COMPARISON OF METHODS FOR EVALUATING CONSTRUCTION EQUIPMENT ACQUISITION

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ABSTRACT

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It is the purpose of this report to examine the problems of equipment acquisition, wherein the following topics must be reviewed:

1. Modes of construction equipment acquisition
2. Financial and non-financial factors involved in the acquisition decision
3. Ways of evaluating mode of acquisition, both from an economic and non-economic point of view.

Purchasing with cash, financing through a loan, renting and leasing are the four most common ways to acquire construction equipment in North America. Each has its own advantages and disadvantages, both financially and otherwise, that must be carefully evaluated by the contractor before acquiring equipment. Maximizing the return on the equipment investment involves not only timing of the replacement and proper equipment selection, but also determining the optimum mode of acquisition. Choosing the correct mode depends on several factors, including work load, timing and amount of payments, repair, maintenance and supply, cost of capital, risk, advertisement, financial position of the firm, and so on. The optimum acquisition strategy must be based on accurate estimates of revenues and costs which incorporate all of the factors affecting the machine's rate of return. A key finding in this report is that a well managed program of equipment acquisition is necessary for the increased profitability and well being of the firm.

ACKNOWLEDGEMENTS

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CHAPTER I

I.I INTRODUCTION

There are four major topics which a contractor must be familiar with in the management of his equipment:

1. Replacement
2. Expansion
3. Selection
4. Method of acquisition.

The replacement problem is related to the replacement of an existing machine which has already been either partially or fully used by the contractor. The expansion problem involves the decision of adding equipment to an existing fleet. Equipment selection deals with the problem of choice, wherein two or more pieces of equipment are compared with respect to certain technical and financial criteria. The method of acquisition involves the alternatives between cash purchase, finance through borrowing, rental or lease.

The proper replacement, expansion and selection of heavy construction equipment is an economic necessity for survival in a fiercely competitive marketplace. The acquisition strategy has a direct affect on the return on investment in equipment, and thus on the overall profitability of the firm. This report, while examining certain aspects of the other three major topics which affect the method of acquisition, will deal with the philosophy of whether to pay cash for the equipment,

or to acquire it in some other way.

In reviewing the existing literature and information on equipment replacement, fleet expansion, selection and methods of acquisition, there appears to be a serious lack of any comprehensive evaluation and comparison of the principal methods available for analyzing equipment acquisition alternatives. It is the intent of this paper to help to rectify this situation by filling part of this void.

I.2 OBJECTIVES OF THE REPORT

The specific objectives of this report are:

I. To review recognized ways of acquiring construction equipment, through a literature survey and interviews with several financial institutions (Chapters I and 2).

2. To analyze the financial and non-financial factors involved in the acquisition decision. Special attention will be given to the weighting of these factors using multi-attributed decision making techniques (Chapters 3 and 4).

3. To examine current ways of evaluating the mode of acquisition of equipment, both from the financial and non-financial point of view of the contractor (Chapter 4).

4. To determine the optimum technique of evaluating the mode of acquisition. This will be done through the use of a case study (Chapter 4).

5. To identify topics to which further research work must be directed (Chapter 5).

I.3 BACKGROUND

Construction is the largest industry in North America, and machinery and equipment account for a large portion of this industry. In I973, contractors bought, rented and leased an estimated $5.4 billion worth of equipment in the United States (I4). According to the President of New York based Hertz Equipment Rental Corp., rentals of construction equipment alone exceeded $2.5 billion in I975, and this figure had been growing at the rate of nearly I5% annually for the previous decade. He sees this rate continuing into the I980's (I4).

Construction equipment sales and rentals in Canada reached an estimated total of $2.I billion in I976, up from $I.9 Billion in I975 (26). Construction equipment leasing has become increasingly popular in Canada, expanding at rates estimated between 30% to 40% annually.

Of the money expended on construction equipment in I975, 5% was lease financed (47). In the United States, the growth of lease financing has been even more dramatic, reaching an estimated I5% of total capital outlays in I975 (3).

From these figures, it may be seen that the acquisition policies of contractors are an important aspect in the construction industry. The saving of millions of dollars could result through the establishment of proper policies on acquisition. Depending on the type of construction the firm is involved in, its profitability could be substantially affected by the method of acquisition.

The establishment of policies for acquisition of construction equipment is an important category of investment decisions in the construction industry. The concept of acquisition involves the decision to obtain equipment through one of four recognized means:

1. Cash purchase
2. Finance through borrowing
3. Rental
4. Lease.

Each method of acquisition has its own advantages and disadvantages, which will be examined in Chapter 2. A brief definition of each acquisition method to be reviewed in this report is included in this section.

CASH PURCHASE

As the term implies, a cash purchase involves the use of working capital to acquire and own equipment. A purchase requires an immediate capital investment of the full market value of the equipment. With a cash purchase, the owner acquires title to a machine and complete equity in it. Equity in this context is the amount of money the contractor has invested directly in his equipment. He is entitled to certain deductions on income taxes, such as depreciation and an investment tax credit. He must also pay fees and other costs to fulfill the obligations of ownership.

FINANCE THROUGH BORROWING

Equipment may also be acquired following the contractor's successful application for a loan. Loans are available from several sources, such as:

1. Banks and credit unions
2. Private sources (individuals, partners, employees)
3. Lending institutions (insurance, trust, mortgage and finance companies)
4. Government (federal and provincial)

As with the cash purchase, the contractor acquires title to the equipment and a growing equity in it as the loan payments are made. He is entitled to deduct depreciation and interest on the loan when calculating income for tax purposes. He cannot write off the payments on principal, since he is already deducting the depreciation expense. There are many combinations of interest and conditions available with a loan, several of which will be examined in Section 2.3.

RENTAL

Rental in this report is meant to apply to the short-term use of construction equipment. Although rental rates are significantly higher than ownership costs, they are justified by the uncertainty and short-term requirements under which all contractors operate. Renting serves a useful purpose for the contractor under specific conditions, which will be examined in Section 2.4 of Chapter 2.

LEASE

Leasing construction equipment involves capital outlays in a stream of payments similar to rental payments. However, the period of the lease is usually much longer than the rental period. Leases are generally written for a year or more. For the privilege and obligations of using the equipment, the contractor (lessee) pays rent periodically to the owner (lessor). There are numerous types of leases available in Canada, of which two important ones will be examined in Chapter 2.

