5
P6
Average

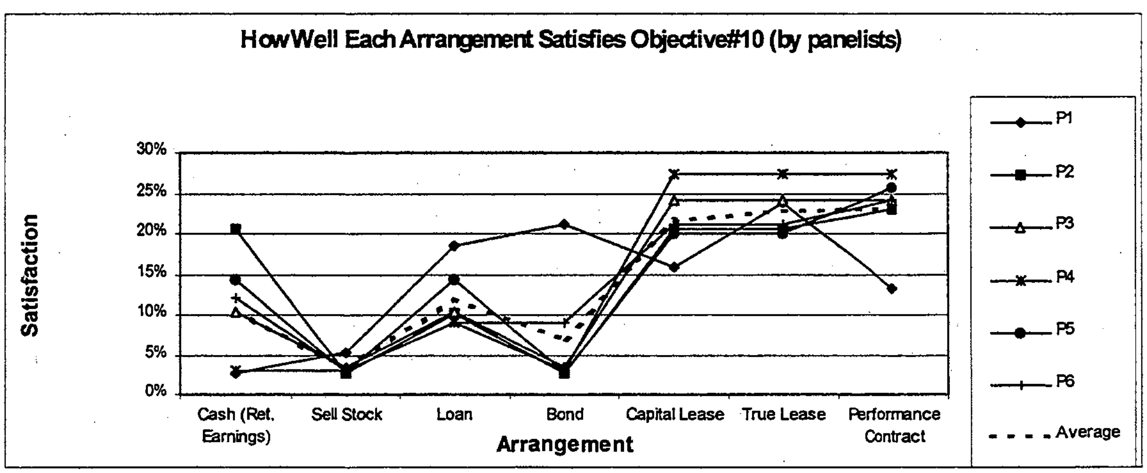

How Well Each Arrangement Satisfies Objective#5 (by panelists)
Satisfaction
35%
30%
25%
20%
15%
10%
5%
0%
Cash (Ret. Earnings)
Sell Stock
Loan
Bond
Capital Lease
True Lease
Performance Contract
Arrangement
P1
P2
P3
P4
P5
P6
Average


How Well Each Arrangement Satisfies Objective#6 (by panelists)
Satisfaction
30%
25%
20%
15%
10%
5%
0%
Cash (Ret. Earnings)
Sell Stock
Loan
Bond
Capital Lease
True Lease
Performance Contract
Arrangement
P1
P2
P3
P4
P5
P6
Average

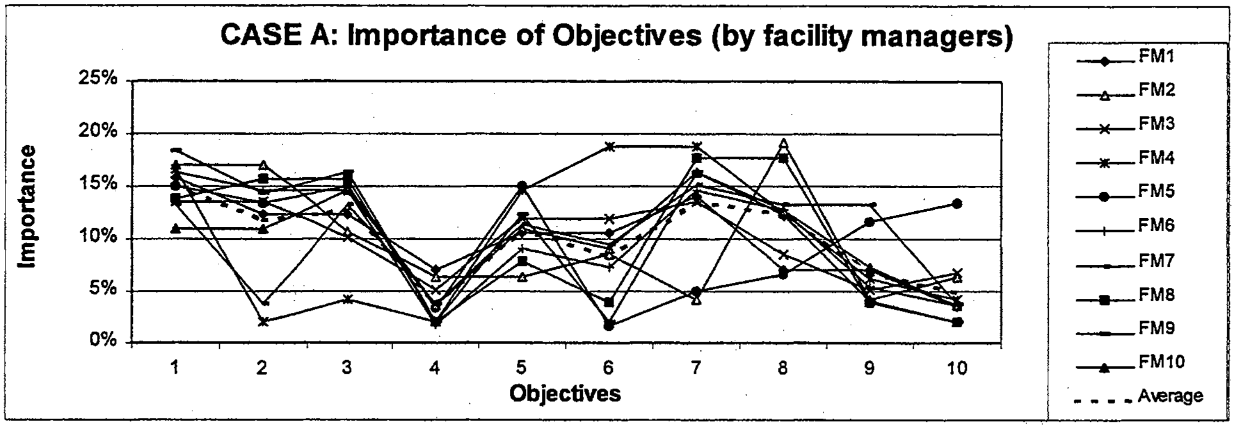

How Well Each Arrangement Satisfies Objective#7 (by panelists)
Satisfaction
50%
40%
30%
20%
10%
0%
Cash (Ret. Earnings)
Sell Stock
Loan
Bond
Capital Lease
True Lease
Performance Contract
Arrangement
P1
P2
P3
P4
P5
P6
Average

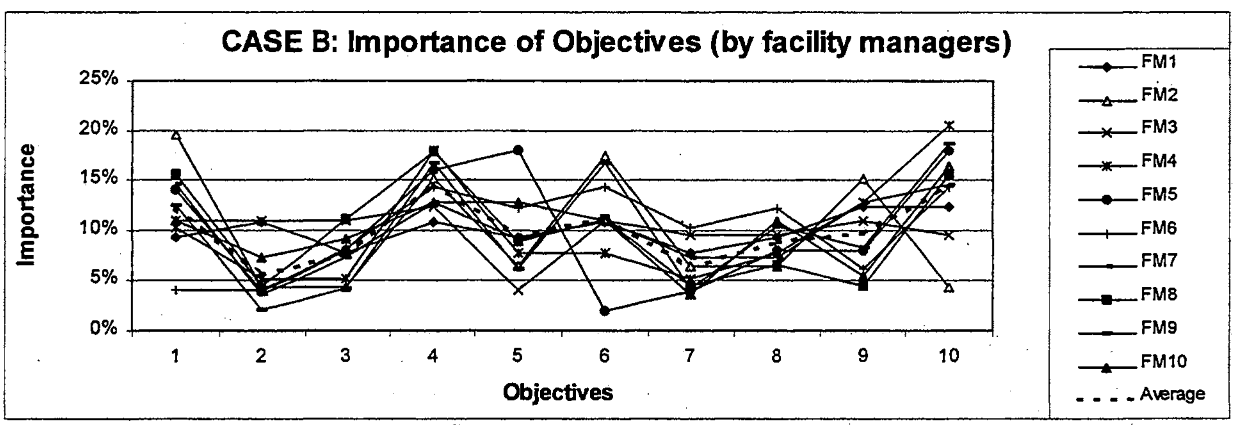

How Well Each Arrangement Satisfies Objective#8 (by panelists)
Satisfaction
35%
30%
25%
20%
15%
10%
5%
0%
Cash (Ret. Earni...
Sell Stock
Loan
Bond
Capital Lease
True Lease
Performance Con...
Arrangement
P1
P2
P3
P4
P5
P6
Average

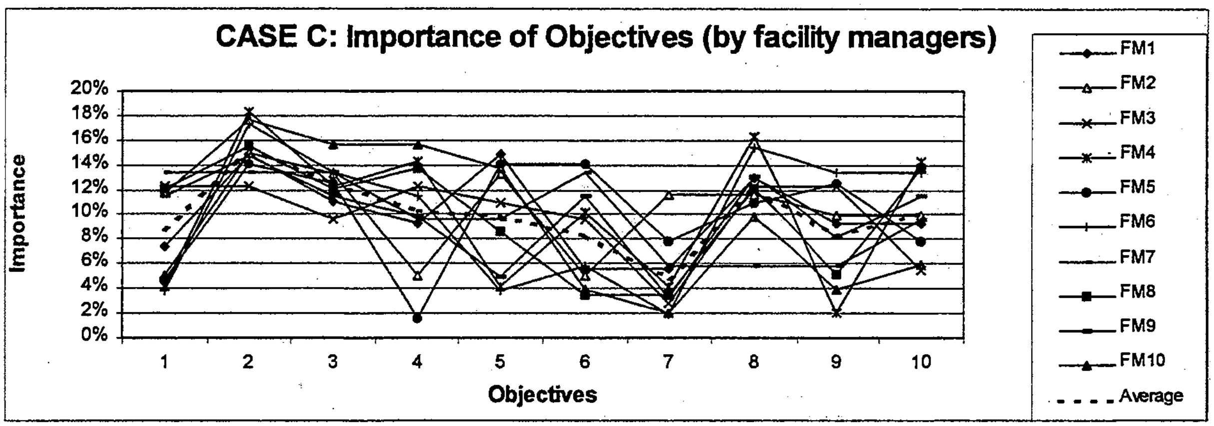

How Well Each Arrangement Satisfies Objective#9 (by panelists)
Satisfaction
35%
30%
25%
20%
15%
10%
5%
0%
Cash (Ret. Earnings)
Sell Stock
Loan
Bond
Capital Lease
True Lease
Performance Contract
Arrangement
P1
P2
P3
P4
P5
P6
Average


How Well Each Arrangement Satisfies Objective#10 (by panelists)
Satisfaction
30%
25%
20%
15%
10%
5%
0%
Cash (Ret. Earnings)
Sell Stock
Loan
Bond
Capital Lease
True Lease
Performance Contract
Arrangement
P1
P2
P3
P4
P5
P6
Average

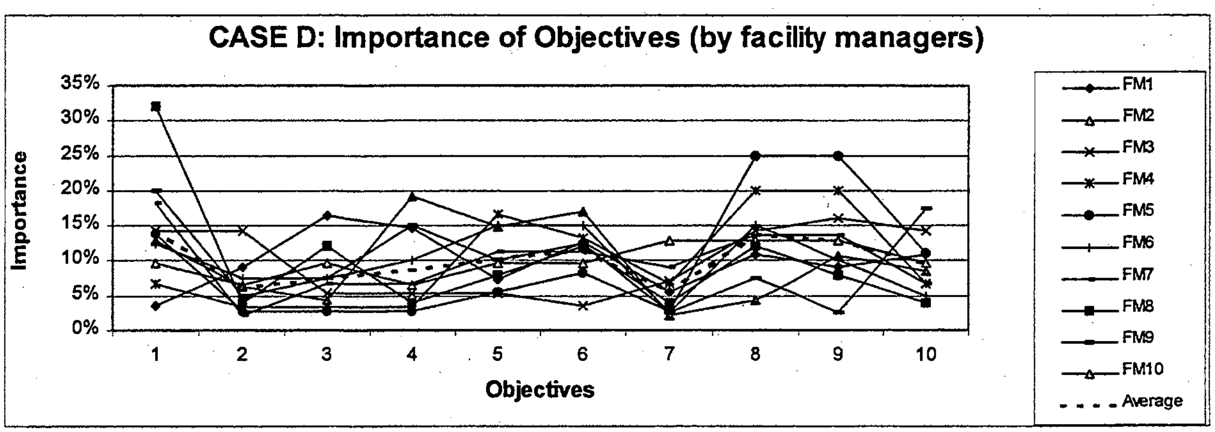
FACILITY MANAGER SURVEY FEEDBACK







CASE C: Importance of Objectives (by facility managers)
Importance
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
1
2
3
4
5
6
7
8
9
10
Objectives
FM1
FM2
FM3
FM4
FM5
FM6
FM7
FM8
FM9
FM10
Average



CASE D: Importance of Objectives (by facility managers)
Importance
35%
30%
25%
20%
15%
10%
5%
0%
1
2
3
4
5
6
7
8
9
10
Objectives
FM1
FM2
FM3
FM4
FM5
FM6
FM7
FM8
FM9
FM10
Average

SUPPORTING INFORMATION

The Cumulative List of Objectives below is supposed to encompass the objectives that a facility manager should consider when selecting a financial arrangement for an energy management project (EMP) in a typical facility. *Note that all economic considerations are included in the "Net Present Value" objective.*

#	CUMULATIVE LIST OF OBJECTIVES	EXPLANATIONS/ EXAMPLES
1	To have a high economic benefit (High Net Present Value, or Short Payback Period).	Facility managers often select projects with a short Payback Period, or projects with a high Net Present Value. *The NPV of each arrangement incorporates all quantitative factors; such as the finance rate assigned by the lender, the timing and amount of the cash flows, as well as the additional costs (administrative, maintenance, legal) required by a certain EMP under a particular arrangement.* Thus, the NPV of each arrangement is the cumulative assessment of all quantitative objectives relating to installing the EMP in a particular facility, using a particular financial arrangement.
2	To reduce the host's risk by using a guaranteed savings performance contract, where the host makes no initial investment, and the project's costs are "paid from savings".	In this case, an Energy Service Company installs and operates the equipment. The ESCO shares the savings with the host, which encourages both parties to maximize savings, and look out for each other. A guaranteed amount of savings (as offered by a performance contract) can reduce the host's risk if the EMP is technically or financially challenging. "Paid from savings" contracts require no up-front investment, allowing the host to preserve in-house funds for other company purposes.
3	To minimize the additional impact on the maintenance and energy management teams. or To compliment maintenance goals and improve effectiveness.	Based on the EMP's complexity and the host's in-house expertise, the host's maintenance and energy management teams may need to devote attention that should be focused elsewhere (i.e. implementing other profit improvement measures). However, if the financial arrangement (such as a performance contract) provides maintenance and technical services or improves maintenance effectiveness, the in-house resources can focus their attention on core business goals.
4	To use a comprehensive, "system-wide" approach to maximize the replacement of outdated equipment.	Performance Contracts can be "bundled" to include other services and projects, creating a larger, more comprehensive package. This is the opposite of "cream skimming." For example, a lighting retrofit may be "bundled" with a chiller retrofit to obtain additional "system-wide" benefits.
5	To have an "easy to understand" agreement that minimizes the impact on the host's administrative personnel.	A simple agreement can "stand by itself" (no matter who is interpreting it) and minimize the potential for litigation in the future. Complex contracts may require the host's administrative personnel to devote attention that should be focused on achieving core business goals.

6	To minimize contractual restraints, so the facility manager has greater flexibility and control over the project.	A performance contract can require the host to operate a minimum number of hours per year, thereby restricting the host's ability to change operations and react to unforeseen circumstances. In addition, contracts may restrict the facility manager's ability to specify equipment, use specific vendors or obtain other preferences.
7	To protect the host's financial image by using off-balance sheet financing and avoid using collateral that could be spared to support future financing.	If available, "off-balance sheet" financing, as with a True Lease (a rental agreement), allows the host to use the equipment without purchasing it. This keeps project liabilities off the balance sheet, allowing the host to retain a stronger financial image. Minimizing the amount of collateral (on Uniform Commercial Code filings) improves the host's ability to obtain future financing.
8	To structure an arrangement such that annual savings are always greater than annual payments. Thus, the project only has positive cash flows.	If the maximum payment is set equal to the minimum savings estimate, the project should have only positive cash flows, (provided the equipment will last long enough to pay itself off). In the event of unforeseen or periodic project expenses, an agreement with adjustable payments can be used to eliminate annual profit shortfalls. In such a case, the agreement could be changed so the host makes smaller payments for a longer time period.
9	To secure fixed interest rate financing for the length of the project.	If possible, securing fixed interest rate financing would reduce risk relating to interest rate fluctuation. This can be helpful when financing the construction and operational phases of the project.
10	To be able to easily expand the scope of the arrangement.	Certain arrangements permit either party to suggest improvements that can be added easily to the scope of work. Also in certain financial arrangements, it is easy to acquire additional financing with minimal paperwork.

Assumptions to Differentiate the Basic Financial Arrangements

Purchase with cash, loan, bond, selling stock or a capital lease

- All of these arrangements assume that the host manages the EMP.
- The Net Present Value of each arrangement will be different due to differences in the cost of capital, tax treatment, and cash flow timing. The differences in NPV will distinguish these arrangements.
- The capital lease is treated as an installment loan.
- With selling stock, the host is expected to pay periodic dividends to shareholders.

True lease or operating lease

- This is an "off-balance sheet" arrangement, and the host avoids adding liabilities or putting up collateral.
- This lease is essentially a rental agreement. The host is "lessee" and although unlikely for large EMPs, does not automatically take ownership of the equipment at the end of the contract. However, the host can purchase the equipment for fair market value at the end of the contract.
- Assume that a maintenance service agreement is included in the lease so that the impact on the host's maintenance team is minimal.

Performance contract

- An Energy Service Company manages the EMP. The ESCO supplies installation, management and maintenance services for the project, thereby minimizing impact on the host's maintenance and energy management teams.
- Assumes the ESCO offers a guaranteed savings performance contract. The ESCO and the facility share any savings that exceed the guaranteed amount. The contract requires the host to operate a minimum number of operating hours per year.
- The host makes no initial investment (the project is "paid from savings")
- The performance contract will require the host's administrative personnel to become more involved (due to more extensive contracts) than with the other agreements.
- The host takes ownership of the equipment at the end of the contract.
- The contract may provide a more comprehensive system-wide approach, which could obtain greater savings with additional equipment installation, or complimentary improvements.
- Assume the ESCO has an excellent reputation and is financially strong.

Facsimile Transmittal

To:	**Eric A. Woodroof** Industrial Engineering and Management 322 Engineering North Stillwater, OK 74078	**Fax:**	**(405) 744-4654**
From:		**Date:**	
Re:	SURVEY RESPONSE	**Pages:**	4

APPENDIX B

QUANTITATIVE CASE STUDY INFORMATION

Appendix B is organized with the following content. First, a few notes on the quantitative information in each case are presented. Second, the assumptions to differentiate the basic financial arrangements are presented. Finally, the qualitative and quantitative information about each case is presented.

Notes on Quantitative Information:
For all case studies, the interest rate for a true lease remains constant, which includes installation and removal fees. For all cases the performance contract fees are the same, except for Case A, which due to a short contract, requires the host to purchase the equipment at the end of the contract. However, as Table B-7 shows, the project balance remains positive.

Assumptions to Differentiate the Basic Financial Arrangements

Purchase with cash, loan, bond, selling stock or a capital lease

- All of these arrangements assume that the host manages the EMP.
- The Net Present Value of each arrangement will be different due to differences in the cost of capital, tax treatment, and cash flow timing. The differences in NPV will distinguish these arrangements.
- The capital lease is treated as an installment loan.
- With selling stock, the host is expected to pay periodic dividends to shareholders.

True lease or operating lease

- This is an "off-balance sheet" arrangement, and the host avoids adding liabilities or putting up collateral.
- This lease is essentially a rental agreement. The host is "lessee" and although unlikely for large EMPs, does not automatically take ownership of the equipment at the end of the contract. However, the host can purchase the equipment for fair market value at the end of the contract.
- Assume that a maintenance service agreement is included in the lease so that the impact on the host's maintenance team is minimal.

Performance contract

- An Energy Service Company manages the EMP. The ESCO supplies installation, management and maintenance services for the project, thereby minimizing impact on the host's maintenance and energy management teams.
- Assumes the ESCO offers a guaranteed savings performance contract. The ESCO and the facility share any savings that exceed the guaranteed amount. The contract requires the host to operate a minimum number of operating hours per year.
- The host makes no initial investment (the project is "paid from savings")
- The performance contract will require the host's administrative personnel to become more involved (due to more extensive contracts) than with the other agreements.
- The host takes ownership of the equipment at the end of the contract.
- The contract may provide a more comprehensive system-wide approach, which could obtain greater savings with additional equipment installation, or complimentary improvements.
- Assume the ESCO has an excellent reputation and is financially strong.

CASE A (DESIGNED TO FAVOR THE TRUE LEASE)

Qualitative Dominating Factors

- Company plans to move in 5 years
- Maintenance and energy management teams are over-burdened
- Management does not want contractual restrictions on production because future facility operating/production hours are not predictable.
- Company is interested in off-balance sheet financing
- Management is opposed to outsourcing

Qualitative Information (supplied to participants)

A small manufacturing plant (PizzaCo) needs a chiller for a new manufacturing process. After five years, PizzaCo plans on moving to a new facility and the chiller will be sold. This project will be the final improvement project for this facility. Management has already downsized the maintenance department and energy management teams, and they are now over-loaded with work. PizzaCo is struggling to maintain its current customers, and production schedules vary widely. PizzaCo needs maximum flexibility and does not want to enter contracts that bind operations. PizzaCo also wants to protect trade secrets and is opposed to outsourcing and using sub-contractors. Cash on hand is limited and short-term cost reduction is a major priority for PizzaCo at this time. Due to a poor credit rating, PizzaCo wants to improve its financial image and does not want to add liabilities to its balance sheet. Adding economic value to PizzaCo is extremely important at this time, and management is only interested in investments that have less than a two-year payback.

Quantitative Dominating Factors

- 5 year planning horizon
- Host has little capital and poor credit; therefore interest rates are high
- Interest rates are high due to small size of borrowed amount. Banks usually give discounts when borrowed amount is larger than $ 1 million.
- Management has mandated that all investments must pay for themselves within two years

Quantitative Information

The facility in Case A is in a poor state of financial strength. The company is barely lucrative, has cash flow and credit problems. The size of the borrowed amount is only $100,000. Thus, the interest rate is relatively high. As expected, the interest rate for selling stock is slightly more than the other options. Because this facility's planning horizon is only 5 years, the economic analysis is calculated for a five-year project. In the performance contract, due to the short time frame of the contract, at the end of year five, the host must purchase the equipment for $40,000. In cases B through D (because they are fifteen year projects), the equipment would be given (or sold for $1) to the host.

	Loan	Bond	Sell Stock	Capital Lease
Interest Rate	18%	18%	19%	18%

Table B-1 CASE A: Economic Analysis for using Cash

EOY	Savings	Depr.	Payments Principal	Payments Interest	Payments Total	Principal Outstanding	Taxable Income	Tax	ATCF
0					100,000				-100,000
1	38,000	14,290					23,710	8,061	29,939
2	38,000	24,490					13,510	4,593	33,407
3	38,000	17,490					20,510	6,973	31,027
4	38,000	12,490					25,510	8,673	29,327
5	38,000	4,465					33,535	11,402	26,598
5*	48,000	26,775					21,225	7,217	40,784
		100,000							

Net Present Value at 20%: $7,325

Notes:	Loan Amount:	0		
	Loan Finance Rate:	0%	MARR =	20%
			Tax Rate	34%
	MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5			
	Accounting Book Value at end of year 5:	0		
	Estimated Market Value at end of year 5:	48,000		
	EOY 5 illustrates the Equipment Sale and Book Value*			
	Taxable Income:	=(Market Value - Book Value)		
		=(48,000 - 26,775) = $21,225		

Table B-2 CASE A: Economic Analysis for a Loan

EOY	Savings	Depr.	Payments Principal	Payments Interest	Payments Total	Principal Outstanding	Taxable Income	Tax	ATCF
0						100,000			
1	38,000	14,290	13,978	18,000	31,978	86,022	5,710	1,941	4,081
2	38,000	24,490	16,494	15,484	31,978	69,528	-1,974	-671	6,693
3	38,000	17,490	19,463	12,515	31,978	50,065	7,995	2,718	3,304
4	38,000	12,490	22,966	9,012	31,978	27,099	16,498	5,609	413
5	38,000	4,465	27,099	4,878	31,978	0	28,657	9,743	-3,720
5*	48,000	26,775					21,225	7,217	40,784
		100,000							

Net Present Value at 20%: $25,054

Notes:	Loan Amount:	100,000 (used to purchase equipment at year 0)		
	Loan Finance Rate:	18%	MARR =	20%
			Tax Rate	34%
	MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5			
	Accounting Book Value at end of year 5:	26,775		
	Estimated Market Value at end of year 5:	48,000		
	EOY 5 illustrates the Equipment Sale and Book Value*			
	Taxable Income:	=(Market Value - Book Value)		
		=(48,000 - 26,775) = $21,225		

Table B-3 CASE A: Economic Analysis for a Bond

EOY	Savings	Depr.	Payments Principal	Payments Interest	Payments Total	Principal Outstanding	Taxable Income	Tax	ATCF
0						100,000			
1	38,000	14,290		18,000	18,000	100,000	5,710	1,941	18,059
2	38,000	24,490		18,000	18,000	100,000	-4,490	-1,527	21,527
3	38,000	17,490		18,000	18,000	100,000	2,510	853	19,147
4	38,000	12,490		18,000	18,000	100,000	7,510	2,553	17,447
5	38,000	4,465	100,000	18,000	118,000	0	15,535	5,282	-85,282
5*	48,000	26,775					21,225	7,217	40,784
		100,000							

Net Present Value at 20%: 31,609

Notes: Bond Amount: 100,000 (used to purchase equipment at year 0)
Coupon Interest Rate: 18% MARR = 20%
Tax Rate 34%
MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5
Accounting Book Value at end of year 5: 26,775
Estimated Market Value at end of year 5: 48,000
EOY 5 illustrates the Equipment Sale and Book Value*
Taxable Income: =(Market Value - Book Value)
=(48,000 - 26,775) = $21,225

Table B-4 CASE A: Economic Analysis for Selling Stock

EOY	Savings	Depr.	Stock Transactions Sale of Stock	Stock Transactions Repurchase	Stock Transactions Dividend Payments	Taxable Income	Tax	ATCF
0			*$ 100,000 from Stock Sale is used to purchase equipment, thus*				*ATCF = 0*	
1	38,000	14,290			19,000	23,710	8,061	10,939
2	38,000	24,490			19,000	13,510	4,593	14,407
3	38,000	17,490			19,000	20,510	6,973	12,027
4	38,000	12,490			19,000	25,510	8,673	10,327
5	38,000	4,465		100,000	19,000	33,535	11,402	-92,402
5*	48,000	26,775				21,225	7,217	40,784
		100,000						

Net Present Value at 20%: 10,316

Notes: Value of Stock Sold (which is repurchased after year 100,000 (used to purchase equipment at year 0)
Cost of Capital = Annual Dividend Rate: 19% MARR = 20%
Tax Rate 34%
MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5
Accounting Book Value at end of year 5: 26,775
Estimated Market Value at end of year 5: 48,000
EOY 5 illustrates the Equipment Sale and Book Value*
Taxable Income: =(Market Value - Book Value)
=(48,000 - 26,775) = $21,225

Table B-5 CASE A: Economic Analysis for a Capital Lease

EOY	Savings	Depr.	Payments in Advance			Principal Outstanding	Taxable Income	Tax	ATCF
			Principal	Interest	Total				
0			27,100	0	27,100	72,900			-27,100
1	38,000	14,290	13,978	13,122	27,100	58,922	10,588	3,600	7,300
2	38,000	24,490	16,494	10,606	27,100	42,428	2,904	987	9,913
3	38,000	17,490	19,463	7,637	27,100	22,965	12,873	4,377	6,523
4	38,000	12,490	22,965	4,134	27,100	0	21,376	7,268	3,633
5	38,000	4,465					33,535	11,402	26,598
5*	48,000	26,775					21,225	7,217	40,784
		100,000							

Net Present Value at 20%: $18,474

Notes: Total Lease Amount: 100,000

However, Since the payments are in advance, the first payment is analogous to a Down-Payment

Thus the actual amount borrowed is only = 100,000 - 27,100 = 72,900

Lease Finance Rate: 18% MARR = 20%

Tax Rate 34%

MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5

Accounting Book Value at end of year 5: 0

Estimated Market Value at end of year 5: 48,000

EOY 5 illustrates the Equipment Sale and Book Value*

Taxable Income: =(Market Value - Book Value)

=(48,000 - 26,775) = $21,225

Table B-6 CASE A: Economic Analysis for a True Lease

EOY	Savings	Depr.	Payments			Principal Outstanding	Taxable Income	Tax	ATCF
			Principal	Interest	Total				
0					16,000		-16,000		-16,000
1	40,000				16,000		24,000	8,160	15,840
2	40,000				16,000		24,000	8,160	15,840
3	40,000				16,000		24,000	8,160	15,840
4	40,000				16,000		24,000	8,160	15,840
5	40,000						40,000	13,600	26,400

Net Present Value at 20%: $35,615

Notes: Annual Lease Payment: 16,000

MARR = 20%

Tax Rate 34%

Table B-7 CASE A: Economic Analysis for a Performance Contract

EOY	Savings	Depr.	ESCO Payments			Principal Outstanding	Taxable Income	Tax	ATCF	Project Balance
					Total					
0										
1	40,000				32,000		8,000	2,720	5,280	5,280
2	40,000				32,000		8,000	2,720	5,280	11,616
3	40,000				32,000		8,000	2,720	5,280	19,219
4	40,000				32,000		8,000	2,720	5,280	28,343
5*	0				40,000		-40,000	-13,600	-26,400	7,612

Net Present Value at 20%: $3,059

Notes: ESCO purchases/operates equipment. Host pays ESCO 80% of the savings = $32,000.
PizzaCo's buys the equipment for $40,000 at the end of year 5. (short contract)

CASE B (DESIGNED TO FAVOR FAVOR A HOST-MANAGED ARRANGEMENT)

Qualitative Dominating Factors

- Company plans to stay in current location
- Maintenance/Energy Management Team is expanding and capable to handle project
- Management is Opposed to Outsourcing
- Management does not want contractual restrictions on production
- Management is interested in long-term projects
- Company is interested in future energy-management projects

Qualitative Information (supplied to participants)

Consider the same project as in Case Study A, except an entire chilled water system will be installed. There are also differences with the facility. In this case study, PizzaCo is very profitable and expanding. Production hours are expected to continue to increase. PizzaCo is increasing the capabilities of its in-house maintenance and energy management teams. The company is not re-locating, and plans to use the chilled water system indefinitely. Upper-level management has publicly engaged in an employee empowerment program, and is training employees to manage technically challenging projects. By delegating major responsibilities, upper-level management has been able to spend more time on generating new sales, which has been the reason for PizzaCo's success. However, PizzaCo wants to protect trade secrets and is opposed to outsourcing. Upper-level management desires "long-term" benefits and is willing to take on risks as well as add liabilities to the balance sheet (as long as all projects have a payback period less than five years). If this project is successfully implemented, additional budget funds will be allocated for energy management projects, which would allow additional equipment to be upgraded.

Quantitative Dominating Factors

- 15 year planning horizon
- Host has capital and good credit; therefore interest rates are low
- Larger loan amount causes a lower interest rate

Quantitative Information

The facility in Case B is in a healthy state of financial strength. The company is lucrative and expanding. The size of the borrowed amount is $2,500,000. Thus, the interest rate is relatively low. As expected, the interest rate for selling stock is slightly more than the other options. This facility's planning horizon is 15 years and the economic analysis is calculated for a project of that length.

	Loan	Bond	Sell Stock	Capital Lease
Interest Rate	10%	10%	11%	10%

Table B-8 CASE B: Economic Analysis for using Cash

EOY	Savings	Depr.	Payments Principal	Payments Interest	Payments Total	Principal Outstanding	Taxable Income	Tax	ATCF
0					2,500,000				-2,500,000
1	950,000	357,250					592,750	201,535	748,465
2	950,000	612,250					337,750	114,835	835,165
3	950,000	437,250					512,750	174,335	775,665
4	950,000	312,250					637,750	216,835	733,165
5	950,000	223,250					726,750	247,095	702,905
6	950,000	223,000					727,000	247,180	702,820
7	950,000	223,250					726,750	247,095	702,905
8	950,000	111,500					838,500	285,090	664,910
9	950,000	0					950,000	323,000	627,000
10	950,000	0					950,000	323,000	627,000
11	950,000	0					950,000	323,000	627,000
12	950,000	0					950,000	323,000	627,000
13	950,000	0					950,000	323,000	627,000
14	950,000	0					950,000	323,000	627,000
15	950,000	0					950,000	323,000	627,000
		2,500,000							

Net Present Value at 20%: $900,429

Notes:	Loan Amount:	0		
	Loan Finance Rate:	0%	MARR =	20%
			Tax Rate	34%
	MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5			
	Accounting Book Value at end of year 15:	0		
	Estimated Market Value at end of year 15:	0		

Table B-9 CASE B: Economic Analysis for using a Loan

EOY	Savings	Depr.	Payments			Principal	Taxable	Tax	ATCF
			Principal	Interest	Total	Outstanding	Income		
0						2,500,000			
1	950,000	357,250	78,684	250,000	328,684	2,421,316	342,750	116,535	504,781
2	950,000	612,250	86,552	242,132	328,684	2,334,764	95,618	32,510	588,806
3	950,000	437,250	95,208	233,476	328,684	2,239,556	279,274	94,953	526,363
4	950,000	312,250	104,728	223,956	328,684	2,134,828	413,794	140,690	480,626
5	950,000	223,250	115,201	213,483	328,684	2,019,626	513,267	174,511	446,805
6	950,000	223,000	126,721	201,963	328,684	1,892,905	525,037	178,513	442,803
7	950,000	223,250	139,394	189,290	328,684	1,753,511	537,460	182,736	438,580
8	950,000	111,500	153,333	175,351	328,684	1,600,179	663,149	225,471	395,845
9	950,000	0	168,666	160,018	328,684	1,431,512	789,982	268,594	352,722
10	950,000	0	185,533	143,151	328,684	1,245,980	806,849	274,329	346,987
11	950,000	0	204,086	124,598	328,684	1,041,894	825,402	280,637	340,679
12	950,000	0	224,495	104,189	328,684	817,399	845,811	287,576	333,740
13	950,000	0	246,944	81,740	328,684	570,455	868,260	295,208	326,108
14	950,000	0	271,639	57,045	328,684	298,816	892,955	303,605	317,711
15	950,000	0	298,816	29,882	328,684	0	920,118	312,840	308,462
		2,500,000							

Net Present Value at 20%: $2,191,179

Notes:	Loan Amount:	2,500,000	(used to purchase equipment at year 0)		
	Loan Finance Rate:	10%		MARR =	20%
				Tax Rate	34%
	MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5				
	Accounting Book Value at end of year 15:	0			
	Estimated Market Value at end of year 15:	0			

Table B-10 CASE B: Economic Analysis for using a Bond

EOY	Savings	Depr.	Payments Principal	Payments Interest	Payments Total	Principal Outstanding	Taxable Income	Tax	ATCF
0						2,500,000			
1	950,000	357,250		250,000	250,000	2,500,000	342,750	116,535	583,465
2	950,000	612,250		250,000	250,000	2,500,000	87,750	29,835	670,165
3	950,000	437,250		250,000	250,000	2,500,000	262,750	89,335	610,665
4	950,000	312,250		250,000	250,000	2,500,000	387,750	131,835	568,165
5	950,000	223,250		250,000	250,000	2,500,000	476,750	162,095	537,905
6	950,000	223,000		250,000	250,000	2,500,000	477,000	162,180	537,820
7	950,000	223,250		250,000	250,000	2,500,000	476,750	162,095	537,905
8	950,000	111,500		250,000	250,000	2,500,000	588,500	200,090	499,910
9	950,000	0		250,000	250,000	2,500,000	700,000	238,000	462,000
10	950,000	0		250,000	250,000	2,500,000	700,000	238,000	462,000
11	950,000	0		250,000	250,000	2,500,000	700,000	238,000	462,000
12	950,000	0		250,000	250,000	2,500,000	700,000	238,000	462,000
13	950,000	0		250,000	250,000	2,500,000	700,000	238,000	462,000
14	950,000	0		250,000	250,000	2,500,000	700,000	238,000	462,000
15	950,000	0	2,500,000	250,000	2,750,000	0	700,000	238,000	-2,038,000
		2,500,000							

Net Present Value at 20%: $2,466,713

Notes:	Bond Amount:	2,500,000 (used to purchase equipment at year 0)		
	Govt. Bond Finance Rate:	10.0%	MARR =	20%
			Tax Rate	34%
	MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5			
	Accounting Book Value at end of year 15:	0		
	Estimated Market Value at end of year 15:	0		

Table B-11 CASE B: Economic Analysis for Selling Stock

EOY	Savings	Depr.	Stock Transactions: Sale of Stock	Repurchase	Dividend Payments	Taxable Income	Tax	ATCF
0			*$ 2,500,000 from Stock Sale is used to purchase equipment, thus*					*ATCF = 0*
1	950,000	357,250			275,000	592,750	201,535	473,465
2	950,000	612,250			275,000	337,750	114,835	560,165
3	950,000	437,250			275,000	512,750	174,335	500,665
4	950,000	312,250			275,000	637,750	216,835	458,165
5	950,000	223,250			275,000	726,750	247,095	427,905
6	950,000	223,000			275,000	727,000	247,180	427,820
7	950,000	223,250			275,000	726,750	247,095	427,905
8	950,000	111,500			275,000	838,500	285,090	389,910
9	950,000	0			275,000	950,000	323,000	352,000
10	950,000	0			275,000	950,000	323,000	352,000
11	950,000	0			275,000	950,000	323,000	352,000
12	950,000	0			275,000	950,000	323,000	352,000
13	950,000	0			275,000	950,000	323,000	352,000
14	950,000	0			275,000	950,000	323,000	352,000
15	950,000	0		2,500,000	275,000	950,000	323,000	-2,148,000
		2,500,000						
					Net Present Value at 20%:			$1,952,411

Notes:	Value of Stock Sold (which is repurchased after year	2,500,000 (used to purchase equipment at year 0)		
	Cost of Capital = Annual Dividend Rate:	11%	MARR =	20%
			Tax Rate	34%
	MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5			
	Accounting Book Value at end of year 15:	0		
	Estimated Market Value at end of year 15:	0		