I.4 CONTRACTORS' ACQUISITION PRACTICES

Through a review of North American Construction Industry literature, an attempt was made to document the attitudes of contractors towards their methods of acquiring construction equipment. The results were varied, and specific guidelines were difficult to find. Each contractor examined claimed to be using the acquisition strategy best suited to his specific circumstances, needs and resources.

In the winter of I978, the National Utility Contractors Association in the United States conducted a survey of its members (28). Since the bulk of business volume for most of the respondents was in trenchwork, contractors tended to have heavy investments in construction equipment. The survey grouped the contractors into three categories according to dollar volume of work:

Firm size	Dollar volume of contracts	Number of respondents
Small	less than $I million	I9
Medium	$I million to $6 million	I2I
Large	over $6 million	28

Medium sized firms reported having an average investment in equipment of approximately $450,000. All contractors indicated that an estimated 20% of their annual operating costs could be attributed to equipment costs. Equipment acquisition stategies varied considerably among the contractors. From the total sample of I68, 70% reported that financing of equipment from outside sources was not used most of the time.

Small contractors were found to use financing much more often than large firms. Fifty percent of the smaller firms financed their equipment, compared to only I5% of the large contractors. Lease with option to purchase and long-term loans were the most common financing methods used to acquire equipment for all firms regardless of size. Short-term loans were used by few contractors. The average amount of equipment financed was approximately $I25,000., which represented 30% of their equipment fleets estimated current market value.

Many of the contractors responding to the survey currently lease, instead of purchase, heavy equipment to avoid the potentially heavy financial burden and maintenance responsibility of purchasing. The overall survey indicated that 80% of the contractors reported leasing equipment at some time.

The median annual lease costs for these respondents amounted to $26,000, or 6% of the market value of their fleets. The reasons reported for the use of equipment leases showed considerable variation within the total sample, and also for firms of different sizes. The most frequent reason expressed was to obtain specialized equipment (27%), although large firms used this justification only 67% as often as small or medium firms did. A desire to improve business ratios was the next most common answer (17%). The next two responses were to test new equipment (12%), and to obtain a tax write-off advantage (11%). These responses occurred in the small firms twice as often as in medium-sized firms, and five times as often as in large firms. Six percent indicated that leasing was used to fill short-term equipment needs, while only 4% of the respondents leased equipment to avoid obsolescence.

The results of this survey indicate that equipment acquisition policies vary considerably between large and small firms. In most of the data, medium-sized firms were more similar to the large companies rather than the smaller ones, however they did exhibit distinctive features of their own. Smaller companies tended to have their principal officers involved directly in the daily field operations of the firm. They had a first hand knowledge of how each piece of equipment was performing, and disregarded methods of record-keeping and acquisition analysis. Large firms had a more specialized staff, as well as more financial resources. Additional skills and time were available to use the more systematic equipment acquisition evaluation techniques.

Large firms were less susceptible to fluctuations in the construction industry, and were found to be able to maintain a more consistent financial position.

A similar but more detailed survey was carried out among 209 construction firms across Canada in I979 (23). Nearly 50% of the respondents were in highway/heavy construction, and about half were based in Ontario. The average market value of the respondents' equipment fleet was $I million. In total, 58% of the firms acquired some type of heavy equipment during the past year. On the average, 43% purchased outright, 35% financed, I7% leased and 8% rented part of the equipment they acquired.

The trend in this survey was based on making comparisons with similar surveys undertaken in I978 and I977. From Table I.I, all three surveys showed that each year firms which leased or rented their equipment plan to do more over the next two years. This indicates a possible trend toward leasing and renting. Renting was the popular method for expensive pieces of equipment such as cranes. Smaller pieces of equipment such as air compressors were purchased with cash, as indicated in Table I.2.

Several other articles contained in-depth interviews with contractors in Canada. Their reasons for each respective method of acquisition vary considerably and are included in this report only as an indication of how diverse acquisition policies may be. One contractor (22) with an annual work volume of $4 million, indicated his philosophy of paying

TABLE I.I: Trend of construction equipment acquisition in Canada over the next two years (23)

		More	Same	Less
Purchase outright	I979	2I	52	27
	I978	2I	59	20
	I977	I2	62	26
Finance	I979	26	52	22
	I978	37	46	I7
	I977	I6	59	25
Lease	I979	6#	I0#	I#
	I978	7#	I2#	2#
	I977	I0#	6#	3#
Rent	I979	9#	23#	I#
	I978	II#	I7#	8#
	I977	I9	69	I2

#Indicates actual numbers, all other values are percentages

TABLE I.2:Preferred methods of acquiring specific types of construction equipment (23)

[illegible]	7%	12%	[illegible]	nil%	23%	27%	16%	31%
[illegible]	10%	13%	[illegible]	1%	24%	28%	16%	34%
[illegible]	9%	12%	[illegible]	1%	24%	30%	20%	32%
[illegible]	18%	17%	[illegible]	39%	27%	28%	38%	29%
[illegible]	27%	18%	[illegible]	62%	29%	31%	42%	31%
[illegible]	19%	13%	[illegible]	38%	28%	25%	28%	29%
[illegible]	7%	5%	[illegible]	3%	7%	6%	8%	4%
[illegible]	10%	9%	[illegible]	1%	6%	6%	5%	7%
[illegible]	6%	9%	[illegible]	1%	5%	7%	7%	7%
[illegible]	30%	26%	[illegible]	14%	14%	15%	17%	16%
[illegible]	25%	21%	[illegible]	23%	17%	15%	18%	10%
[illegible]	33%	21%	[illegible]	30%	14%	18%	22%	16%

cash for his equipment, and utilizing it to the full. Several advantages cited were:

1. Same operator stays with the machine all the time, for continuous efficiency and better productivity.

2. The machine is available when required, since not dependent on others as with renting or leasing.

3. When work is slow and the equipment is owned outright, the loss is restricted to the basic operating costs.

4. Due to his unique policy of paying cash, this contractor had an extra option available to him. For a machine worth $100,000. he often paid only 25% down, and the remainder in a three to six month period. This had the affect of cushioning the payments in time to earn revenue from the machine.

Equipment would only be purchased if it could be utilized at least 10 months of the year. The situation was carefully analyzed, and if certain acquisition factors could not be met, then the equipment was not purchased. Such factors included:

1. Dealer service - quality, cost
2. Maintenance costs
3. Company needs
4. Profit from resale
5. Economic life of equipment.