Table B-12 CASE B: Economic Analysis for a Capital Lease

EOY	Savings	Depr.	Payments in Advance			Principal	Taxable	Tax	ATCF
			Principal	Interest	Total	Outstanding	Income		
0			298,804	0	298,804	2,201,196			-298,804
1	950,000	357,250	78,684	220,120	298,804	2,122,512	372,630	126,694	524,502
2	950,000	612,250	86,553	212,251	298,804	2,035,959	125,499	42,670	608,526
3	950,000	437,250	95,208	203,596	298,804	1,940,751	309,154	105,112	546,084
4	950,000	312,250	104,729	194,075	298,804	1,836,022	443,675	150,849	500,347
5	950,000	223,250	115,202	183,602	298,804	1,720,820	543,148	184,670	466,526
6	950,000	223,000	126,722	172,082	298,804	1,594,098	554,918	188,672	462,524
7	950,000	223,250	139,394	159,410	298,804	1,454,704	567,340	192,896	458,300
8	950,000	111,500	153,334	145,470	298,804	1,301,370	693,030	235,630	415,566
9	950,000	0	168,667	130,137	298,804	1,132,703	819,863	278,753	372,443
10	950,000	0	185,534	113,270	298,804	947,169	836,730	284,488	366,708
11	950,000	0	204,087	94,717	298,804	743,082	855,283	290,796	360,400
12	950,000	0	224,496	74,308	298,804	518,586	875,692	297,735	353,461
13	950,000	0	246,945	51,859	298,804	271,641	898,141	305,368	345,828
14	950,000	0	271,641	27,164	298,804	0	922,836	313,764	337,431
15	950,000	0					950,000	323,000	627,000
		2,500,000							
						Net Present Value at 20%:			$2,003,973

Notes: Total Lease Amount: 2,500,000

However, Since the payments are in advance, the first payment is analogous to a Down-Payment

Thus the actual amount borrowed is only = 2,500,000 - 298,804 = 2,201,196

Lease Finance Rate: 10% — MARR = 20%

Tax Rate 34%

MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5

Accounting Book Value at end of year 15: 0

Estimated Market Value at end of year 15: 0

Table B-13 CASE B: Economic Analysis for a True Lease

EOY	Savings	Depr.	Payments Principal	Payments Interest	Payments Total	Principal Outstanding	Taxable Income	Tax	ATCF
0					400,000		-400,000	-136,000	-264,000
1	1,000,000				400,000		600,000	204,000	396,000
2	1,000,000				400,000		600,000	204,000	396,000
3	1,000,000				400,000		600,000	204,000	396,000
4	1,000,000				400,000		600,000	204,000	396,000
5	1,000,000				400,000		600,000	204,000	396,000
6	1,000,000				400,000		600,000	204,000	396,000
7	1,000,000				400,000		600,000	204,000	396,000
8	1,000,000				400,000		600,000	204,000	396,000
9	1,000,000				400,000		600,000	204,000	396,000
10	1,000,000				400,000		600,000	204,000	396,000
11	1,000,000				400,000		600,000	204,000	396,000
12	1,000,000				400,000		600,000	204,000	396,000
13	1,000,000				400,000		600,000	204,000	396,000
14	1,000,000				400,000		600,000	204,000	396,000
15	1,000,000				400,000		600,000	204,000	396,000

Net Present Value at 20%: $1,587,487

Notes: Annual Lease Payment:		400,000
MARR =	20%	
Tax Rate	34%	
Equipment Re-leased Every 5 years		

Table B-14 CASE B: Economic Analysis for a Performance Contract

EOY	Savings	Depr.	ESCO Payments		Total	Principal Outstanding	Taxable Income	Tax	ATCF
0									
1	1,000,000				800,000		200,000	68,000	132,000
2	1,000,000				800,000		200,000	68,000	132,000
3	1,000,000				800,000		200,000	68,000	132,000
4	1,000,000				800,000		200,000	68,000	132,000
5	1,000,000				800,000		200,000	68,000	132,000
6	1,000,000				800,000		200,000	68,000	132,000
7	1,000,000				800,000		200,000	68,000	132,000
8	1,000,000				800,000		200,000	68,000	132,000
9	1,000,000				800,000		200,000	68,000	132,000
10	1,000,000				800,000		200,000	68,000	132,000
11	1,000,000				800,000		200,000	68,000	132,000
12	1,000,000				800,000		200,000	68,000	132,000
13	1,000,000				800,000		200,000	68,000	132,000
14	1,000,000				800,000		200,000	68,000	132,000
15	1,000,000				800,000		200,000	68,000	132,000

Net Present Value at 20%: $617,162

Notes: ESCO purchases/operates equipment. Host pays ESCO 80% of the savings = $800,000.
PizzaCo receives ownership of the equipment at the end of year 15. (No additional purchase required)

CASE C (DESIGNED TO FAVOR THE PERFORMANCE CONTRACT)

Qualitative Dominating Factors

- No budget funds for equipment upgrade, thus project must be paid from savings
- Maintenance/Energy management team is insufficient for project
- Equipment needs to be replaced as soon as possible
- Facility manager is willing to outsource and structure an work with a contract
- Future facility operating hours are predictable

Qualitative Information (supplied to participants)

A large federal government building desperately needs to upgrade its 40 year-old HVAC system. The current equipment is extremely inefficient and falling apart. Maintenance has been deferred for many years due to decreasing budgets, minimal maintenance staff and lack of experience. The budgets for utility expenses and maintenance are expected to decline further in the future and the facility manager must upgrade or replace equipment to meet energy conservation goals established by Presidential Executive Orders. However, there are no budget funds available for major capital improvements. The building is needed for at least 30 more years, and operational hours are very predictable. If the HVAC system can be successfully upgraded, additional equipment retrofits are possible. Since this is a government facility, management is not as concerned about its "financial image" with respect to obtaining strong credit ratings. The facility manager is willing to invest time and structure an agreement to get the equipment installed. He is also willing to cooperate and outsource projects as long as they pay for themselves with savings and reduce technical and financial risks.

Quantitative Dominating Factors

- 15 year planning horizon
- Host has no budget funds for equipment upgrade
- Government facility can not sell stock
- Facility has access to moderate bond rates

Quantitative Information

The facility in Case C is in a poor state of financial strength. The facility has practically no capital to invest and is unable to manage the project internally. However, because the size of the borrowed amount is $2,500,000, the interest rate is at a moderate level. Selling stock is not an option for a government facility. However, the government facility can offer low-interest bonds, at an equivalent after-tax yield for investors. This facility's planning horizon is 15 years and the economic analysis is calculated for a project of that length.

	Loan	Bond	Sell Stock	Capital Lease
Interest Rate	15%	9.9%	Not Avail.	15%

Table B-15 CASE C: Economic Analysis for Using Cash

EOY	Savings	Depr.	Payments			Principal	Taxable	Tax	ATCF
			Principal	Interest	Total	Outstanding	Income		
0					2,500,000				-2,500,000
1	950,000	357,250					592,750	0	950,000
2	950,000	612,250					337,750	0	950,000
3	950,000	437,250					512,750	0	950,000
4	950,000	312,250					637,750	0	950,000
5	950,000	223,250					726,750	0	950,000
6	950,000	223,000					727,000	0	950,000
7	950,000	223,250					726,750	0	950,000
8	950,000	111,500					838,500	0	950,000
9	950,000	0					950,000	0	950,000
10	950,000	0					950,000	0	950,000
11	950,000	0					950,000	0	950,000
12	950,000	0					950,000	0	950,000
13	950,000	0					950,000	0	950,000
14	950,000	0					950,000	0	950,000
15	950,000	0					950,000	0	950,000
		2,500,000							

Net Present Value at 20%: $1,941,699

Notes:	Loan Amount:	0		
	Loan Finance Rate:	0%	MARR =	20%
			Tax Rate	34%
	MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5			
	Accounting Book Value at end of year 15:	0		
	Estimated Market Value at end of year 15:	0		
	Federal Government Facilities do not pay taxes			

Table B-16 CASE C: Economic Analysis for Using a Loan

EOY	Savings	Depr.	Payments Principal	Payments Interest	Payments Total	Principal Outstanding	Taxable Income	Tax	ATCF
0						2,500,000			
1	950,000	357,250	52,543	375,000	427,543	2,447,457	217,750	0	522,457
2	950,000	612,250	60,424	367,119	427,543	2,387,033	-29,369	0	522,457
3	950,000	437,250	69,488	358,055	427,543	2,317,544	154,695	0	522,457
4	950,000	312,250	79,911	347,632	427,543	2,237,633	290,118	0	522,457
5	950,000	223,250	91,898	335,645	427,543	2,145,735	391,105	0	522,457
6	950,000	223,000	105,683	321,860	427,543	2,040,052	405,140	0	522,457
7	950,000	223,250	121,535	306,008	427,543	1,918,517	420,742	0	522,457
8	950,000	111,500	139,765	287,778	427,543	1,778,752	550,722	0	522,457
9	950,000	0	160,730	266,813	427,543	1,618,022	683,187	0	522,457
10	950,000	0	184,840	242,703	427,543	1,433,182	707,297	0	522,457
11	950,000	0	212,566	214,977	427,543	1,220,616	735,023	0	522,457
12	950,000	0	244,451	183,092	427,543	976,165	766,908	0	522,457
13	950,000	0	281,118	146,425	427,543	695,047	803,575	0	522,457
14	950,000	0	323,286	104,257	427,543	371,761	845,743	0	522,457
15	950,000	0	371,761	55,764	427,543	0	894,236	0	522,475
		2,500,000							

Net Present Value at 20%: $2,442,735

Notes:	Loan Amount:	2,500,000 (used to purchase equipment at year 0)		
	Loan Finance Rate:	15%	MARR =	20%
			Tax Rate	34%
	MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5			
	Accounting Book Value at end of year 15:	0		
	Estimated Market Value at end of year 15:	0		
	Federal Government Facilities do not pay taxes			

Table B-17 CASE C: Economic Analysis for Using a Bond

EOY	Savings	Depr.	Payments Principal	Payments Interest	Payments Total	Principal Outstanding	Taxable Income	Tax	ATCF
0						2,500,000			
1	950,000	357,250		247,500	247,500	2,500,000	345,250	0	702,500
2	950,000	612,250		247,500	247,500	2,500,000	90,250	0	702,500
3	950,000	437,250		247,500	247,500	2,500,000	265,250	0	702,500
4	950,000	312,250		247,500	247,500	2,500,000	390,250	0	702,500
5	950,000	223,250		247,500	247,500	2,500,000	479,250	0	702,500
6	950,000	223,000		247,500	247,500	2,500,000	479,500	0	702,500
7	950,000	223,250		247,500	247,500	2,500,000	479,250	0	702,500
8	950,000	111,500		247,500	247,500	2,500,000	591,000	0	702,500
9	950,000	0		247,500	247,500	2,500,000	702,500	0	702,500
10	950,000	0		247,500	247,500	2,500,000	702,500	0	702,500
11	950,000	0		247,500	247,500	2,500,000	702,500	0	702,500
12	950,000	0		247,500	247,500	2,500,000	702,500	0	702,500
13	950,000	0		247,500	247,500	2,500,000	702,500	0	702,500
14	950,000	0		247,500	247,500	2,500,000	702,500	0	702,500
15	950,000	0	2,500,000	247,500	2,747,500	0	702,500	0	-1,797,500
		2,500,000							

Net Present Value at 20%: $3,122,256

Notes: Bond Amount: 2,500,000 (used to purchase equipment at year 0)
Govt. Bond Finance Rate: 9.9% MARR = 20%
Tax Rate 34%
MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5
Accounting Book Value at end of year 15: 0
Estimated Market Value at end of year 15: 0

Federal Government Facilities do not pay taxes

Table B-18 CASE C: Economic Analysis for Selling Stock

GOVERNMENT FACILITIES CAN NOT SELL STOCK
THUS NET PRESENT VALUE (AS INSERTED INTO E-FUND) = $0

Table B-19 CASE C: Economic Analysis for a Capital Lease

EOY	Savings	Depr.	Payments in Advance			Principal	Taxable	Tax	ATCF
			Principal	Interest	Total	Outstanding	Income		
0			371,776	0	371,776	2,128,224			-371,776
1	950,000	357,250	52,542	319,234	371,776	2,075,682	273,516	0	578,224
2	950,000	612,250	60,424	311,352	371,776	2,015,258	26,398	0	578,224
3	950,000	437,250	69,487	302,289	371,776	1,945,771	210,461	0	578,224
4	950,000	312,250	79,910	291,866	371,776	1,865,860	345,884	0	578,224
5	950,000	223,250	91,897	279,879	371,776	1,773,963	446,871	0	578,224
6	950,000	223,000	105,682	266,094	371,776	1,668,282	460,906	0	578,224
7	950,000	223,250	121,534	250,242	371,776	1,546,748	476,508	0	578,224
8	950,000	111,500	139,764	232,012	371,776	1,406,984	606,488	0	578,224
9	950,000	0	160,728	211,048	371,776	1,246,256	738,952	0	578,224
10	950,000	0	184,838	186,938	371,776	1,061,418	763,062	0	578,224
11	950,000	0	212,563	159,213	371,776	848,855	790,787	0	578,224
12	950,000	0	244,448	127,328	371,776	604,407	822,672	0	578,224
13	950,000	0	281,115	90,661	371,776	323,292	859,339	0	578,224
14	950,000	0	323,292	48,494	371,776	0	901,506	0	578,214
15	950,000	0					950,000	0	950,000
		2,500,000							

Net Present Value at 20%: $2,355,824

Notes: Total Lease Amount: 2,500,000

However, Since the payments are in advance, the first payment is analogous to a Down-Payment
Thus the actual amount borrowed is only = 2,500,000 - 371776 = 2,128,224

Lease Finance Rate: 15% MARR = 20%
Tax Rate 34%

MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5
Accounting Book Value at end of year 15: 0
Estimated Market Value at end of year 15: 0

Federal Government Facilities do not pay taxes

Table B-20 CASE C: Economic Analysis for a True Lease

EOY	Savings	Depr.	Payments			Principal	Taxable	Tax	ATCF
			Principal	Interest	Total	Outstanding	Income		
0					400,000		-400,000	0	-400,000
1	1,000,000				400,000		600,000	0	600,000
2	1,000,000				400,000		600,000	0	600,000
3	1,000,000				400,000		600,000	0	600,000
4	1,000,000				400,000		600,000	0	600,000
5	1,000,000				400,000		600,000	0	600,000
6	1,000,000				400,000		600,000	0	600,000
7	1,000,000				400,000		600,000	0	600,000
8	1,000,000				400,000		600,000	0	600,000
9	1,000,000				400,000		600,000	0	600,000
10	1,000,000				400,000		600,000	0	600,000
11	1,000,000				400,000		600,000	0	600,000
12	1,000,000				400,000		600,000	0	600,000
13	1,000,000				400,000		600,000	0	600,000
14	1,000,000				400,000		600,000	0	600,000
15	1,000,000				400,000		600,000	0	600,000

Net Present Value at 20%: $2,405,284

Notes:	Annual Lease Payment:		400,000
	MARR =	20%	
	Tax Rate	34%	
Equipment Re-leased Every 5 years			

Table B-21 CASE C: Economic Analysis for a Performance Contract

EOY	Savings	Depr.	ESCO Payments		Total	Principal Outstanding	Taxable Income	Tax	ATCF
0									
1	1,000,000				800,000		200,000	0	200,000
2	1,000,000				800,000		200,000	0	200,000
3	1,000,000				800,000		200,000	0	200,000
4	1,000,000				800,000		200,000	0	200,000
5	1,000,000				800,000		200,000	0	200,000
6	1,000,000				800,000		200,000	0	200,000
7	1,000,000				800,000		200,000	0	200,000
8	1,000,000				800,000		200,000	0	200,000
9	1,000,000				800,000		200,000	0	200,000
10	1,000,000				800,000		200,000	0	200,000
11	1,000,000				800,000		200,000	0	200,000
12	1,000,000				800,000		200,000	0	200,000
13	1,000,000				800,000		200,000	0	200,000
14	1,000,000				800,000		200,000	0	200,000
15	1,000,000				800,000		200,000	0	200,000

Net Present Value at 20%: $935,095

Notes: ESCO purchases/operates equipment. Host pays ESCO 80% of the savings = $800,000.
PizzaCo receives ownership of the equipment at the end of year 15.
Federal Government Facilities do not pay taxes.

CASE D (DESIGNED TO FAVOR A HOST-MANAGED ARRANGEMENT, MOST LIKELY A BOND)

Qualitative Dominating Factors:

- Maintenance/energy management team is capable to handle project
- Management is opposed to outsourcing
- Management is interested in getting maximum value per dollar spent
- This is the final phase in large project
- Future facility operational hours are predictable

Qualitative information (supplied to participants)

A State University (that has access to low bond rates) is entering the final phase of a campus-wide energy efficiency retrofit. The last facility to be retrofitted is the main library. The lighting system is old and needs to be replaced. Maintenance and utility budgets have remained constant for the past five years, and the university has an experienced maintenance team and in-house lighting experts, who are presently under-utilized. The university does not wish to outsource the project. The facility manager is very busy, but has had success working with his in-house staff to accomplish university growth and renovation objectives. He feels comfortable with his staff and is willing to assume technical and financial risks in order to implement an economically attractive project. This library is expected to be used for another 30 years, and the lighting retrofit needs to be completed quickly. The university is not desperate for capital, yet would like to evaluate its financing options carefully to get the most value per dollar spent. The facility manager is responsible for keeping costs below the budget limit. However, he is not as concerned about financial image with respect to obtaining strong credit ratings.

Quantitative Dominating Factors:

- 15 year planning horizon
- Low bond rates
- Selling stock is not an option for government facilities

Quantitative Information

The facility in Case D is in a healthy state of financial strength. The State University has extra capital to invest and is willing to assume risk for greater returns on investments. The size of the borrowed amount is $2,500,000. Thus, the interest rate is relatively low. Selling stock is not an option for a government facility. However, the government facility can offer low-interest bonds, at an equivalent after-tax yield for investors. This facility's planning horizon is 15 years and the economic analysis is calculated for a project of that length.