Another contractor interviewed (20) with an annual work volume of $5 million indicated his feelings towards purchasing:

1. Building of equity in a well-rounded fleet of machines.

2. Know availability of equipment when bidding work.

3. Purchasing the right kind of equipment helps cut labour costs on the job, and makes you more competitive.

4. Faster repair work is performed by maintenance personnel experienced in dealing with the same units from one project to another.

5. By purchasing used equipment, approximately 45% of the original cost is saved, and someone else has had the time to work out the defects.

6. If you have to rent, then it's obvious you need that machine for your fleet.

An alternate view was found in British Columbia, with a highway contractor (20) expressing his philosophy on the advantages of leasing:

1. Freedom to have the newest and best equipment on the market without having to commit large amounts of capital.

2. When the leased equipment is no longer required, back it goes to the leasing company.

3. Better to pay the penalty (amount depends on lease contract) and return idle equipment, than having to lose money spent in straight purchase.

4. Leasing reduces threat of obsolescence.

5. Not concerned with equipment life - not involved with having to write off the purchase over a certain time period.

6. Creates a favourable cash flow by paying equipment expenses as they accrue rather than all in advance as with a cash purchase.

7. Provides another source of credit (enlarges credit resources).

8. Utilize expertise of engineering staff of lessor for guidance in the selection and maintenance of equipment.

No reference was found in the existing literature as to the methodologies used by individual contractors to evaluate and compare the modes of acquiring construction equipment. However, some references do exist regarding a normative approach that all contractors should use. With respect to the economic evaluation of acquisition

alternatives, there are basically three methods:

1. Cash flow
2. Net present value (NPV)
3. Minimum attractive rate of return (MARR)

These methods are explained in detail in references (24) and (50), and are reviewed further in Chapter 4.

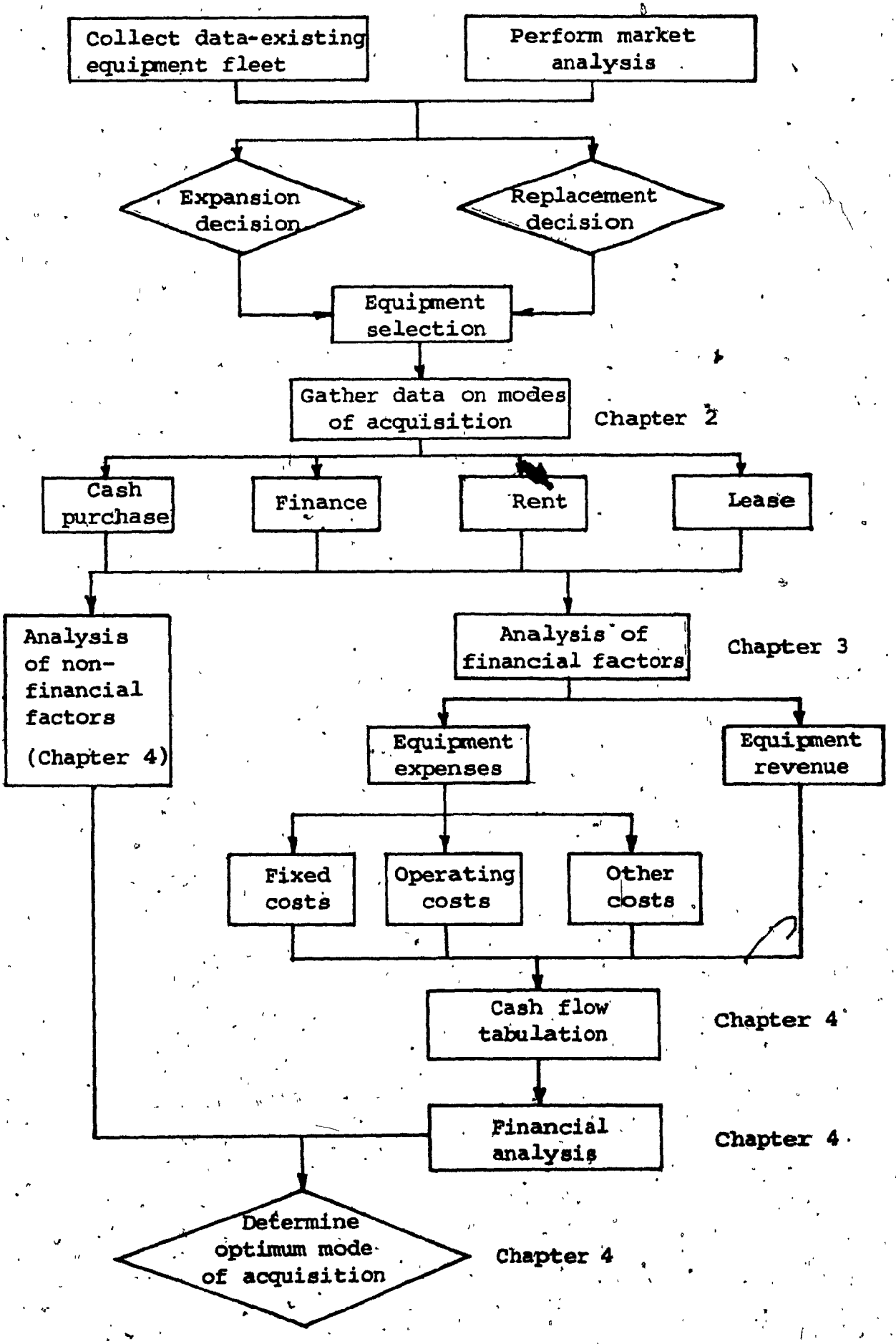
In terms of a non-economic evaluation, several contractors cited in this section appear to consider other factors along with financial criteria. However, no evidence was found of an actual method comparing the various financial and non-financial aspects of the acquisition problem. In Chapter 4, both of these important aspects will be considered simultaneously through the use of multi-attributed decision making.

Figure I.I contains a flowchart of the overall equipment analysis problem. It provides a framework for the remaining report, in order that the reader may keep in mind how the various pieces of the puzzle fit together.

Several references consulted indicated the cursory analysis carried out by many contractors in determining the optimum mode of acquisition. From Figure I.I, it may be seen that the analysis proposed in this report is a rigorous one, and should not be treated lightly. Selecting the correct mode depends on several factors, including timing and amount of payments, work load, repair, maintenance and supply costs,

interest rates, inflation, taxation rates, cost of capital, risk, company advertisement, the financial position of the firm, and so on. The optimum acquisition strategy must be based on accurate estimates of revenues and expenses which incorporate all of the pertinent factors affecting the machine's rate of return.