	Loan	Bond	Sell Stock	Capital Lease
Interest Rate	10%	6.6%	Not Avail.	10%

Table B-22 Case D: Economic Analysis for Using Cash

EOY	Savings	Depr.	Payments: Principal	Payments: Interest	Payments: Total	Principal Outstanding	Taxable Income	Tax	ATCF
0					2,500,000				-2,500,000
1	950,000	357,250					592,750	0	950,000
2	950,000	612,250					337,750	0	950,000
3	950,000	437,250					512,750	0	950,000
4	950,000	312,250					637,750	0	950,000
5	950,000	223,250					726,750	0	950,000
6	950,000	223,000					727,000	0	950,000
7	950,000	223,250					726,750	0	950,000
8	950,000	111,500					838,500	0	950,000
9	950,000	0					950,000	0	950,000
10	950,000	0					950,000	0	950,000
11	950,000	0					950,000	0	950,000
12	950,000	0					950,000	0	950,000
13	950,000	0					950,000	0	950,000
14	950,000	0					950,000	0	950,000
15	950,000	0					950,000	0	950,000
		2,500,000							

Net Present Value at 20%: $1,941,699

Notes:	Loan Amount:	0		
	Loan Finance Rate:	0%	MARR =	20%
			Tax Rate	34%
	MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5			
	Accounting Book Value at end of year 15:	0		
	Estimated Market Value at end of year 15:	0		
	Federal Government Facilities do not pay taxes			

Table B-23 Case D: Economic Analysis for a Loan

EOY	Savings	Depr.	Payments Principal	Payments Interest	Payments Total	Principal Outstanding	Taxable Income	Tax	ATCF
0						2,500,000			
1	950,000	357,250	78,684	250,000	328,684	2,421,316	342,750	0	621,316
2	950,000	612,250	86,552	242,132	328,684	2,334,764	95,618	0	621,316
3	950,000	437,250	95,208	233,476	328,684	2,239,556	279,274	0	621,316
4	950,000	312,250	104,728	223,956	328,684	2,134,828	413,794	0	621,316
5	950,000	223,250	115,201	213,483	328,684	2,019,626	513,267	0	621,316
6	950,000	223,000	126,721	201,963	328,684	1,892,905	525,037	0	621,316
7	950,000	223,250	139,394	189,290	328,684	1,753,511	537,460	0	621,316
8	950,000	111,500	153,333	175,351	328,684	1,600,179	663,149	0	621,316
9	950,000	0	168,666	160,018	328,684	1,431,512	789,982	0	621,316
10	950,000	0	185,533	143,151	328,684	1,245,980	806,849	0	621,316
11	950,000	0	204,086	124,598	328,684	1,041,894	825,402	0	621,316
12	950,000	0	224,495	104,189	328,684	817,399	845,811	0	621,316
13	950,000	0	246,944	81,740	328,684	570,455	868,260	0	621,316
14	950,000	0	271,639	57,045	328,684	298,816	892,955	0	621,316
15	950,000	0	298,816	29,882	328,684	0	920,118	0	621,302
		2,500,000							

Net Present Value at 20%: $2,904,945

Notes:
Loan Amount: 2,500,000 (used to purchase equipment at year 0)
Loan Finance Rate: 10% MARR = 20%
Tax Rate 34%
MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5
Accounting Book Value at end of year 15: 0
Estimated Market Value at end of year 15: 0

Federal Government Facilities do not pay taxes

Table B-24 Case D: Economic Analysis for a Bond

EOY	Savings	Depr.	Payments			Principal	Taxable	Tax	ATCF
			Principal	Interest	Total	Outstanding	Income		
0						2,500,000			
1	950,000	357,250		165,000	165,000	2,500,000	427,750	0	785,000
2	950,000	612,250		165,000	165,000	2,500,000	172,750	0	785,000
3	950,000	437,250		165,000	165,000	2,500,000	347,750	0	785,000
4	950,000	312,250		165,000	165,000	2,500,000	472,750	0	785,000
5	950,000	223,250		165,000	165,000	2,500,000	561,750	0	785,000
6	950,000	223,000		165,000	165,000	2,500,000	562,000	0	785,000
7	950,000	223,250		165,000	165,000	2,500,000	561,750	0	785,000
8	950,000	111,500		165,000	165,000	2,500,000	673,500	0	785,000
9	950,000	0		165,000	165,000	2,500,000	785,000	0	785,000
10	950,000	0		165,000	165,000	2,500,000	785,000	0	785,000
11	950,000	0		165,000	165,000	2,500,000	785,000	0	785,000
12	950,000	0		165,000	165,000	2,500,000	785,000	0	785,000
13	950,000	0		165,000	165,000	2,500,000	785,000	0	785,000
14	950,000	0		165,000	165,000	2,500,000	785,000	0	785,000
15	950,000	0	2,500,000	165,000	2,665,000	0	785,000	0	-1,715,000
		2,500,000							

Net Present Value at 20%: $3,507,982

Notes:	Bond Amount:	2,500,000 (used to purchase equipment at year 0)		
	Govt. Bond Finance Rate:	6.6%	MARR =	20%
			Tax Rate	34%
	MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5			
	Accounting Book Value at end of year 15:	0		
	Estimated Market Value at end of year 15:	0		
	Federal Government Facilities do not pay taxes			

Table B-25 Case D: Economic Analysis for Selling Stock

GOVERNMENT FACILITIES CAN NOT SELL STOCK
THUS NET PRESENT VALUE (AS INSERTED INTO E-FUND) = $0

Table B-26 Case D: Economic Analysis for a Capital Lease

EOY	Savings	Depr.	Payments in Advance Principal	Payments in Advance Interest	Payments in Advance Total	Principal Outstanding	Taxable Income	Tax	ATCF
0			298,804	0	298,804	2,201,196			-298,804
1	950,000	357,250	78,684	220,120	298,804	2,122,512	372,630	0	651,196
2	950,000	612,250	86,553	212,251	298,804	2,035,959	125,499	0	651,196
3	950,000	437,250	95,208	203,596	298,804	1,940,751	309,154	0	651,196
4	950,000	312,250	104,729	194,075	298,804	1,836,022	443,675	0	651,196
5	950,000	223,250	115,202	183,602	298,804	1,720,820	543,148	0	651,196
6	950,000	223,000	126,722	172,082	298,804	1,594,098	554,918	0	651,196
7	950,000	223,250	139,394	159,410	298,804	1,454,704	567,340	0	651,196
8	950,000	111,500	153,334	145,470	298,804	1,301,370	693,030	0	651,196
9	950,000	0	168,667	130,137	298,804	1,132,703	819,863	0	651,196
10	950,000	0	185,534	113,270	298,804	947,169	836,730	0	651,196
11	950,000	0	204,087	94,717	298,804	743,082	855,283	0	651,196
12	950,000	0	224,496	74,308	298,804	518,586	875,692	0	651,196
13	950,000	0	246,945	51,859	298,804	271,641	898,141	0	651,196
14	950,000	0	271,641	27,164	298,804	0	922,836	0	651,195
15	950,000	0					950,000	0	950,000
		2,500,000							

Net Present Value at 20%: $2,765,239

Notes: Total Lease Amount: 2,500,000

However, Since the payments are in advance, the first payment is analogous to a Down-Payment
Thus the actual amount borrowed is only = 2,500,000 - 298,804 = 2,201,196

Lease Finance Rate: 10%

MARR = 20%

Tax Rate 34%

MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5

Accounting Book Value at end of year 15: 0

Estimated Market Value at end of year 15: 0

Federal Government Facilities do not pay taxes

Table B-27 Case D: Economic Analysis for a True Lease

EOY	Savings	Depr.	Payments Principal	Payments Interest	Payments Total	Principal Outstanding	Taxable Income	Tax	ATCF
0					400,000		-400,000	0	-400,000
1	1,000,000				400,000		600,000	0	600,000
2	1,000,000				400,000		600,000	0	600,000
3	1,000,000				400,000		600,000	0	600,000
4	1,000,000				400,000		600,000	0	600,000
5	1,000,000				400,000		600,000	0	600,000
6	1,000,000				400,000		600,000	0	600,000
7	1,000,000				400,000		600,000	0	600,000
8	1,000,000				400,000		600,000	0	600,000
9	1,000,000				400,000		600,000	0	600,000
10	1,000,000				400,000		600,000	0	600,000
11	1,000,000				400,000		600,000	0	600,000
12	1,000,000				400,000		600,000	0	600,000
13	1,000,000				400,000		600,000	0	600,000
14	1,000,000				400,000		600,000	0	600,000
15	1,000,000				400,000		600,000	0	600,000

Net Present Value at 20%: $2,405,284

Notes:	Annual Lease Payment:		400,000
	MARR =	20%	
	Tax Rate	34%	
Equipment Re-leased Every 5 years			

Table B-28 Case D: Economic Analysis for a Performance Contract

EOY	Savings	Depr.	ESCO Payments			Principal Outstanding	Taxable Income	Tax	ATCF
					Total				
0									
1	1,000,000				800,000		200,000	0	200,000
2	1,000,000				800,000		200,000	0	200,000
3	1,000,000				800,000		200,000	0	200,000
4	1,000,000				800,000		200,000	0	200,000
5	1,000,000				800,000		200,000	0	200,000
6	1,000,000				800,000		200,000	0	200,000
7	1,000,000				800,000		200,000	0	200,000
8	1,000,000				800,000		200,000	0	200,000
9	1,000,000				800,000		200,000	0	200,000
10	1,000,000				800,000		200,000	0	200,000
11	1,000,000				800,000		200,000	0	200,000
12	1,000,000				800,000		200,000	0	200,000
13	1,000,000				800,000		200,000	0	200,000
14	1,000,000				800,000		200,000	0	200,000
15	1,000,000				800,000		200,000	0	200,000

Net Present Value at 20%: $935,095

Notes: ESCO purchases/operates equipment. Host pays ESCO 80% of the savings = $800,000.
PizzaCo receives ownership of the equipment at the end of year 15.
Federal Government Facilities do not pay taxes.

APPENDIX C

A USER'S GUIDE TO E-FUND

E-FUND
A USER'S GUIDE

E-FUND is a decision support system to help facility managers select financial arrangements for energy management projects

Developed by
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TABLE OF CONTENTS

INTRODUCTION TO E-FUND

E-FUND is a decision support system designed to help facility managers select the best financial arrangements for energy management projects. As you know, there are many ways to finance energy management projects, (loans, bonds, leases, performance contracts, etc.). Each financial arrangement has its own set of "pros" and "cons" that effect the true value added to the company. Through your responses, E-FUND will determine which financial arrangement is best for a particular energy management project in your facility.

To get started, proceed directly to the "How to use the E-FUND Spreadsheet" section, (next page). Following that section, reference material is provided to help you use the E-FUND model. It is important that you read the Assumptions About The Financial Arrangements before trying to use the E-FUND model. The Cumulative List of Objectives is also important because it represents the objectives a facility manager should consider when selecting a financial arrangement.

HOW TO USE THE E-FUND SPREADSHEET

Using the diskette included in this packet, open the E-FUND file using Microsoft Excel. Click on the "User's Guide" worksheet. *Note that although you will not need to use the "Behind the Scenes Calculations" worksheet, it presents the full spreadsheet with cell calculations.* Simply follow STEPS A, B and C to use the spreadsheet. Please note that your input should only go into columns that are colored "red" within the spreadsheet.

STEP A

Refer to the Cumulative List of Objectives and score the importance of each objective Table #1. In other words, based on the energy management project and your facility's needs, ask yourself, "how important is each objective to me?" The scoring scale is based on a "1" to "9" scale, where a rating of "9" indicates that the objective is very important. Insert your scores under the middle column (colored red) in Table #1 within the spreadsheet. Note that you are only supposed to change the middle column in Tables #1 through #3. The E-FUND spreadsheet will automatically adjust the "% Importance" column. *Based on the example below, sample scores are already entered in the spreadsheet. When applying E-FUND to your facility, simply overwrite these "red" scores.*

EXAMPLE CASE STUDY

Consider a government facility with an under-staffed maintenance crew and a small budget to invest in projects. Tremendous savings are possible if a complex energy management control system is installed. The facility manager would like to use a specific equipment brand that functions well with existing equipment. The energy manager is a volunteer employee, and it would be risky to have him manage such a complex project. The facility needs many other equipment retrofits, but is lacking energy management and maintenance expertise. Since this is a government facility, management is not as concerned about its "financial image" with respect to obtaining strong credit ratings. However, the facility manager must use his budget wisely. Thus, having an economically beneficial project is important, especially if the project only generates funds.

EXAMPLE CASE STUDY (continued)

In this scenario, the "scores of importance" in the middle column of the Example Score Sheet below could represent a facility manager's responses.

Unimportant : 1 : 2 : 3 : 4 : 5 : 6 : 7 : 8 : 9 : Very Important

EXAMPLE SCORE SHEET

Objective #	Score of Importance	*% Importance*
1	8	*18*
2	7	*16*
3	5	*11*
4	3	*7*
5	4	*9*
6	5	*11*
7	1	*2*
8	7	*16*
9	1	*2*
10	3	*7*

After you insert your scores in the middle column, Table #1 will be complete, and will serve as a record of the original scores for each objective. Table #2 will be used to optimize the model. First, in the middle column of Table #2, retype the same scores as in Table #1. Now we will eliminate the unimportant objectives (the objectives with the lowest % importance). In the middle column of Table #2, place a "0" score next to the lowest ranking objectives until achieving at least 70% Cumulative Importance Maintained (bottom of Table #2). This will require you to go below 70% and then re-insert the score for the last objective eliminated.

Table #3 shows the normalized values of the revised scores (from Table #2). The normalized values in Table #3 (% Importance) are the values used for E-FUND's calculations. If you want to change the importance of the objectives, simply change the scores in Table #3 (beyond the 9-point scale), until you reach the desired % Importance for each objective. *In the example, by changing Objective #1's score to 24, the normalized % Importance changes to 50%.*

STEP B

Now insert the Net Present Value for each financial arrangement in Table #4. Insert these values into the appropriate column (colored red).

STEP C

Now look at the results from E-FUND. The highest scoring arrangement is the arrangement that E-FUND selected based on your input.

ASSUMPTIONS ABOUT THE FINANCIAL ARRANGEMENTS

Some assumptions were made to allow the E-FUND model to work. This model assumes that the facility manager already wants to implement the project, and is seeking the best financing arrangement to do so. Seven different financial arrangements were included in the model: using cash, a loan, a bond, selling stock, a capital lease, a true lease and a performance contract. As described in the Appendix, these are the basic arrangements used to finance energy management projects. *However, it is acknowledged that these arrangements can be combined to produce unique "hybrid" arrangements for a specific application.* The true lease and performance contract are generally structured with maintenance service and/or project management agreements. All other arrangements are "host-managed"; thus the host manages the project. The assumptions below distinguish the different financial arrangements used in this model. For a thorough explanation of the different financial arrangements, see the Appendix.

<u>Purchase with cash, loan, bond, selling stock or a capital lease</u>

- All of these arrangements assume that the host manages the EMP.
- The Net Present Value of each arrangement will be different due to differences in the cost of capital, tax treatment, and cash flow timing. The differences in NPV will distinguish these arrangements.
- The capital lease is treated as an installment loan.
- With selling stock, the host is expected to pay periodic dividends to shareholders.

<u>True lease or operating lease</u>

- This is an "off-balance sheet" arrangement, and the host avoids adding liabilities or putting up collateral.
- This lease is essentially a rental agreement. The host is "lessee" and although unlikely for large EMPs, does not automatically take ownership of the equipment at the end of the contract. However, the host can purchase the equipment for fair market value at the end of the contract.
- Assume that a maintenance service agreement is included in the lease so that the impact on the host's maintenance team is minimal.

<u>Performance contract</u>

- An Energy Service Company manages the EMP. The ESCO supplies installation, management and maintenance services for the project, thereby minimizing impact on the host's maintenance and energy management teams.
- Assumes the ESCO offers a guaranteed savings performance contract. The ESCO and the facility share any savings that exceed the guaranteed amount. The contract requires the host to operate a minimum number of operating hours per year.
- The host makes no initial investment (the project is "paid from savings")
- The performance contract will require the host's administrative personnel to become more involved (due to more extensive contracts) than with the other agreements.
- The host takes ownership of the equipment at the end of the contract.
- The contract may provide a more comprehensive system-wide approach, which could obtain greater savings with additional equipment installation, or complimentary improvements.
- Assume the ESCO has an excellent reputation and is financially strong.

THE CUMULATIVE LIST OF OBJECTIVES

The Cumulative List of Objectives below represent key objectives that a facility manager should consider when selecting a financial arrangement for an EMP in a typical facility. Please refer to the Cumulative List of Objectives when applying E-FUND. *Note that all economic considerations are included in Objective #1.*

#	CUMULATIVE LIST OF OBJECTIVES	EXPLANATIONS/ EXAMPLES
1	To have a high economic benefit (High Net Present Value, or Short Payback Period).	Facility managers often select projects with a short Payback Period, or projects with a high Net Present Value. *The NPV of each arrangement incorporates all quantitative factors; such as the finance rate assigned by the lender, the timing and amount of the cash flows, as well as the additional costs (administrative, maintenance, legal) required by a certain EMP under a particular arrangement.* Thus, the NPV of each arrangement is the cumulative assessment of all quantitative objectives relating to installing the EMP in a particular facility, using a particular financial arrangement.
2	To reduce the host's risk by using a guaranteed savings performance contract, where the host makes no initial investment, and the project's costs are "paid from savings".	In this case, an Energy Service Company installs and operates the equipment. The ESCO shares the savings with the host, which encourages both parties to maximize savings, and look out for each other. A guaranteed amount of savings (as offered by a performance contract) can reduce the host's risk if the EMP is technically or financially challenging. "Paid from savings" contracts require no up-front investment, allowing the host to preserve in-house funds for other company purposes.
3	To minimize the additional impact on the maintenance and energy management teams. or To compliment maintenance goals and improve effectiveness.	Based on the EMP's complexity and the host's in-house expertise, the host's maintenance and energy management teams may need to devote attention that should be focused elsewhere (i.e. implementing other profit improvement measures). However, if the financial arrangement (such as a performance contract) provides maintenance and technical services or improves maintenance effectiveness, the in-house resources can focus their attention on core business goals.
4	To use a comprehensive, "system-wide" approach to maximize the replacement of outdated equipment.	Performance Contracts can be "bundled" to include other services and projects, creating a larger, more comprehensive package. This is the opposite of "cream skimming." For example, a lighting retrofit may be "bundled" with a chiller retrofit to obtain additional "system-wide" benefits.

5	To have an "easy to understand" agreement that minimizes the impact on the host's administrative personnel.	A simple agreement can "stand by itself" (no matter who is interpreting it) and minimize the potential for litigation in the future. Complex contracts may require the host's administrative personnel to devote attention that should be focused on achieving core business goals.
6	To minimize contractual restraints, so the facility manager has greater flexibility and control over the project.	A performance contract can require the host to operate a minimum number of hours per year, thereby restricting the host's ability to change operations and react to unforeseen circumstances. In addition, contracts may restrict the facility manager's ability to specify equipment, use specific vendors or obtain other preferences.
7	To protect the host's financial image by using off-balance sheet financing and avoid using collateral that could be spared to support future financing.	If available, "off-balance sheet" financing, as with a True Lease (a rental agreement), allows the host to use the equipment without purchasing it. This keeps project liabilities off the balance sheet, allowing the host to retain a stronger financial image. Minimizing the amount of collateral (on Uniform Commercial Code filings) improves the host's ability to obtain future financing.
8	To structure an arrangement such that annual savings are always greater than annual payments. Thus, the project only has positive cash flows.	If the maximum payment is set equal to the minimum savings estimate, the project should have only positive cash flows, (provided the equipment will last long enough to pay itself off). In the event of unforeseen or periodic project expenses, an agreement with adjustable payments can be used to eliminate annual profit shortfalls. In such a case, the agreement could be changed so the host makes smaller payments for a longer time period.
9	To secure fixed interest rate financing for the length of the project.	If possible, securing fixed interest rate financing would reduce risk relating to interest rate fluctuation. This can be helpful when financing the construction and operational phases of the project.
10	To be able to easily expand the scope of the arrangement.	Certain arrangements permit either party to suggest improvements that can be added easily to the scope of work. Also in certain financial arrangements, it is easy to acquire additional financing with minimal paperwork.

APPENDIX: *An Article about Financing Energy Management Projects*

This article can help the facility manager understand the basic financial arrangements for energy management projects. The source is Chapter II from Eric A. Woodroof's Ph.D. Dissertation at Oklahoma State University, 1998. This chapter was also published: Woodroof, E. and Turner, W. (1998), "Financial Arrangements for Energy Management Projects", *Energy Engineering*, 95(3), pp. 23-71.

2.1 OUTLINE

2.2 INTRODUCTION

Cost-effective energy management projects (EMPs) exist; however, many are not implemented due to a firm's cash flow constraints. A study of manufacturing facilities revealed that first-cost and capital constraints represented over 35% of the reasons cost-effective EMPs were not implemented [U.S. Department of Energy, 1996]. Thus, additional energy savings can be reaped, if we find a way to reduce the facility manager's fear of "first costs".

Alternative finance arrangements can overcome the "initial cost" obstacle, allowing firms to implement more EMPs. However, many facility managers are either unaware or have difficulty understanding the variety of financial arrangements available to them. Sullivan and Smith [1993] found that most facility managers use simple payback analyses to evaluate projects, which do not reveal the added value of after-tax benefits. Fretty [1996] found that sometimes facility managers do not implement an EMP because financial terminology and contractual details intimidate them.

To meet the growing demand, there has been a dramatic increase in the number of finance companies specializing in EMPs. At the 1996 World Energy Engineering Congress, finance companies represented the most common exhibitor type. These financiers are introducing new payment arrangements to implement EMPs. Often, the financier's innovation will satisfy the unique customer needs of a large facility. This is a great service however, most financiers are not attracted to small facilities with EMPs requiring less than $100,000 [Burke, 1997; Duca, 1998]. Thus, many facility managers remain unaware or confused about the common financial arrangements that could help them implement EMPs.

The purpose of this paper is to help facility managers understand the financial arrangements available to them. Hopefully, with an improved understanding, facility managers will use financial arrangements more frequently and increase the implementation rate of good energy management projects.

This article is divided into several parts. First, a simple example will introduce the basic financial arrangements. Then, terminology is defined and each arrangement is explained in greater detail. To show how to evaluate each arrangement, they are applied to a case study. *For readers that understand the financial arrangements, the section "Pros & Cons of each Financial Arrangement" may be useful.*

2.3 A SIMPLE EXAMPLE

Consider a small company "PizzaCo" that makes frozen pizzas, and distributes them regionally. PizzaCo uses an old delivery truck that breaks down frequently and is inefficient. Assume the old truck has no salvage value and is fully depreciated. PizzaCo's management would like to obtain a new and more efficient truck to reduce expenses and improve reliability. However, they do not have the cash on hand to purchase the truck. Thus, they consider their financing options.

2.3.1 Purchase the Truck with a Loan or Bond

Just like most car purchases, PizzaCo borrows money from a lender (a bank) and agrees to a monthly re-payment plan. Figure II-1 shows PizzaCo's annual cash flows for a loan. The *solid arrows* represent the financing cash flows between PizzaCo and the bank. Thus, at time zero when PizzaCo borrows the money, they receive a large sum of money from the bank, which is a positive cash flow. Each year, PizzaCo makes payments (on the principal, plus interest based on the unpaid balance), until the balance owed is zero. The payments are the negative cash flows.

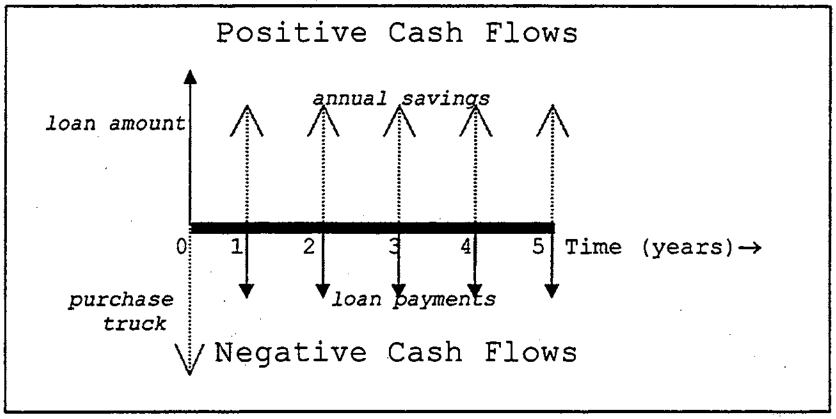

Figure VI-1 PizzaCo's Cash Flows for a Loan

The *dashed arrows* represent the truck purchase as well as savings cash flows. Thus, at time zero, PizzaCo purchases the truck (a negative cash flow) with the money from the bank. Due to the new truck's greater efficiency, PizzaCo's annual expenses are reduced (which is a savings). The annual savings are the positive cash flows. The remaining cash flow diagrams in this paper utilize the same format.

PizzaCo could also purchase the truck by selling a bond. This arrangement is similar to a loan, except investors (not a bank) give PizzaCo a large sum of money (called the bond's "par value"). Periodically, PizzaCo would pay the investors *only* the interest accumulated. As Figure II-2 shows, when the bond reaches maturity, PizzaCo returns the par value to the investors. The equipment purchase and savings cash flows are the same as with the loan.

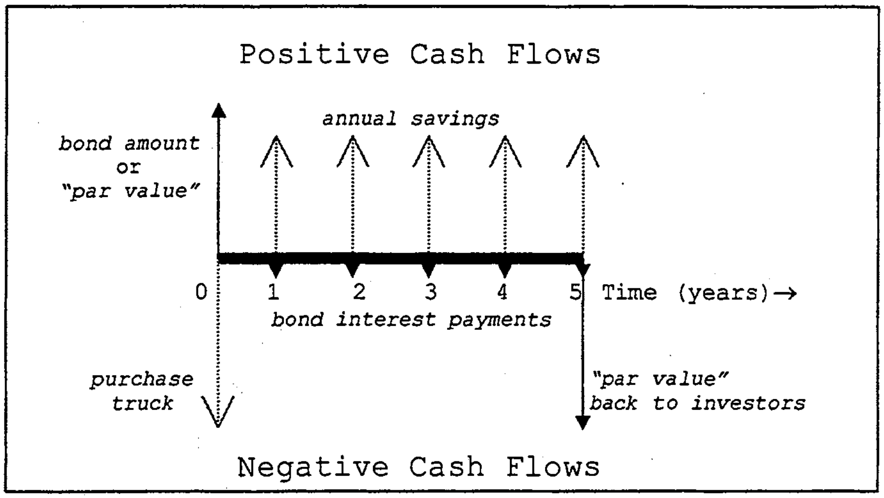

Figure VI-2 PizzaCo's Cash Flows for a Bond

2.3.2 Sell Stock to Purchase the Truck

In this arrangement, PizzaCo sells its stock to raise money to purchase the truck. In return, PizzaCo is expected to pay dividends back to shareholders. Selling stock has a similar cash flow pattern as a bond, with a few subtle differences. Instead of interest payments to bondholders, PizzaCo would pay dividends to shareholders until some future date when PizzaCo could buy the stock back. However, these dividend payments are not mandatory, and if PizzaCo is experiencing financial strain, it does not need to distribute dividends. On the other hand, if PizzaCo's profits increase, this wealth will be shared with the new stockholders, because they now own a part of the company.

2.3.3 Rent the Truck

Just like renting a car, PizzaCo could rent a truck for an annual fee. This would be equivalent to a true lease. The rental company (lessor) owns and maintains the truck for PizzaCo (the lessee). PizzaCo pays the rental fees (lease payments) which are tax-deductible business expenses.

Figure II-3 shows that the lease payments (solid arrows) start as soon as the equipment is leased (year zero) to account for lease payments paid in advance.[9] Notice that the savings cash flows are essentially the same as the previous arrangements, except there is no equipment purchase, which is a large negative cash flow at year zero.

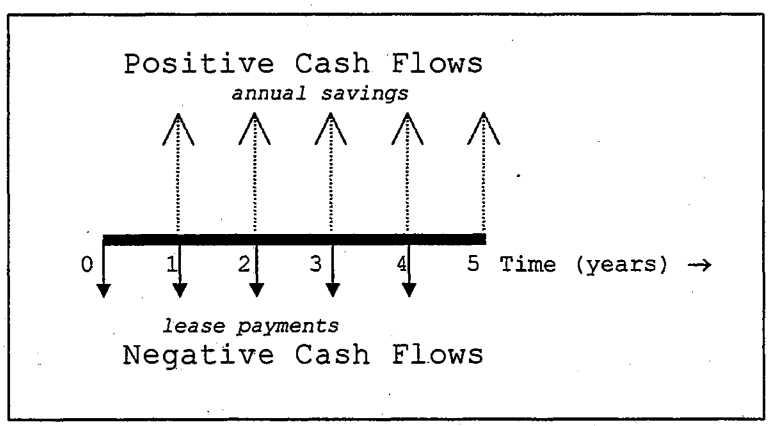

Figure VI-3 PizzaCo's Cash Flows for a True Lease

the equipment's useful life. The lease is cancelable because the truck can be leased easily to someone else. At the end of the lease, PizzaCo can either return the truck or renew the lease. In a separate transaction, PizzaCo could also negotiate to buy the truck at the fair market value.

If PizzaCo wanted to secure the option to buy the truck (for a bargain price) at the end of the lease, then they would use a capital lease. A capital lease can be structured like an installment loan, however ownership is not transferred until the end of the lease. The lessor retains ownership as security in case the lessee (PizzaCo) defaults on payments. Because the entire cost of the truck is eventually paid, the lease payments are larger than the payments in a true lease, (assuming similar lease periods). Figure II-4 shows the cash flows for a capital lease with advance payments and a bargain purchase option at the end of year five.

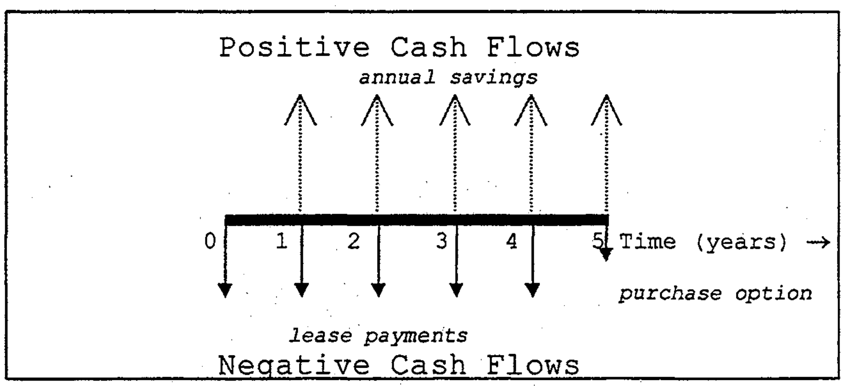

Figure VI-4 PizzaCo's Cash Flows for a Capital Lease

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[g] Lease payments "in arrears" (starting at the end of the first year) could also be arranged. However, the leasing company may require a security deposit as collateral.

There are some additional scenarios for lease arrangements. A "vendor-financed" agreement is when the lessor (or lender) is the equipment manufacturer. Alternatively, a third party could serve as a financing source. With "third party financing", a finance company would purchase a new truck and lease it to PizzaCo. In either case, there are two primary ways to repay the lessor.

1. With a "fixed payment plan"; where payments are due whether or not the new truck actually saves money.
2. With a "flexible payment plan"; where the savings from the new truck are shared with the third party, until the truck's purchase cost is recouped with interest. This is basically a "shared savings" arrangement.

2.3.4 Subcontract Pizza Delivery to a Third Party

Since PizzaCo's primary business is not delivery, it could subcontract that responsibility to another company. Let's say that a delivery service company would provide a truck and deliver the pizzas at a reduced cost. Each month, PizzaCo would pay the delivery service company a fee. However, this fee is guaranteed to be less than what PizzaCo would have spent on delivery. Thus, PizzaCo would obtain savings without investing any money or risk in a new truck. This arrangement is analogous to a performance contract.

This arrangement is very similar to a third-party lease and a shared savings agreement. However with a performance contract, the contractor assumes most of the risk, (because he supplies the equipment, with little or no investment from PizzaCo). The contractor also is responsible for ensuring that the delivery fee is less than what PizzaCo would have spent. For the PizzaCo example, the arrangement would designed under the conditions below.

- The delivery company owns and maintains the truck. It also is responsible for all operations related to delivering the pizzas.
- The monthly fee is related to the number of pizzas delivered. This is the *performance* aspect of the contract; if PizzaCo doesn't sell many pizzas, the fee is reduced.[h] Thus, the delivery company assumes these risks:
    1. PizzaCo will remain solvent, and
    2. PizzaCo will sell enough pizzas to cover costs, and
    3. the new truck will operate as expected and will actually reduce expenses per pizza, and
    4. the external financial risk, such as inflation and interest rate changes, are acceptable.

[h] A minimum amount of pizzas may be required by the delivery company (performance contractor) to cover costs.

- Because the delivery company is financially strong and experienced, it can usually obtain loans at low interest rates.
- The delivery company is an expert in delivery; it has specially skilled personnel and uses efficient equipment. Thus, the delivery company can deliver the pizzas at a lower cost (even after adding a profit) than PizzaCo.

Figure II-5 shows the net cash flows according to PizzaCo. Since the delivery company simply reduces PizzaCo's operational expenses, there is only a net savings. There are no negative financing cash flows.

Unlike the other arrangements, the delivery company's fee is a less expensive <u>substitute</u> for PizzaCo's in-house delivery expenses. With the other arrangements, PizzaCo had to pay a specific financing cost (loan, bond or lease payments, or dividends) associated with the truck, whether or not the truck actually saved money. With a performance contract, the delivery company is paid from the operational savings it generates. Because the savings are greater than the fee, there is a net savings. Often, the contractor guarantees the savings.

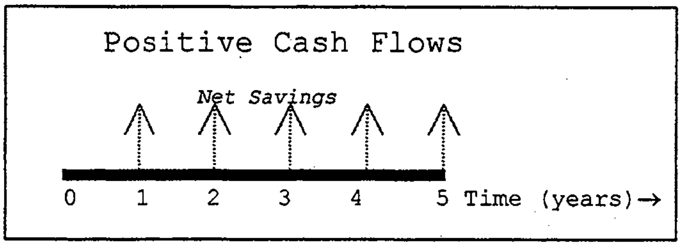

Figure VI-5 PizzaCo's Cash Flows for a Performance Contract

Supplementary Note: Combinations of the basic finance arrangements are possible. For example, a shared savings arrangement can be structured within a performance contract. Also, performance contracts are often designed so that the host facility (PizzaCo) would own the asset at the end of the contract.

2.4 FINANCIAL ARRANGEMENTS IN DETAIL

To explain the basic financial arrangements in more detail, each one is applied to an energy management-related case study. To understand the economics behind each arrangement, some finance terminology is presented below.

2.4.1 Finance Terminology

Equipment can be purchased with cash on-hand (officially labeled "retained earnings"), a loan, a bond, a capital lease or by selling stock. Alternatively, equipment can be utilized with a true lease or with a performance contract.

Note that with performance contracting, the building owner is not paying for the equipment itself, but the benefits provided by the equipment. *In the Simple Example, the benefit was the pizza delivery. PizzaCo was not concerned with what type of truck was used.*

The decision to purchase or utilize equipment is partly dependent on the company's strategic focus. Cooke and Bonmeli [1967] found that if the company wants to delegate some or all of the responsibility of managing a project, it should use a true lease, or a performance contact. However, if the company wants to be intricately involved with the

EMP, purchasing and self-managing the equipment could yield the greatest profits. When the building owner purchases equipment, he/she usually maintains the equipment, and lists it as an asset on the balance sheet so it can be depreciated.

Financing for purchases has two categories:

1. Debt Financing, which is borrowing money from someone else, or another firm.
   (using loans, bonds and capital leases)

2. Equity Financing, which is using money from your company, or your stockholders.
   (using retained earnings, or issuing common stock)

In all cases, the borrower will pay an interest charge to borrow money. The interest rate is called the "cost of capital". The cost of capital is essentially dependent on three factors: (1) the borrower's credit rating, (2) project risk and (3) external risk. External risk can include energy price volatility, industry-specific economic performance as well as global economic conditions and trends. The cost of capital (or "cost of borrowing") influences the return on investment. If the cost of capital increases, then the return on investment decreases.

The "minimum attractive rate of return" (MARR) is a company's "hurdle rate" for projects. Only projects with a return on investment greater than the MARR should be accepted. The MARR is also used as the discount rate to determine the "net present value" (NPV).

The NPV converts the worth of future cash flows into their equivalent worth today, so all cash flows can be compared at the same point in time. NPV converts future cash flows by using a specific discount rate. *For example, at 10%, $1,000 dollars received one year from now is worth only $909.09 dollars today. In other words, if $909.09 dollars is invested today (at 10% interest per year), in one year it would be worth $1,000.* NPV is useful because future cash flows can be converted back to "time zero" (present). Then, the project's initial cost is subtracted from the converted cash flows to determine the NPV. If the NPV is positive, the investment is acceptable.

2.4.2 Explanation of Figures and Tables

Throughout this chapter's case study, figures are presented to illustrate the transactions of each arrangement. Tables are also presented to show how to perform the economic analyses of the different arrangements. The NPV is calculated for each arrangement.

It is important to note that the NPV of a particular arrangement can change significantly if the cost of capital, MARR, equipment residual value, or project life is adjusted. Thus, the examples within this paper are provided only to illustrate how to perform the analyses. The cash flows and interest rates are estimates, which can vary from project to project. To keep the calculations simple, end-of-year cash flows are used throughout this paper.

Within the tables, the following abbreviations and equations are used:

EOY	= End of Year
Savings	= Pre-Tax Cash Flow
Depr.	= Depreciation
Taxable Income	= Savings - Depreciation - Interest Payment
Tax	= (Taxable Income)*(Tax Rate)
ATCF	= After Tax Cash Flow = Savings - Total Payments - Taxes

Table II-1 shows the basic equations that are used to calculate the values under each column heading within the economic analysis tables.