FIGURE I.I: Contractors' equipment analysis flowchart



CHAPTER 2

2.1 METHODS OF ACQUIRING CONSTRUCTION EQUIPMENT

It may not be difficult for the contractor to select the most suitable piece of equipment to satisfy his specific needs, but it is an altogether different problem for him to decide whether to purchase the machine with cash, or acquire it by other means. The four recognized means of acquiring equipment were briefly defined in Section I.3. The objective of this Chapter is to examine in detail the four methods of equipment acquisition.

2.2 CASH PURCHASE

This is the oldest method of acquiring equipment. The contractor gives cash for the machine, and the seller releases his title to the buyer. Accurate records, effective equipment management and a businesslike approach to equipment replacement and selection are the keys to success for the contractor who decides to purchase with cash (I7). By keeping accurate records of the profitability status of a piece of equipment, the contractor is in better control of the major factors of ownership:

1. Hours equipment is in operation
2. Equipment productivity, performance records
3. Depreciation of equipment's market value
4. Salvage value
5. Cost of repairs
6. Cost of administration, licensing, insurance and taxes.

Some contractors with enough working capital find it profitable to purchase a machine for a certain project, then sell it immediately after the job is completed (8). With new and used equipment prices soaring, the profit-conscious contractor should not overlook this possibility. The value of contractors' equipment is continually being pushed up as inflation increases replacement costs (I5). Statistics Canada (48) reported that prices of construction machinery in I978 were I0% greater than in I977. Equipment prices are escalating at a faster pace than other areas of construction. Over the past 4 years in the United States, machinery prices have increased I0% annually, while other construction costs have increased an average of only 8% annually (I5). In Canada, Figures 2.I and 2.2 indicate the various increases in non-residential building and highway construction costs respectively. Equipment increased an average of 9I% from I968 to I978. Figure 2.3 contains a summary of cost increases in other construction areas, and also in consumer goods.

There are many advantages of purchasing equipment with cash. It allows the contractor to do whatever he wants with the equipment. Firms that purchase equipment outright can take advantage of accelerated depreciation methods. As will be pointed out in Section 3.2.2 and Table 3.2, the rapid write-off of an asset can mean important tax benefits given the time value of money. A third advantage of straight cash purchase is the investment tax credit. The maximum allowable credit is currently 5% of the qualifying investment, and may be claimed only during the year that particular piece

FIGURE 2.1: Increase in non-residential building costs (48)

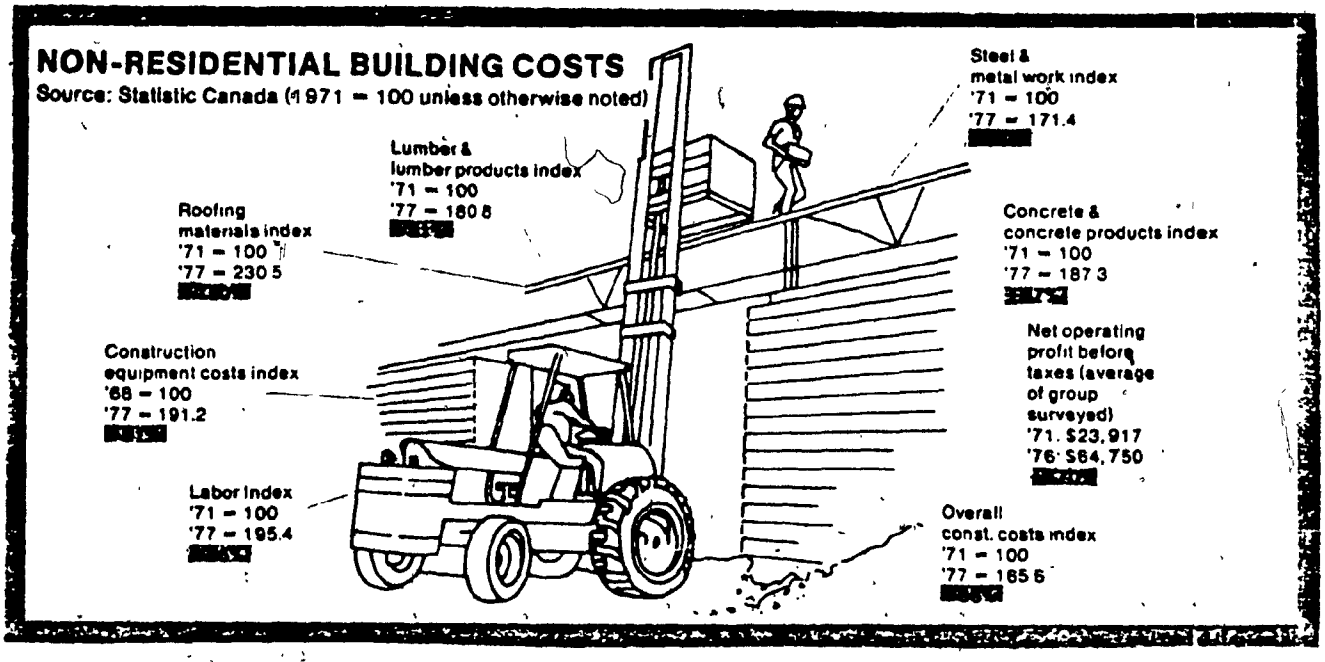


FIGURE 2.2: Increase in highway construction costs (48)