Table VI-1 Table of Sample Equations used in Economic Analyses

A	B	C	D	E	F	G	H	I	J
EOY	Savings	Depreciation	Payments			Principal Outstanding	Taxable Income	Tax	ATCF
			Principal	Interest	Total				
n n+1 n+2		= (MACRS %)*(Purchase Price)			=(D)+(E)	=(G at year n)-(D at year n+1)	=(B)-(C)-(E)	=(H)*(tax rate)	=(B)-(F)-(I)

Regarding depreciation, the "modified accelerated cost recovery system" (MACRS) is used in the economic analyses. This system indicates the percent depreciation claimable year-by-year after the equipment is purchased. Table II-2 shows the MACRS percentages for seven-year property. *For example, after the first year, an owner could depreciate 14.29% of an equipment's value. The equipment's "book value" equals the remaining unrecovered depreciation. Thus, after the first year, the book value would be 100%-14.29%, which equals 85.71% of the original value. If the owner sells the property before it has been fully depreciated, he/she can claim the book value as a tax-deduction.* [i]

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[i] To be precise, the IRS uses a "half-year convention" for equipment that is sold before it has been completely depreciated. In the tax year that the equipment is sold, (say year "x") the owner claims only ½ of the MACRS depreciation percent for that year. (This is because the owner has only used the equipment for a fraction of the final year.) Then on a separate line entry, (in the year "x*"), the remaining unclaimed depreciation is claimed as "book value". The x* year is presented as a separate line item to show the book value treatment, however x* entries occur in the same tax year as "x".

Table VI-2 MACRS Depreciation Percentages

EOY	MACRS Depreciation Percentages for 7-Year Property
0	0
1	14.29%
2	24.49%
3	17.49%
4	12.49%
5	8.93%
6	8.92%
7	8.93%
8	4.46%

2.5 THE CASE STUDY

Suppose PizzaCo (*the host*) needs a new chilled water system for a specific process in its manufacturing plant. The installed cost of the new system is $2.5 million. The expected equipment life is 15 years, however the process will only be needed for 5 years, after which the chilled water system will be sold at an estimated market value of $1,200,000 (book value at year five = $669,375). The chilled water system should save PizzaCo about $1 million/year in energy savings. PizzaCo's tax rate is 34%. The equipment's annual maintenance and insurance cost is $50,000. PizzaCo's MARR is 18%.

Since at the end of year 5, PizzaCo expects to sell the asset for an amount greater than its book value, the additional revenues are called a "capital gain", (which equals the market value - book value) and are taxed. If PizzaCo sells the asset for less than its book value, PizzaCo incurs a "capital loss".

PizzaCo does not have $2.5 million to pay for the new system, thus it considers its finance options. PizzaCo is a small company with an average credit rating, which means that it will pay a higher cost of capital than a larger company with an excellent credit rating. As with any borrowing arrangement, if investors believe that an investment is risky, they will demand a higher interest rate.

2.5.1 Purchase Equipment with Retained Earnings

If PizzaCo did have enough retained earnings (cash on-hand) available, it could purchase the equipment without external financing. Although external finance expenses would be zero, any cash used to purchase the equipment would carry an "opportunity cost", because that cash could have been used to earn a return somewhere else. This opportunity cost rate is usually set equal to the MARR.

Of all the arrangements described in this paper, purchasing equipment with retained earnings is probably the simplest to understand. For this reason, it will serve as a brief example and introduction to the economic analysis tables that are used throughout this paper.

Application to the Case Study

Figure II-6 illustrates the resource flows between the parties. In this arrangement, PizzaCo purchases the chilled water system directly from the equipment manufacturer.

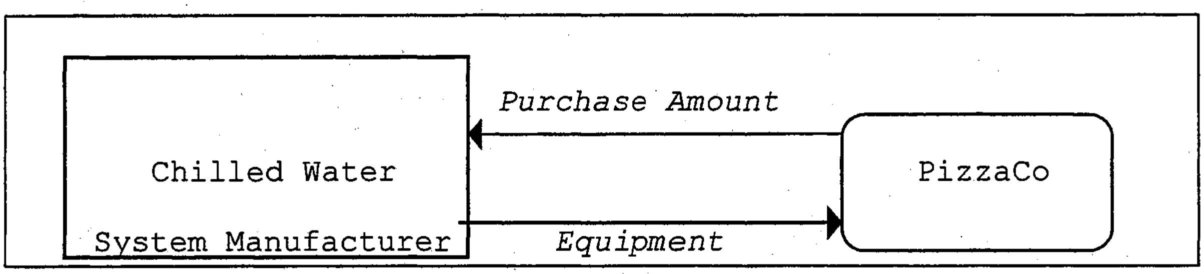

Figure VI-6 Resource Flows for Using Retained Earnings

Once the equipment is installed, PizzaCo recovers the full $1 million/year in savings for the entire five years, but must spend $50,000/year on maintenance and insurance. At the end of the five-year project, PizzaCo expects to sell the equipment for its market value of $1,200,000. Assume MARR is 18%, and the equipment is classified as 7-year property for MACRS depreciation. Table II-3 shows the economic analysis for purchasing the equipment with retained earnings.

Table VI-3 Economic Analysis for Using Retained Earnings

EOY	Savings	Depr.	Payments Principal	Payments Interest	Payments Total	Principal Outstanding	Taxable Income	Tax	ATCF
0					2,500,000				-2,500,000
1	950,000	357,250					592,750	201,535	748,465
2	950,000	612,250					337,750	114,835	835,165
3	950,000	437,250					512,750	174,335	775,665
4	950,000	312,250					637,750	216,835	733,165
5	950,000	111,625					838,375	285,048	664,953
5*	1,200,000	669,375					530,625	180,413	1,019,588
		2,500,000							

Net Present Value at 18%: $320,675

Notes:	Loan Amount:	0		
	Loan Finance Rate:	0%	MARR =	18%
			Tax Rate	34%
	MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5			
	Accounting Book Value at end of year 5:	669,375		
	Estimated Market Value at end of year 5:	1,200,000		
	EOY 5 illustrates the Equipment Sale and Book Value*			
	Taxable Income:	=(Market Value - Book Value)		
		=(1,200,000 - 669,375) = $530,625		

Reading Table II-3 from left to right, and top to bottom, at EOY 0, the single payment is entered into the table. Each year thereafter, the savings as well as the depreciation (which equals the equipment purchase price multiplied by the appropriate MACRS % for each year) are entered into the table. Year by year, the taxable income = savings - depreciation. The taxable income is then taxed at 34% to obtain the tax for each year. The after-tax cash flow = savings - tax for each year.

At EOY 5, the equipment is sold before the entire value was depreciated. EOY 5* shows how the equipment sale and book value are claimed. In summary, the NPV of all the ATCFs would be $320,675.

2.5.2 Loans

Loans have been the traditional financial arrangement for many types of equipment purchases. Kastantin [1986] claimed that a bank's willingness to loan depends on the borrower's financial health, experience in energy management and number of years in business.

Morgan [1991] pointed out that obtaining a bank loan can be difficult if the loan officer is unfamiliar with EMPs. Loan officers and financiers may not understand energy-related terminology (demand charges, kVAR, etc.). In addition, facility managers may not be comfortable with the financier's language. Thus, to save time, a bank that can understand EMPs should be chosen.

Most banks will require a down payment and collateral to secure a loan. However, securing assets can be difficult with EMPs because the equipment often becomes part of the real estate of the plant. *For example, it would be very difficult for a bank to repossess lighting fixtures from a retrofit.* In these scenarios, lenders may be willing to secure other assets as collateral.

Application to the Case Study

Figure II-7 illustrates the resource flows between the parties. In this arrangement, PizzaCo purchases the chilled water system with a loan from a bank. PizzaCo makes equal payments (principal + interest) to the bank for five years to retire the debt. Due to PizzaCo's small size, credibility, and inexperience in managing chilled water systems, PizzaCo is likely to pay a relatively high cost of capital. For example, let's assume 15%.

PizzaCo recovers the full $1 million/year in savings for the entire five years, but must spend $50,000/year on maintenance and insurance. At the end of the five-year project, PizzaCo expects to sell the equipment for its market value of $1,200,000. Tables II-4 and II-5 show the economic analysis for loans with a zero down payment and a 20% down payment, respectively. Assume that the bank reduces the interest rate to 14% for the loan with the 20% down payment. Since the asset is listed on PizzaCo's balance sheet, PizzaCo can use depreciation benefits to reduce the after-tax cost. In addition, all loan interest expenses are tax-deductible.

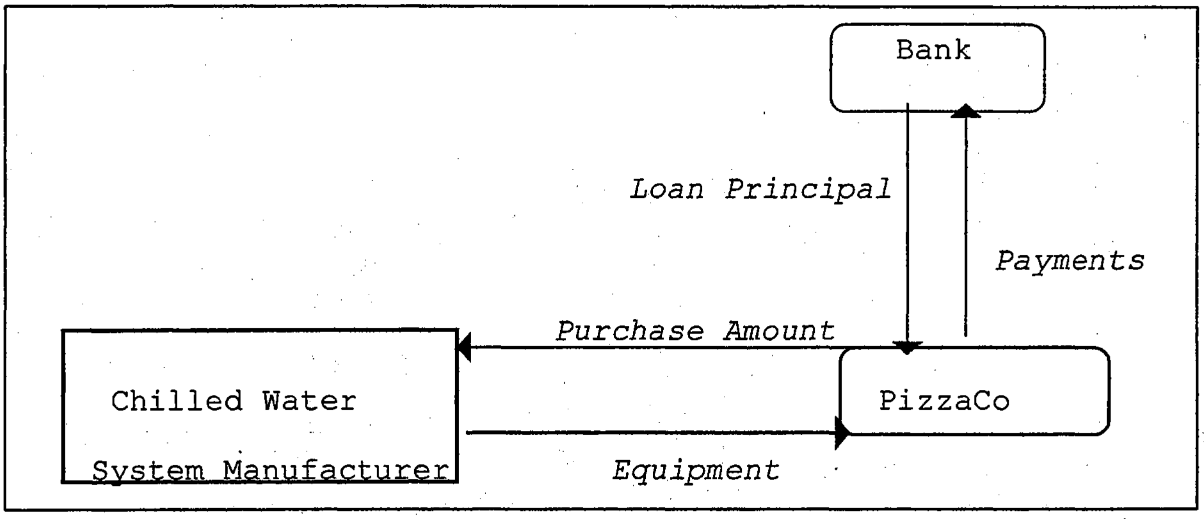

Figure VI-7 Resource Flow Diagram for a Loan

Table VI-4 Economic Analysis for a Loan with No Down Payment

EOY	Savings	Depr.	Payments			Principal	Taxable	Tax	ATCF
			Principal	Interest	Total	Outstanding	Income		
0						2,500,000			
1	950,000	357,250	370,789	375,000	745,789	2,129,211	217,750	74,035	130,176
2	950,000	612,250	426,407	319,382	745,789	1,702,804	18,368	6,245	197,966
3	950,000	437,250	490,368	255,421	745,789	1,212,435	257,329	87,492	116,719
4	950,000	312,250	563,924	181,865	745,789	648,511	455,885	155,001	49,210
5	950,000	111,625	648,511	97,277	745,789	0	741,098	251,973	-47,761
5*	1,200,000	669,375					530,625	180,413	1,019,588
		2,500,000							

Net Present Value at 18%: $757,121

Notes: Loan Amount: 2,500,000 (used to purchase equipment at year 0)
Loan Finance Rate: 15% MARR = 18%
Tax Rate 34%
MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5
Accounting Book Value at end of year 5: 669,375
Estimated Market Value at end of year 5: 1,200,000
EOY 5 illustrates the Equipment Sale and Book Value*
Taxable Income: =(Market Value - Book Value)
=(1,200,000 - 669,375) = $530,625

Table VI-5 Economic Analysis for a Loan with a 20% Down-Payment

EOY		Depr.	Payments			Principal	Taxable	Tax	ATCF
			Principal	Interest	Total	Outstanding	Income		
0					500,000	2,000,000			-500,000
1	950,000	357,250	302,567	280,000	582,567	1,697,433	312,750	106,335	261,098
2	950,000	612,250	344,926	237,641	582,567	1,352,507	100,109	34,037	333,396
3	950,000	437,250	393,216	189,351	582,567	959,291	323,399	109,956	257,477
4	950,000	312,250	448,266	134,301	582,567	511,024	503,449	171,173	196,260
5	950,000	111,625	511,024	71,543	582,567	0	766,832	260,723	106,710
5*	1,200,000	669,375					530,625	180,413	1,019,588
		2,500,000							

Net Present Value at 18%: $710,962

Notes:
Loan Amount: 2,000,000 (used to purchase equipment at year 0)
Loan Finance Rate: 14% MARR = 18%
Down-payment: 500,000 Tax Rate 34%
MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5
Accounting Book Value at end of year 5: 669,375
Estimated Market Value at end of year 5: 1,200,000
EOY 5 illustrates the Equipment Sale and Book Value*
Taxable Income: =(Market Value - Book Value)
=(1,200,000 - 669,375) = $530,625

2.5.3 Bonds

Bonds are very similar to loans; a sum of money is borrowed and repaid with interest over a period of time. The primary difference is that with a bond, the issuer (PizzaCo) periodically pays the investors *only* the interest earned. This periodic payment is called the "coupon interest payment". *For example, a $1,000 bond with a 10% coupon will pay $100 per year. When the bond matures, the issuer returns the face value ($1,000) to the investors.*

Bonds are issued by corporations and government entities. Government bonds generate tax-free income for investors, thus these bonds can be issued at lower rates than corporate bonds. This benefit provides government facilities an economic advantage to use bonds to finance projects.

Application to the Case Study

Although PizzaCo (a private company) would not be able to obtain the low rates of a government bond, they could issue bonds with coupon interest rates competitive with the loan interest rate of 15%.

In this arrangement, PizzaCo receives the investors' cash (bond par value) and purchases the equipment. PizzaCo uses part of the energy savings to pay the coupon interest payments to the investors. When the bond matures, PizzaCo must then return the par value to the investors. See Figure II-8.

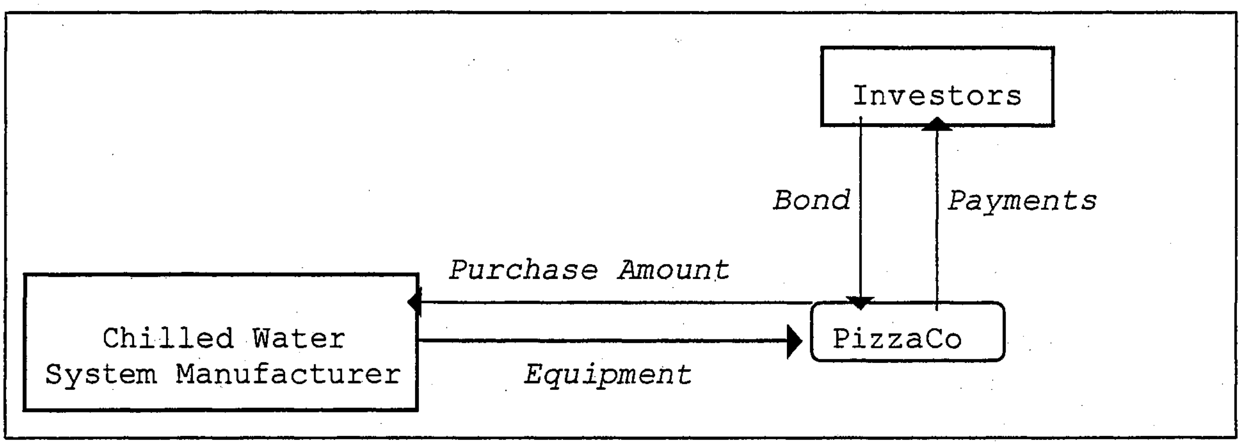

Figure VI-8 Resource Flow Diagram for a Bond

As with a loan, PizzaCo owns, maintains and depreciates the equipment throughout the project's life. All coupon interest payments are tax-deductible. At the end of the five-year project, PizzaCo expects to sell the equipment for its market value of $1,200,000. Table II-6 shows the economic analysis of this finance arrangement.

Table VI-6 Economic Analysis for a Bond

EOY	Savings	Depr.	Payments			Principal	Taxable	Tax	ATCF
			Principal	Interest	Total	Outstanding	Income		
0						2,500,000			
1	950,000	357,250		375,000	375,000	2,500,000	217,750	74,035	500,965
2	950,000	612,250		375,000	375,000	2,500,000	-37,250	-12,665	587,665
3	950,000	437,250		375,000	375,000	2,500,000	137,750	46,835	528,165
4	950,000	312,250		375,000	375,000	2,500,000	262,750	89,335	485,665
5	950,000	111,625	2,500,000	375,000	2,875,000	0	463,375	157,548	-2,082,548
5*	1,200,000	669,375					530,625	180,413	1,019,588
		2,500,000							
						Net Present Value at 18%:			953,927

Notes: Bond Amount: 2,500,000 (used to purchase equipment at year 0)
Coupon Interest Rate: 15% MARR = 18%
Tax Rate 34%
MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5
Accounting Book Value at end of year 5: 669,375
Estimated Market Value at end of year 5: 1,200,000
EOY 5 illustrates the Equipment Sale and Book Value*
Taxable Income: =(Market Value - Book Value)
=(1,200,000 - 669,375) = $530,625

2.5.4 Selling Stock

Although less popular, selling company stock is an equity financing option which can raise capital for projects. For the host, selling stock offers a flexible repayment schedule, because dividend payments to shareholders aren't absolutely mandatory. Selling stock is also often used to help a company attain its desired capital structure. However, selling new shares of stock dilutes the power of existing shares and may send an inaccurate "signal" to investors about the company's financial strength. If the company is selling stock, investors may think that it is desperate for cash and in a poor financial condition. Under this belief, the company's stock price could decrease. However, recent research by Wingender and Woodroof [1997] indicates that when a firm announces an EMP, investors react favorably. On average, stock prices were shown to increase abnormally by 21.33%.

The cost of capital for selling stock is essentially:

$$\text{cost of capital}_{\text{selling stock}} = D/P$$

where D *= annual dividend payment*

P *= company stock price*

In most cases, the after-tax cost of capital for selling stock is higher than the after-tax cost of debt capital (using loans, bonds and capital leases). This is because interest expenses (on debt) are tax deductible, but dividend payments to shareholders are not.

In addition to tax considerations, there are other reasons why the cost of debt capital is less than the cost of selling stock. Lenders and bond buyers (creditors) will accept a lower rate of return because they are in a less risky position due to the reasons below.

- Creditors have a contract to receive money at a certain time and future value (stockholders have no such guarantee with dividends).

- Creditors have first claim on earnings (interest is paid before shareholder dividends are allocated).
- Creditors usually have secured assets as collateral and have first claim on assets in the event of bankruptcy.

Despite the high cost of capital, selling stock does have some advantages. This arrangement does not bind the host to a rigid payment plan (like debt financing agreements) because dividend payments are not mandatory. The host has control over when it will pay dividends. Thus, when selling stock, the host receives greater payment flexibility, but at a higher cost of capital.

Application to the Case Study

As Figure II-9 shows, the financial arrangement is very similar to a bond, at year zero the firm receives $2.5 million, except the funds come from the sale of stock. Instead of coupon interest payments, the firm distributes dividends. At the end of year five, PizzaCo repurchases the stock. Alternatively, PizzaCo could capitalize the dividend payments, which means setting aside enough money so that the dividends could be paid with the interest generated.

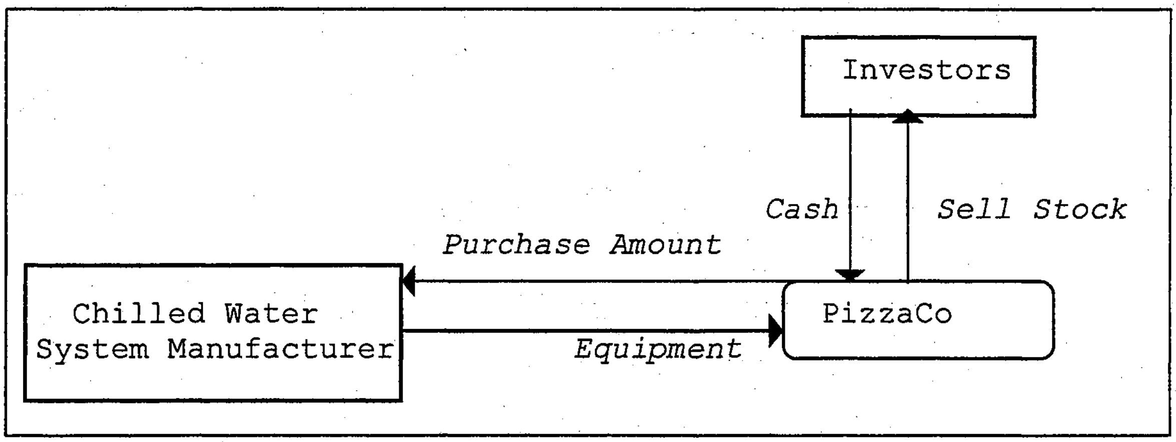

Figure VI-9 Resource Flow Diagram for Selling Stock

Table II-7 shows the economic analysis for issuing stock at a 16% cost of equity capital, and repurchasing the stock at the end of year five. (For consistency of comparison to the other arrangements, the stock price does not change during the contract.) Like a loan or bond, PizzaCo owns and maintains the asset. Thus, the annual savings are only $950,000. PizzaCo pays annual dividends worth $400,000. At the end of year 5, PizzaCo expects to sell the asset for $1,200,000.

Table VI-7 Economic Analysis of Selling Stock

EOY	Savings	Depr.	Stock Transactions			Taxable Income	Tax	ATCF
			Sale of Stock	Repurchase	Dividend Payments			
0			*$ 2,500,000 from Stock Sale is used to purchase equipment, thus*					*ATCF = 0*
1	950,000	357,250			400,000	592,750	201,535	348,465
2	950,000	612,250			400,000	337,750	114,835	435,165
3	950,000	437,250			400,000	512,750	174,335	375,665
4	950,000	312,250			400,000	637,750	216,835	333,165
5	950,000	111,625		2,500,000	400,000	838,375	285,048	-2,235,048
5*	1,200,000	669,375				530,625	180,413	1,019,588
		2,500,000						
				Net Present Value at 18%:				477,033

Notes: Value of Stock Sold (which is repurchased after year 2,500,000 (used to purchase equipment at year 0)
Cost of Capital = Annual Dividend Rate: 16% MARR = 18%
Tax Rate 34%
MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5
Accounting Book Value at end of year 5: 669,375
Estimated Market Value at end of year 5: 1,200,000
EOY 5 illustrates the Equipment Sale and Book Value*
Taxable Income: =(Market Value - Book Value)
=(1,200,000 - 669,375) = $530,625

Note that Table II-7 is slightly different from the other tables in this paper:

Taxable Income = Savings - Depreciation, and

ATCF = Savings - Stock Repurchases - Dividends - Tax

2.5.5 Leases

Firms generally own assets, however it is the *use* of these assets that is important, not the ownership. Leasing is one way of obtaining the use of assets. There are numerous types of leasing arrangements, ranging from basic rental agreements to extended payment plans for purchases. Sharp and Nguyen [1995] claim that leasing is used for nearly one-third of all equipment utilization. Leases can be structured and approved very quickly, even within 48 hours.

Table II-8 lists some additional reasons why leasing can be an attractive arrangement for the lessee.

Table VI-8 Good Reasons to Lease

Financial Reasons
With some leases, the entire lease payment is tax-deductible.
Some leases allow "off-balance sheet" financing, preserving credit lines
Risk Sharing
Leasing is good for short-term asset use, and reduces the risk of getting stuck with obsolete equipment
Leasing offers less risk and responsibility

Basically, there are two types of leases; the "true lease" (a.k.a. "operating" or "guideline lease") and the "capital lease". One of the primary differences between a true lease and a capital lease is the tax treatment. In a true lease, the lessor owns the equipment and receives the depreciation benefits. However, the lessee can claim the entire lease payment as a tax-deductible business expense. In a capital lease, the lessee (PizzaCo) owns and depreciates the equipment. However, only the interest portion of the lease payment is tax-deductible. In general, a true lease is effective for a short-term project, where the company does not plan to use the equipment when the project ends. A capital lease is effective for long-term equipment.

<u>The True Lease</u>

Figure II-10 illustrates the legal differences between a true lease and a capital lease as described by Schallheim [1994]. A true lease (or operating lease) is strictly a rental agreement. The word "strict" is appropriate because the Internal Revenue Service will only recognize a true lease if it satisfies the following criteria:

1. the lease period must be less than 80% of the equipment's life, and
2. the equipment's estimated residual value must be ≥ 20% of its value at the beginning of the lease, and
3. there is no "bargain purchase option", and
4. there is no planned transfer of ownership, and
5. the equipment must not be custom-made and only useful in a particular facility.

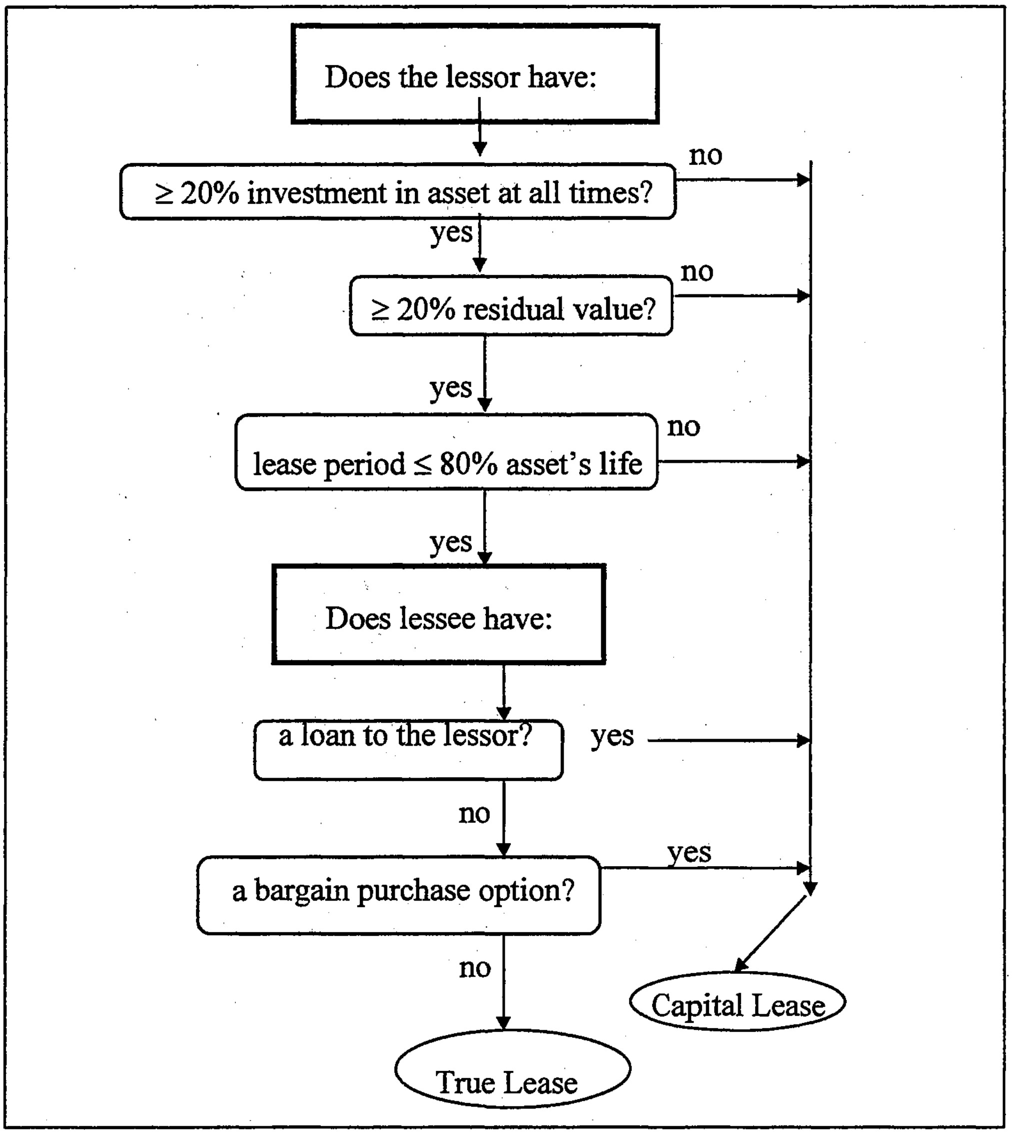

Figure VI-10 Classification for a True Lease

Application to the Case Study

It is unlikely that PizzaCo could find a lessor that would be willing to lease a sophisticated chilled water system and after five years, move the system to another facility. Thus, obtaining a true lease would be unlikely. However, Figure II-11 shows the basic relationship between the lessor and lessee in a true lease. A third-party leasing company could also be involved by purchasing the equipment and leasing to PizzaCo. Such a resource flow diagram is shown for the capital lease.

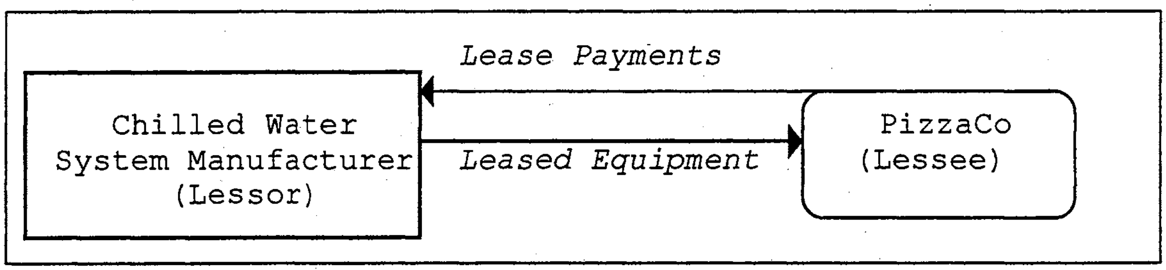

Figure VI-11 Resource Flow Diagram for a True Lease

Table II-9 shows the economic analysis for a true lease. Notice that the lessor pays the maintenance and insurance costs, so PizzaCo saves the full $1 million per year. PizzaCo can deduct the entire lease payment of $400,000 as a business expense. However PizzaCo does not obtain ownership, so it can't depreciate the asset.

Table VI-9 Economic Analysis for a True Lease

EOY	Savings	Depr.	Payments			Principal	Taxable	Tax	ATCF
			Principal	Interest	Total	Outstanding	Income		
0					400,000		-400,000		-400,000
1	1,000,000				400,000		600,000	204,000	396,000
2	1,000,000				400,000		600,000	204,000	396,000
3	1,000,000				400,000		600,000	204,000	396,000
4	1,000,000				400,000		600,000	204,000	396,000
5	1,000,000						1,000,000	340,000	660,000

Net Present Value at 18%: $953,757

Notes:	Annual Lease Payment:		400,000
	MARR =	18%	
	Tax Rate	34%	

The Capital Lease

The capital lease has a much broader definition than a true lease. A capital lease fulfills any one of the following criteria:

1. the lease term ≥ 75% of the equipment's life;
2. the present value of the lease payments ≥ 90% of the initial value of the equipment;
3. the lease transfers ownership;
4. the lease contains a "bargain purchase option", which is negotiated at the inception of the lease.

Most capital leases are basically extended payment plans, except ownership is usually not transferred until the end of the contract. This arrangement is common for large EMPs because the equipment (such as a chilled water system) is usually difficult to reuse at another facility. With this arrangement, the lessee eventually pays for the entire asset (plus interest). In most capital leases, the lessee pays the maintenance and insurance costs.

The capital lease has some interesting tax implications because the lessee must list the asset on its balance sheet from the *beginning* of the contract. Thus, like a loan, the lessee gets to depreciate the asset and only the interest portion of the lease payment is tax deductible.

Application to the Case Study

Figure II-12 shows the basic relationship between the equipment manufacturer, lessor and lessee in a capital lease. The finance company purchases the equipment and leases it to PizzaCo. The finance company (lessor) is shown as a third party, although it also could be a division of the equipment manufacturer. Because the finance company is involved, a lower cost of capital (12%) is possible due to reduced risk of payment default.

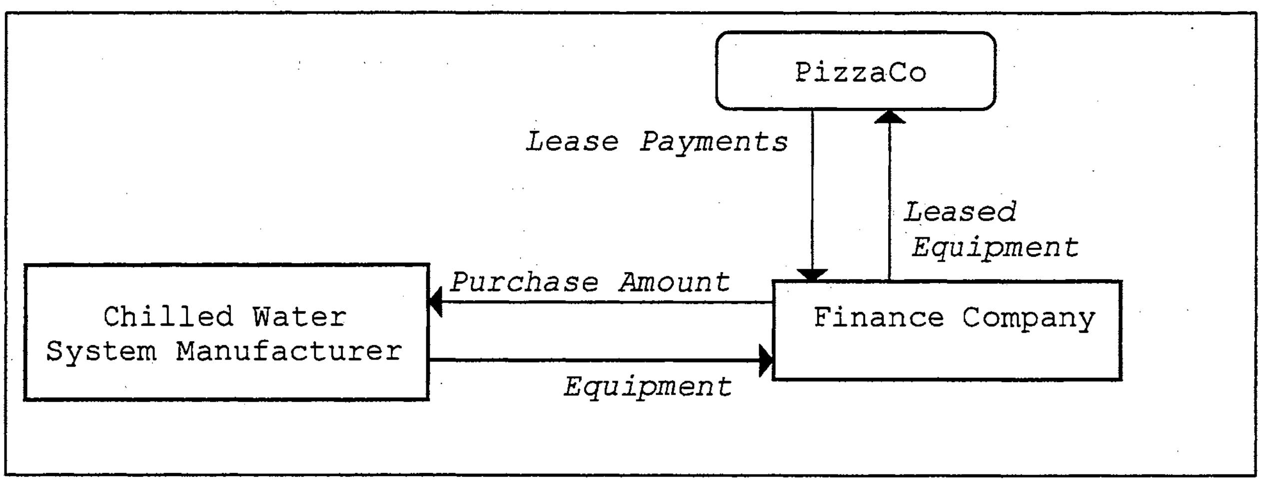

Figure VI-12 Resource Flow Diagram for a Capital Lease

Like an installment loan, PizzaCo's lease payments cover the entire equipment cost. However, the lease payments are made in advance. Because PizzaCo is considered the owner, it pays the $50,000 annual maintenance expenses, which reduces the annual savings to $950,000. PizzaCo receives the benefits of depreciation and tax-deductible interest payments. To be consistent with the analyses of the other arrangements, PizzaCo would sell the equipment at the end of the lease for its market value. Table II-10 shows the economic analysis for a capital lease.

Table VI-10 Economic Analysis for a Capital Lease

EOY	Savings	Depr.	Payments in Advance			Principal	Taxable	Tax	ATCF
			Principal	Interest	Total	Outstanding	Income		
0			619,218	0	619,218	1,880,782			-619,218
1	950,000	357,250	393,524	225,694	619,218	1,487,258	367,056	124,799	205,983
2	950,000	612,250	440,747	178,471	619,218	1,046,511	159,279	54,155	276,627
3	950,000	437,250	493,637	125,581	619,218	552,874	387,169	131,637	199,145
4	950,000	312,250	552,874	66,345	619,218	0	571,405	194,278	136,503
5	950,000	111,625					838,375	285,048	664,953
5*	1,200,000	669,375					530,625	180,413	1,019,588
		2,500,000							
						Net Present Value at 18%:			$681,953

Notes: Total Lease Amount: 2,500,000
However, Since the payments are in advance, the first payment is analogous to a Down-Payment
Thus the actual amount borrowed is only = 2,500,000 - 619,218 = 1,880,782
Lease Finance Rate: 12% MARR = 18%
Tax Rate 34%
MACRS Depreciation for 7-Year Property, with half-year convention at EOY 5
Accounting Book Value at end of year 5: 669,375
Estimated Market Value at end of year 5: 1,200,000
EOY 5 illustrates the Equipment Sale and Book Value*
Taxable Income: =(Market Value - Book Value)
=(1,200,000 - 669,375) = $530,625

With most types of leases, loans and bonds the monthly payments are fixed, regardless of the equipment's utilization, or performance. However, shared savings agreements can be incorporated into certain types of leases. The following financial arrangements are performance-based.

2.5.6 Performance Contracting

Performance contracting is a unique arrangement that allows the building owner to make necessary improvements while investing very little money up-front. The contractor usually assumes responsibility for purchasing and installing the equipment, as well as maintenance throughout the contract. But the unique aspect of performance contracting is that the contractor is paid based on the performance of the installed equipment. Only after the installed equipment actually reduces expenses does the contractor get paid. Energy service companies (ESCOs) typically serve as contractors within this line of business.

Unlike most loans, leases and other fixed payment arrangements, the ESCO is paid based on the performance of the equipment. In other words, if the finished product doesn't save energy, the host doesn't pay. This aspect removes the incentive to "cut corners" on construction or other phases of the project, as with bid/spec contracting. In fact, often there is an incentive to exceed savings estimates. For this reason, performance contracting usually entails a more "facility-wide" scope of work (to find extra energy savings), than loans or leases on particular pieces of equipment.

With a facility-wide scope, many improvements can occur at the same time. For example, lighting and air conditioning systems can be upgraded at the same time. In addition, the indoor air quality can be improved. With a comprehensive facility management approach, a "domino-effect" on cost reduction is possible. For example, if facility improvements create a safer and higher quality environment for workers, productivity could increase. As a result of decreased employee absenteeism, the workman's compensation cost could also be reduced. These are additional benefits to the facility.