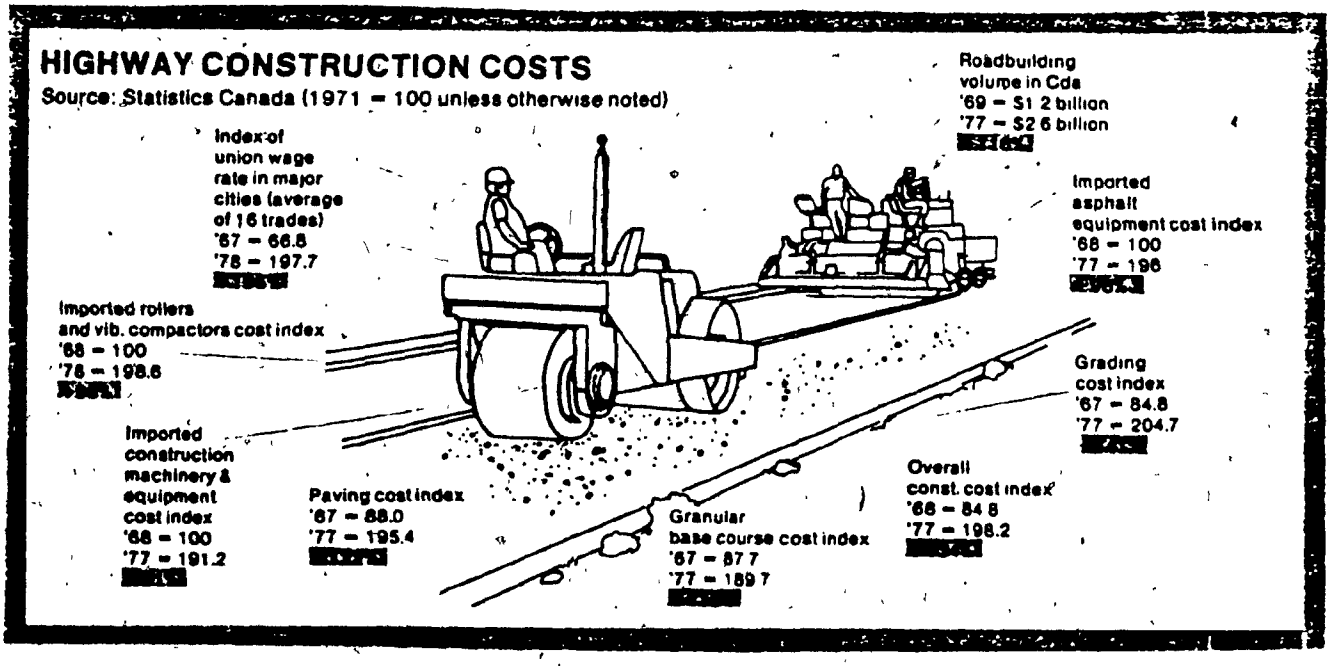
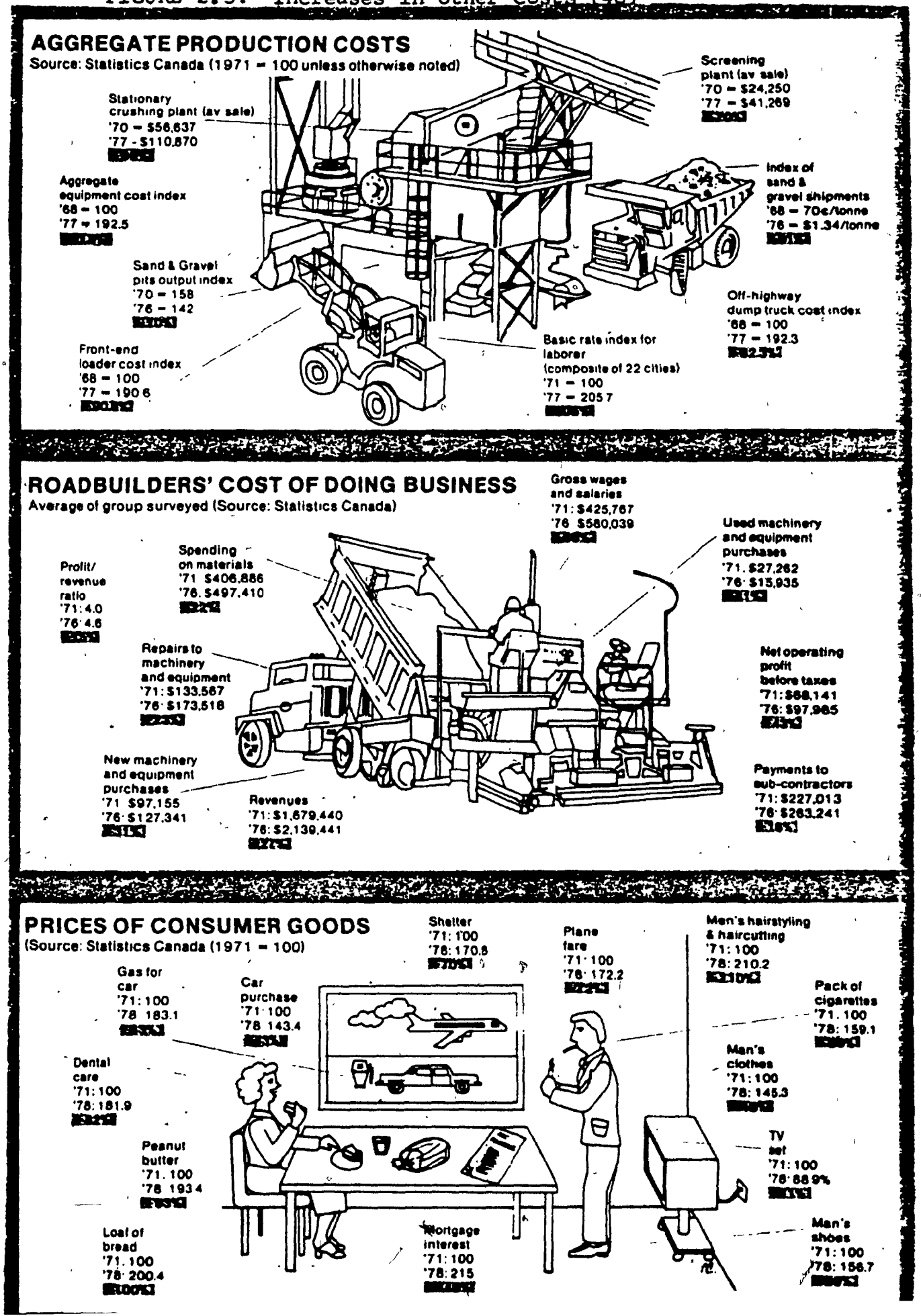


FIGURE 2.3: Increases in other costs (48)



of equipment is acquired. An example appears below (29):

Cost of equipment	$I0,000.
Investment tax credit	$500.
Income before capital cost allowance (C.C.A.)	$4,000.
C.C.A. 30% of cost of equipment	$3,000.
Net income	$I,000.
Federal tax (50%)	$500.
Allowable investment tax credit	$500.
Tax payable	nil

The major drawback to cash purchase is the large cash outlay required at one point in time. The contractor must examine the effects of negative cash flow on the financial position of the firm in the machine's first year. If projected cash flows for the firm indicate little room for sinking large sums of money into new equipment, then alternative methods of acquisition should be examined. The ultimate decision rests with the firm's ability to absorb large expenditures without interfering with other cash requirements of the business. Section 3.2.2 examines the use of cash flow diagrams in analyzing the effects of a cash purchase.