Performance contracting is a risk-sharing relationship between the host and the ESCO. Kane [1995] claims that risk-sharing agreements are optimized when each risk is allocated to the party in the best position to control that risk. Depending on the host's capability to manage the risks (equipment performance, financing, etc.) the host will delegate some of these responsibilities to the ESCO. In general, the amount of risk assigned to the ESCO is directly related to the percent savings that must be shared with the ESCO.

For facilities that are not in a good position to manage the risks of an energy project, performance contracting may be the only economically feasible implementation method. *For example, the US Federal Government used performance contracting to upgrade facilities when budgets were being dramatically cut. In essence, they "sold" some of their future energy savings to an ESCO.*

In general, performance contracting may be the best option for facilities that:

- are severely constrained by their cash flows;
- have a high cost of capital;
- don't have sufficient resources, such as a lack of in-house energy management expertise or an inadequate maintenance capacity[j];
- are seeking to reduce in-house responsibilities and focus more on their core business objectives; or
- are attempting a new type of project that has an uncertain reliability[k].

Performance contracting does have some drawbacks. In addition to sharing the savings with an ESCO, the tax benefits of depreciation and other economic benefits must be negotiated. Whenever large contracts are involved, there is reason for concern. Hines [1996] found that 11% of customers who were considering EMPs felt that dealing with an ESCO was too confusing or complicated. Another 23% said

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[j] Maintenance capacity represents the ability that the maintenance personnel will be able to maintain the new system. It has been shown that systems fail and are replaced when maintenance concerns are not incorporated into the planning process. See Woodroof, [1997b] "Lighting Retrofits: Don't Forget About Maintenance", Energy Engineering, 94(1) p. 59.

[k] For example, a lighting retrofit has a high probability of producing the expected cash flows, whereas a completely new process does not have the same "time-tested" reliability. If the in-house energy management

the deal wouldn't provide sufficient financial benefits. Coates and DelPonti [1996] claim, "with complex contracts, there may be more options and more room for error." Therefore, it is critical to choose an ESCO with a good reputation and experience within the types of facilities that are involved.

There are a few common types of contracts. The ESCO will usually offer the following options:

- guaranteed fixed dollar savings;
- guaranteed fixed energy (MMBTU) savings;
- a percent of energy savings; or
- a combination of the above.

Obviously, facility managers would prefer the options with "guaranteed savings". However this extra security (and risk to the ESCO) usually costs more. The primary difference between the two guaranteed options is that guaranteed fixed dollar savings contracts ensure dollar savings, even if energy prices fall. *For example, if energy prices drop and the equipment does not save as much money as predicted, the ESCO must pay (out of its own pocket) the contracted savings to the host.*

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team cannot manage this risk, performance contracting may be an attractive alternative.

Percent energy savings contracts are agreements that basically share energy savings between the host and the ESCO. The more energy saved, the higher the revenues to both parties. However, the host has less predictable savings and must also monitor the ESCO to ensure compliance to the contract. There are numerous hybrid contracts available that combine the positive aspects of the above options.

Application to the Case Study

PizzaCo would enter into a hybrid contract; *percent energy savings/guaranteed arrangement.* The ESCO would purchase, install and operate a highly efficient chilled water system. The ESCO would guarantee that PizzaCo would save the $1,000,000 per year, but PizzaCo would pay the ESCO 80% of the savings. In this way, PizzaCo would not need to invest any money, and would simply collect the net savings of $200,000 each year.

With this arrangement, there are no depreciation, interest payments or tax-benefits for PizzaCo. However, PizzaCo receives a positive cash flow with no investment and little risk. At the end of the contract, the ESCO removes the equipment. At the end of most performance contracts, the host usually acquires or purchases the equipment for fair market value. However, for this case study, the equipment was removed to make a consistent comparison with the other financial arrangements.

Figure II-13 illustrates the transactions between the parties. Table II-11 presents the economic analysis for performance contracting.

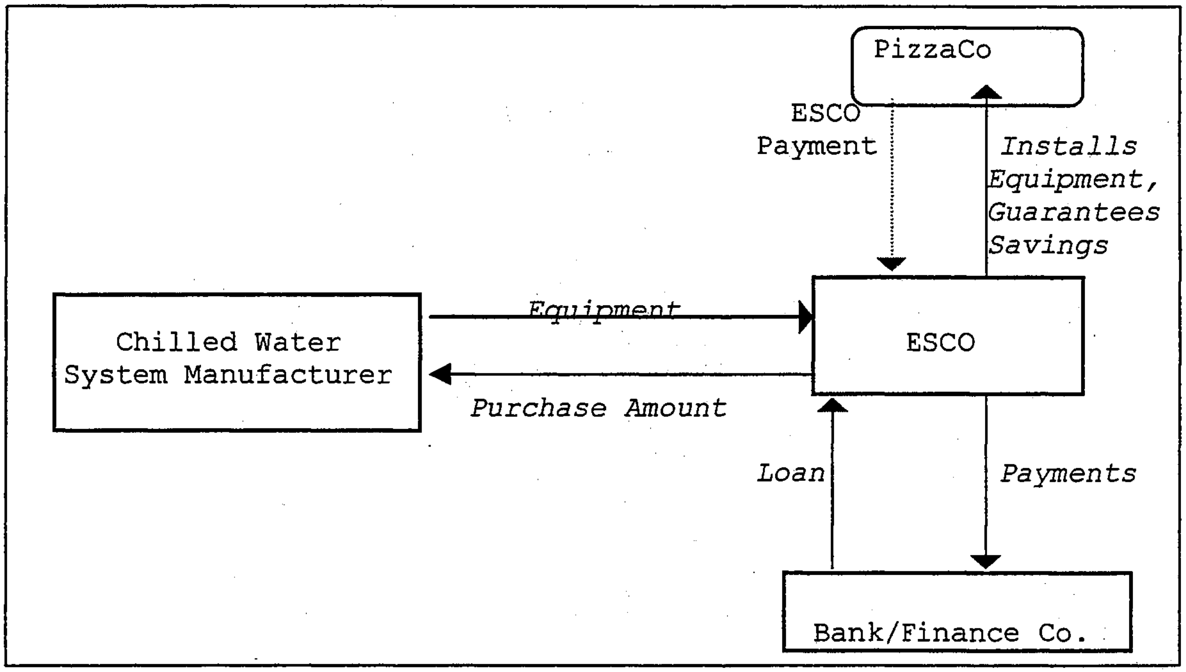

Figure VI-13 Transactions for a Performance Contract

Table VI-11 Economic Analysis of a Performance Contract

EOY	Savings	Depr.	ESCO Payments			Principal Outstanding	Taxable Income	Tax	ATCF
					Total				
0									
1	1,000,000				800,000		200,000	68,000	132,000
2	1,000,000				800,000		200,000	68,000	132,000
3	1,000,000				800,000		200,000	68,000	132,000
4	1,000,000				800,000		200,000	68,000	132,000
5	1,000,000				800,000		200,000	68,000	132,000

Net Present Value at 18%: $412,787

Notes: ESCO purchases/operates equipment. Host pays ESCO 80% of the savings = $800,000.
The contract could also be designed so that PizzaCo can buy the equipment at the end of year 5.

Note that Table II-11 is slightly different from the other tables in this paper: Taxable Income = Savings-Depreciation - ESCO Payments.

2.5.7 Summary Of Tax Benefits

Table II-12 summarizes the tax benefits of each financial arrangement presented in this paper.

Table VI-12 Host's Tax Benefits for each Arrangement

ARRANGEMENT	Depreciation Benefits	Interest Payments are Tax-Deductible	Total Payments are Tax-Deductible
Retained Earnings	X		
Loan	X	X	
Bond	X	X	
Sell Stock	X		
Capital Lease	X	X	
True Lease			X
Performance Contract			X

2.5.8 Additional Options

Combinations of the basic financial arrangements can be created to enhance the value of a project. A sample of the possible combinations are described below.

- Third party financiers often cooperate with performance contracting firms to implement EMPs.
- Utility rebates and government programs may provide additional benefits for particular projects.
- Tax-exempt leases are available to government facilities.

- Insurance can be purchased to protect against risks relating to equipment performance, energy savings, etc.
- Some financial arrangements can be structured as *non-recourse* to the host. Thus, the ESCO or lessor would assume the risks of payment default. However, as mentioned before, profit sharing increases with risk sharing.

Attempting to identify the absolute best financial arrangement is a rewarding goal, unless it takes too long. As every minute passes, potential dollar savings are lost forever. Thus as Hansen [1993] claims, when considering special grant funds, rebate programs or other unique opportunities, it is important to consider the lost savings due to delay.

2.6 "PROS" & "CONS" OF EACH FINANCIAL ARRANGEMENT

This section presents a brief summary of the "Pros" and "Cons" of each financial arrangement from the host's perspective.

Loan

"Pros":
- host keeps all savings,
- depreciation & interest payments are tax-deductible,
- host owns the equipment, and
- the arrangement is good for long-term use of equipment

"Cons":
- host takes all the risk, and must install and manage project

Bond

Has the same Pros/Cons as loan, and

"Pro":

- good for government facilities, because they can offer a tax-free rate (that is lower, but considered favorable by investors)

Sell Stock

Has the same Pros/Cons as loan, and

"Pro":

- selling stock could help the host achieve its target capital structure

"Con":

- dividend payments (unlike interest payments) are not tax-deductible, and
- dilutes company control

Use Retained Earnings

Has the same Pros/Cons as loan, and

"Pro":

- host pays no external interest charges. However retained earnings do carry an opportunity cost, because such funds could be invested somewhere at the MARR.

"Con":

- host loses tax-deductible benefits of interest charges

Capital Lease

Has the same Pros/Cons as loan, and

"Pro":

- Greater flexibility in financing, possible lower cost of capital with third-party participation

True Lease

"Pros":

- allows use of equipment, without ownership risks,
- reduced risk of poor performance, service, equipment obsolescence, etc.,
- good for short-term use of equipment, and
- entire lease payment is tax-deductible

"Cons":

- no ownership at end of lease contract, and
- no depreciation tax benefits'

Performance Contract

"Pros":

- allows use of equipment, with reduced installment/operational risks, and
- reduced risk of poor performance, service, equipment obsolescence, etc., and
- allows host to focus on its core business objectives

"Cons":

- potentially binding contracts, legal expenses, and increased administrative costs, and
- host must share project savings

2.7 RULES OF THUMB

When investigating financing options, consider the following generalities:

loans, bonds and other host-managed arrangements should be used when a customer has the resources (experience, financial support, and time) to handle the risks.

Performance contracting (ESCO assumes most of the risk) is usually best when a customer doesn't have the resources to properly manage the project. Remember that with any arrangement where the host delegates risk to another firm, the host must also share the savings.

Leases are the "middle ground" between owning and delegating risks. Leases are very popular due to their tax benefits. True leases tend to be preferred when:

- the equipment is needed on a short-term basis;

- the equipment has unusual service problems that cannot be handled by the host;
- technological advances cause equipment to become obsolete quickly; or
- depreciation benefits are not useful to the lessee.

Capital Leases are preferred when:

- the installation and removal of equipment is costly;
- the equipment is needed for a long time; or
- the equipment user desires to secure a "bargain purchase option".

An Alternative Indicator of which Financial Arrangement may be Best

The decision to manage the project with in-house resources or use performance contracting may be indicated by the interest rate the host must pay. Most lenders specializing in energy projects are experts at assessing risks associated with a company and a potential project. Lenders will assign an interest rate based on three risks: (1) the host's credit risk, (2) project risk and (3) external risk.

If lenders assign a high interest rate (relative to prime rate), they believe the arrangement is risky. If lenders assign a low rate, they believe that all three risk areas can be managed.

Assuming that the cost of capital assigned by a lender represents the cumulative risk of a project within a specific company, a ballpark decision can be made using the following relationship: If the cost of capital is relatively:

High	>>>use performance contracting
Medium	>>>use leases
Low	>>>use loans, bonds and other host-managed arrangements

Thus if the cost of capital is relatively high, the host may want to pursue performance contracting, or another risk-shedding arrangement. However, if the lenders assign a low cost of capital, (the host is probably in good enough shape to handle the project) the project could be funded internally with loans or bonds.

2.8 SUMMARY

There are practically an infinite number of financial alternatives to consider. This paper has provided some information on the basic financial arrangements. Combining these arrangements to construct the best contract for your facility is only limited by your creativity.

2.9 GLOSSARY

Capitalize
To convert a schedule of cash flows into a principal amount, called *capitalized value,* by dividing by a rate of interest. In other words, to set aside an amount large enough to generate (via interest) the desired cash flows forever.

Capital *or* Financial Lease
Lease that under Statement 13 of the Financial Accounting Standards Board must be reflected on a company's balance sheet as an asset and corresponding liability. Generally, this applies to leases where the lessee acquires essentially all of the economic benefits and risks or the leased property.

Depreciation
The amortization of fixed assets, such as plant and equipment, so as to allocate the cost over their depreciable life. Depreciation reduces taxable income, but is not an actual cash flow.
Energy Service Company (ESCO)
Company that provides energy services (and possibly financial services) to an energy consumer.

Host
The building owner or facility that uses the equipment.

Lender
Individual or firm that extends money to a borrower with the expectation of being repaid, usually with interest. Lenders create debt in the form of loans or bonds. If the borrower is liquidated, the lender is paid off before stockholders receive distributions.

Lessee
The renter. The party that buys the right to use equipment by making lease payments to the lessor.

Lessor
The owner of the leased equipment.

Line of Credit
An informal agreement between a bank and a borrower indicating the maximum credit the bank will extend. A line of credit is popular because it allows numerous borrowing transactions to be approved without the re-application paperwork.

Liquidity
Ability of a company to convert assets into cash or cash equivalents without significant loss. For example, investments in money market funds are much more liquid than investments in real estate.

Leveraged Lease
Lease that involves a lender in addition to the lessor and lessee. The lender, usually a bank or insurance company, puts up a percentage of the cash required to purchase the asset, usually more than half. The balance is put up by the lessor, who is both the equity participant and the borrower. With the cash the lessor acquires the asset, giving the lender (1) a mortgage on the asset and (2) an assignment of the lease and lease payments. The lessee then makes periodic payments to the lessor, who in turn pays the lender. As owner of the asset, the lessor is entitled to tax deductions for depreciation on the asset and interest on the loan.

MARR (Minimum Attractive Rate of Return)
MARR is the "hurdle rate" for projects within a company. MARR is used to determine the NPV; the annual after-tax cash flow is discounted at MARR (which represents the rate the company could have received with a different project).

Net Present Value (NPV)
As the saying goes, "a dollar received next year is not worth as much as a dollar today." The NPV converts the worth of that future dollar into what is worth today. NPV converts future cash flows by using a given discount rate. *For example, at 10%, $1,000 dollars received one year from now is worth only $909.09 dollars today. In other words, if you invested $909.09 dollars today at 10%, in one year it would be worth $1,000.*

NPV is useful because you can convert future savings cash flows back to "time zero" (present), and then compare to the cost of a project. If the NPV is positive, the investment is acceptable. In capital budgeting, the discount rate used is called the *hurdle rate* and is usually equal to the incremental cost of capital.

"Off-Balance Sheet" Financing
Typically refers to a True Lease, because the assets are not listed on the balance sheet. Because the liability is not on the balance sheet, the Host appears to be financially stronger. However, most large leases must be listed in the footnotes of financial statements, which reveals the "hidden assets".

Par Value *or* Face Value
Equals the value of the bond at maturity. For example, a bond with a $1,000 dollar par value will pay $1,000 to the issuer at the maturity date.

Preferred Stock
A hybrid type of stock that pays dividends at a specified rate (like a bond), and has preference over common stock in the payment of dividends and liquidation of assets. However, if the firm is financially strained, it can avoid paying the preferred dividend as it would the common stock dividends. Preferred stock doesn't ordinarily carry voting rights.

Project Financing
A type of arrangement, typically meaning that a Single Purpose Entity (SPE) is constructed. The SPE serves as a special bank account. All funds are sent to the SPE, from which all construction costs are paid. Then all savings cash flows are also distributed from the SPE. The SPE is essentially a mini-company, with the sole purpose of funding a project.

Secured loan
Loan that pledges assets as collateral. Thus, in the event that the borrower defaults on payments, the lender has the legal right to seize the collateral and sell it to pay off the loan.

True Lease *or* Operating Lease *or* Tax-Oriented Lease
Type of lease, normally involving equipment, whereby the contract is written for considerably less time than the equipment's life and the lessor handles all maintenance and servicing; also called *service lease*. Operating leases are the opposite of capital leases, where the lessee acquires essentially all the economic benefits and risks of ownership. Common examples of equipment financed with operating leases are office copiers, computers, automobiles and trucks. Most operating leases are cancelable.

WACC (Weighted Average Cost of Capital)
The firm's average cost of capital, as a function of the proportion of different sources of capital: Equity, Debt, Preferred Stock, etc.. *For example, a firm's target capital structure is:*

Capital Source	Weight (w_i)
Debt	30%
Common Equity	60%
Preferred Stock	10%

and the firm's costs of capital are:

before tax cost of debt = k_d= 10%
cost of common equity = k_s= 15%
cost of preferred stock = k_{ps}= 12%

Then the weighted average cost of capital will be:

$$WACC= w_d k_d(1-T) + w_s k_s + w_{ps} k_{ps}$$

where w_i = *weight of Capital Source*$_i$
T = *tax rate* = *34%*
After-tax cost of debt = $k_d(1-T)$

Thus,

$$WACC= (.3)(.1)(1-.34) + (.6)(.15) + (.1)(.12)$$
$$WACC= 12.18\%$$

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APPENDIX D

INSTITUTIONAL REVIEW BOARD APPROVAL

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 04-17-98 **IRB #: EG-98-003**

Proposal Title: FINANCIAL ARRANGEMENT SELECTION FOR ENERGY MANAGEMENT PROJECTS

Principal Investigator(s): Wayne C. Turner, Eric A. Woodroof

Reviewed and Processed as: Expedited

Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING, AS WELL AS ARE SUBJECT TO MONITORING AT ANY TIME DURING THE APPROVAL PERIOD.
APPROVAL STATUS PERIOD VALID FOR DATA COLLECTION FOR A ONE CALENDAR YEAR PERIOD AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Disapproval are as follows:

Signature: John H. Wyckoff

Chair of Institutional Review Board

cc: Eric A. Woodroof

Date: April 20, 1998

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VITA

Eric Aubrey Woodroof

Candidate for the Degree of

Doctor of Philosophy

Dissertation: FINANCIAL ARRANGEMENT SELECTION FOR ENERGY MANAGEMENT PROJECTS

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