There are other disadvantages to purchasing with cash. It hurts business ratios and bonding capacity. Because of the tax laws, a tendency exists to keep equipment longer than is economical. Obsolescence can cut down a machine's competitive value. Inflation makes the equipment cost more because contractors pay cash in high-value dollars and depreciate and earn income with the equipment in dollars of less value.

2.3 FINANCING

Financing is the most common alternative to straight cash purchase. Acquiring new equipment by financing does not deplete the firm's cash reserves (equity capital). The major advantage of outside financing is that the cash remains available for daily working capital, which is important for contractors that experience seasonal slowdowns or other income interruptions.

Every contractor has debt of some kind. Debt serves to increase the return on equity (leveraging), as long as the contractor earns more with the money than he pays in interest. Relative to down payments and interest costs, leveraging can produce high rates of return. It permits the contractor to undertake additional work and increase the firm's profit potential with equipment that he could not otherwise afford. Growth is thereby possible with relatively small cash requirements. Stage by stage, as the company matures and assets grow, the possible sources of capital expand.

2.3.1 TYPES OF FINANCING

The five major types of loans available are:

I. Term loans - which are available through many types of financial institutions specializing in term lending. Banks, finance companies, credit unions and acceptance companies loan on commercial assets

including buildings, land and equipment. Terms may be 10 years or more, with floating interest rates. Insurance, trust and mortgage companies also lend on mortgates on land and buildings. A term loan is a business loan with a final maturity of more than one year, repayable according to a specified schedule. The payment schedule of the loan is usually geared to the contractor's cash flow ability to service the debt. Typically, the schedule calls for equal periodic installments.

2. Installment loans - which are available through a dealer or manufacturer, and differ greatly. Most require at least a 10% down payment, an interest rate generally several points above the prime rate, and are relatively short term. The term of the installment loan varies more than the other elements, extending to four or five years in some plans. Most often, the term runs from one to three years, depending on the useful life of the machine.

3. Demand - deposit loans - which are available through banks and are less damaging to ratios in financial statements than term loans. Besides financing equipment, they increase bonding capacity. The demand-deposit (usually 20%) serves as a compensating balance and also as a cash asset. The contractor may withdraw from the deposit at any time and pay extra interest on the outstanding debt. This type of loan is

particularly attractive to growth-goal contractors with a problem in bonding capacity.

4. Conditional sales loans - are loans where the seller of the equipment retains title to it until the contractor has satisfied all the terms of the contract. The buyer signs a conditional sales contract security agreement under which he agrees to make periodic installments to the seller over a specified period of time. The seller receives a down payment and a promissory note for the balance of the purchase price. The note is secured by the contract, which gives the seller the authority to repossess the equipment if the buyer does not meet all the terms of the contract. The seller may either hold the contract himself or sell it, simply by endorsing it, to a bank or finance company.

5. Chattel Mortgages - are loans where title to the equipment remains with the contractor (borrower). A chattel mortgage is a lien on property other than real estate. Generally there is little other difference between conditional sales contracts and chattel mortgages. Interest rates are also approximately the same.

All loans still enable contractors to use tax advantages fully. In addition, interest payments on the loan are tax deductible. The investment tax credit applies and should be considered when planning a repayment schedule.

A disadvantage of borrowing is that current equipment needs are financed with long term credit. The financing ties up lines and sources of credit that could be used for other ventures. Equipment payments frequently must be met regardless of the machine's use, which may change completely from one season to the next. Arrangements may have to be negotiated which tailor the contractor's payments to high income periods.

Lending institutions that supply money for equipment do their best to make sure they don't lose if something goes wrong. They often require 20 to 30% downpayments and/or a compensating balance that is released when the loan is paid off. These precautions insure that it will not be worthwhile for the contractor to abandon the equipment. Loans can last up to 80% of the life of the equipment.

Usually an insurance company can offer the cheapest loan rates, but they often require extensive rights and liens. Banks are the most convenient source of money to contractors. Because of the risks and unpredictability inherent to the construction industry, and the limitations banks impose by their lending policy, most contractors like to leave part of their bank credit lines open for emergencies. Table 2.I summarizes the preferred funding sources of the Canadian construction firms contacted in the 1979 ECR survey (23). The preferred repayment plans are contained in Table 2.2.

TABLE 2.I: Preferred funding sources (23)

Banks/trust companies			National finance companies			Manufacturer's credit companies			Other		
73%	67%	57%	42%	40%	51%	5%	15%	20%	3%	5%	7%
1979	1978	1977	1979	1978	1977	1979	1978	1977	1979	1978	1977

TABLE 2.2: Preferred loan repayment plans (23). For a definition of the terms refer to Figure 2.5 and ensuing discussion.

Straight 60%	Rental-purchase 40%	Skip 16%	Declining payment 16%	Low down payment 13%	Other 5%
1978 61%	1978 39%	1978 16%	1978 13%	1978 13%	1978 5%
1977 64%	1977 41%	1977 21%	1977 15%	1977 12%	1977 5%

Construction contractors in search of a loan may find a widespread resistance by banks and other lending institutions. The reasons for this are many. The construction industry by nature is a high risk industry. Poor weather, labour unrest, unknown soil conditions, complicated erection methods and other similar factors are responsible for this risk. Because of the risk factor and the basic nature of the industry, some lenders doubt the likelihood of repayment, and consequently decline the loan application. Some contractors are refused loans due to a lack of collateral such as land, buildings or other equipment with which they could use as security for the repayment of a loan. If the contractor does have some collateral, the lender looks critically at its marketability - how much it would be worth in the future should the borrower default on his payments.

There must be a mutual feeling of trust between the contractor and lender. This can be developed through frequent meetings between the two, where frank and open discussions are held. Some lenders require the contractor to submit a financial report, including an audited annual report. Interim financial reports might also be required quarterly. The lender may also request contract status reports, which are fundamental to understanding the financial condition of the contractor. Contract status reports show what is occurring on jobs in progress, and provide a good opportunity for the contractor to demonstrate successful performance.

2.3.2 FACTORS AFFECTING THE LENDER'S DECISION

It is helpful for contractors to know more about the way lending institutions look at a financing transaction, and to study the factors that help them reach a decision. In this way, a firm planning to seek financing would be able to analyze itself from the perspective of the money source. The major factors lending institutions examine are:

I. History of borrower
2. Management strength and capability (past performance)
3. Length of time in business and experience
4. Availability of facts and figures
5. Market reputation and integrity
6. Stability of company and commitment of the owners
7. Ability to service the debt (pay interest and retire the loan on time)
8. Marketability of collateral (durability, useful life and resale value)
9. Financial statements - trends in
   a) current assets
   b) current liabilities
   c) working capital
   d) non-current assets
   e) non-current liabilities
   f) total debt
   g) net worth
   h) cash flow status
   i) source and application of funds.

An example balance sheet is contained on the following page. B & G Construction is obviously a profitable company with a healthy capital position. Working capital (current assets less current liabilities) is $373,000., with retained earnings of $412,000. However, the bank will look more closely at this particular statement, and conclude the following:

I. Cash - which refers to the funds on hand and in the bank, is high. It should be used to reduce the $260,000 bank loan, or be invested in short term deposits which would earn a higher interest rate.

2. Accounts receivable

Trade - which refers to uncollected billings for completed and approved contractual work. This large figure indicates that the contractor needs to carry out a greater follow-up on his collections. A reduction in this account could be used to reduce the bank loan and interest expense.

Retentions on incomplete contracts - which refers to the holdback portion of the contract value. This high amount indicates that the contractor has a problem clearing up contractual work. The contractor should place greater emphasis on eliminating deficiencies, which would release holdbacks and improve the company's cash flow.

3. Inventory of equipment parts - refers to repair and spare parts for equipment. The amount shown is not

B & G Construction Co. LTD.

Balance Sheet As At December 3I, I979

Assets

Current Assets	
Cash	$I25,000.
Accounts receivable	
Trade	523,000.
Retentions on incomplete contracts	322,000.
Inventory of equipment parts	56,000.
Costs in excess of billings on uncompleted contracts	4I5,000.
Prepaid expenses	I6,000.
	$I,457,000.
Fixed Assets	
Land and building	I25,000.
Construction equipment	385,000.
Less accumulated depreciation	280,000.
Net property and equipment	$230,000.
	$I,687,000.

Liabilities

Current Liabilities	
Bank loan	$260,000.
Accounts payable and accrued liabilities	786,000.
Income taxes payable	38,000.
	$I,084,000.
Long-Term Debt	I85,000.
	$I,269,000.

Shareholder's Equity

Capital Stock	
Authorized - 5000 common shares of no par value	
Issued and fully paid - 6000 common shares	6,000.
Retained Earnings	412,000.
	418,000.
	$1,687,000.

that large, however compared to the net book value of the equipment, it is too high.

4. Costs in excess of billings - which refers to labour, material and other contractual costs incurred for work in progress, but not yet billed to the client. The high figure of $415,000 shows a serious problem. A more detailed and constant review of work in progress is needed, with the objective of billing earlier and more frequently.

5. Accounts payable and accrued liabilities - which includes amounts due to suppliers for construction materials, wages payable, payroll deductions such as income taxes and unemployment insurance, and holdbacks payable to subcontractors. The amount of $786,000. is high, and indicates that the contractor may not be taking full advantage of suppliers' cash discounts.

Changes in the contractor's debt structure are examined to learn the makeup and relationship of current and non-current liabilities, and in particular the ratio of total debt to net worth. A sharp increase in debt relative to net worth can create vulnerability. One of the most critical factors in determining the contractor's eligibility for a loan is his cash flow status. Cash flow is defined as the net profit after taxes, plus depreciation. It is the excess of cash income over cash expenses for the period under review. Net profit and depreciation are often used, since they provide the major source from which term debt can be retired without altering the structure of the assets necessary to operate

the firm. In analyzing cash flow the lender is interested in trends, including whether the cash flow is narrowing or increasing relative to debt due within one year.

Special attention by the bank is also directed towards the "Statement of Changes in Financial Position" which pinpoints the depreciation figure and the amount of cash generated by the firm's operations. It also indicates how the cash flow generated in the last year was utilized.

It is important that contractors think further into the future in terms of their capital requirements. They must plan as far as possible so that they can not only project money needs, but also position themselves to assure that these needs will be met. This may be done in two ways:

I. Identify capital sources that are experienced with and have a commitment to the construction industry.
2. Manage the internal financial structure of the firm so that the lender can clearly see that the contractor is planning to accomplish objectives.

A period of growth is a time when most contractors experience severe capital strain. New equipment must be acquired, additional facilities are needed, and the demands of an expanding payroll and overhead must be met. The contractor may even want to expand by acquiring another company.

When the need for cash arises, it is usually urgent. However, lending institutions do not react instantaneously.

This is another reason why it is important to prepare in advance by carefully analyzing the firms requirements and projecting its needs.

2.3.3 SELECTION OF LENDING SOURCE

While financial institutions rigourously evaluate all pertinent data relating to the contractor, the contractor can and should act in a similar manner and carefully examine the credentials of potential lenders. The selection of a financing institution is as important as the terms of the agreement itself. The following list of selection criteria will prove useful to any contractor: (3) (3I) (38) (23)

I. Look for a stable and reputable organization, preferably one that is familiar with the intricacies of construction financing and will likely be participating in equipment financing in the years ahead.

2. Lender should appear willing to continue equipment financing during tight money periods and construction industry down cycles.

3. Financier must have sufficient resources to handle additional requirements.

4. Contract terms, conditions and payment schedule must be compatible with contractor's financial and operational status. Figure 2.4 contains several popular payment schedules currently available.

5. Interest rates and financing costs must be competitive.

6. Beware of hidden charges and special terms such as early payoff conditions and premature trade-in.

7. Prior experience with lending institution.

8. Availability of insurance coverage.

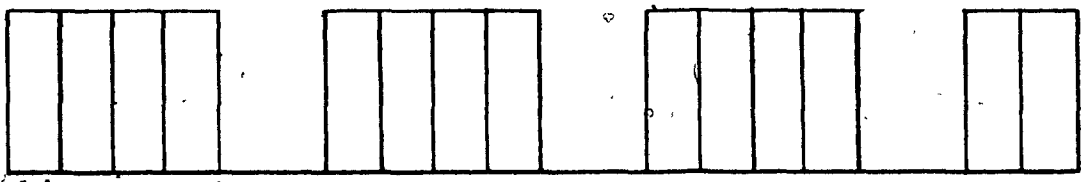
9. Nearby location of institution.

2.3.4 LOAN PAYMENT SCHEDULES

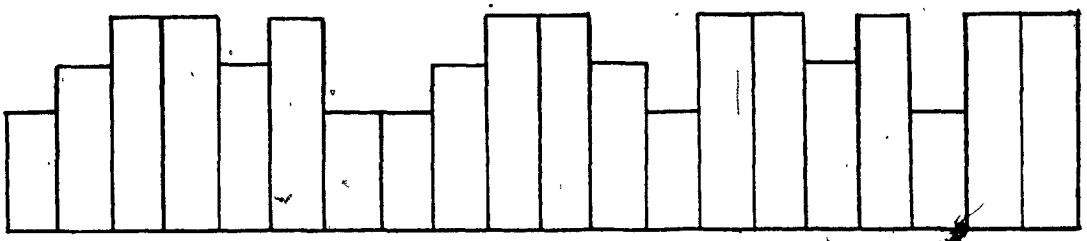
Not every contractor has a steady year round volume of work. Peaks, valleys and seasonal trends all put demands on cash. Tying up bank lines can severely hamper cash flow or the liquidity of the firm, when a seasonal slump puts pressure on money needs. Planning the method of loan payment for construction equipment can save the pressures of times when money supply is tight, periods of emergency or normal nonproductive downtime when the machine grinds to a halt. For such occasions skip payment loans may best serve the contractors needs. Under a skip payment plan, it is possible to weather a change in the climatic conditions. Bad weather periods of the year can cause a major setback in some firms. For this type of problem, no loan payments are scheduled during off season months when equipment revenue is light.

For a piece of equipment destined to be a steady producer,

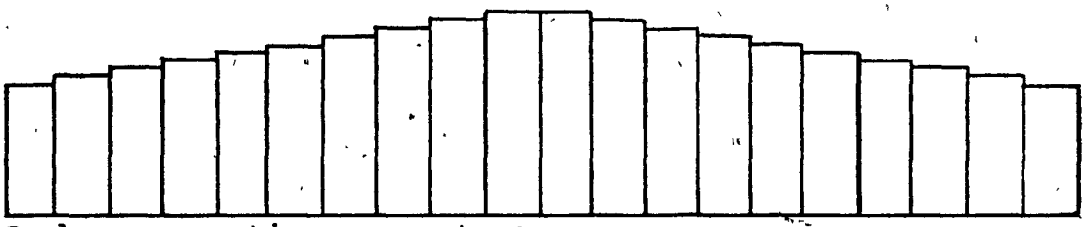
FIGURE 2.4: Loan payment schedules



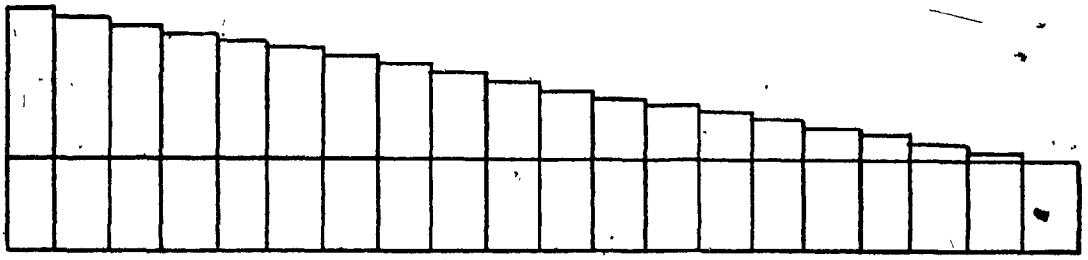
Skip payments



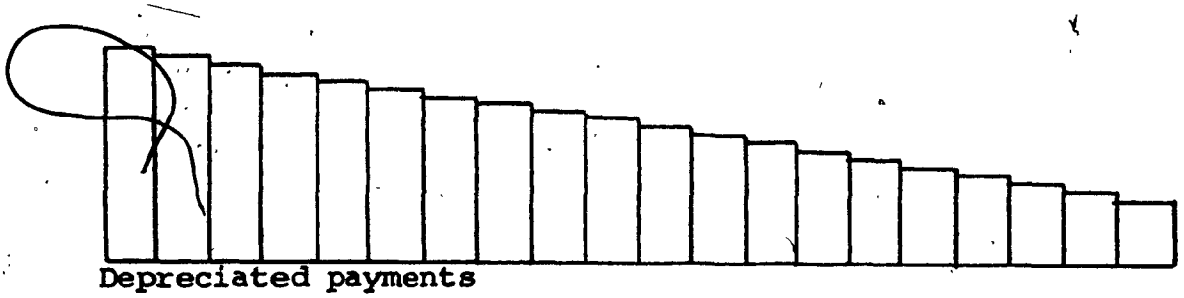
Equipment usage payments



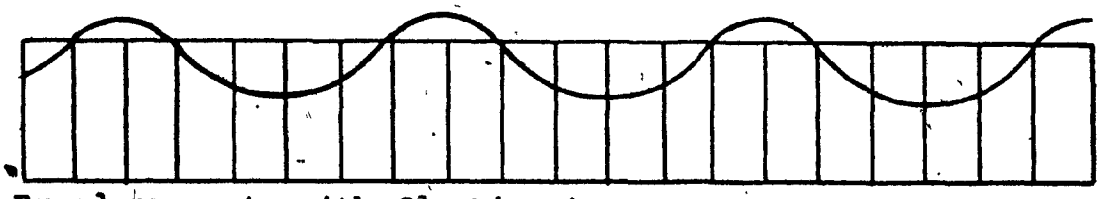
Cash conservation payments



Equal principal plus interest payments



Depreciated payments



Equal payments with floating interest

there is what is termed equipment usage payments. This schedule provides the most comfortable payment plan, where machine performance sets the payment scale. The more the machine is used, the higher the loan payments become. Conversely, during slack periods, payments lessen. The "usage rate" is based on the number of hours of operation.

One of the problems of purchasing new equipment is that it may take six to eight months before the "bugs" are worked out, and the machine is operating at or close to peak efficiency. Cash conservation payments enable the contractor to make smaller payments while the equipment is being assembled, operators are being trained, and the machine is being broken in. This pyramid loan arrangement is comprised of increasing payments, continuing at a higher level during the equipment's maximum production period. Then, as the machine ages and more downtime is encountered, the payments decline also.

Another method that protects the contractor's cash flow against the uncertainties of the future is through equal principal plus interest payments. Under this plan, principal payments remain fixed throughout the duration of the contract. As the principal is reduced, the interest declines, offering sharply reduced payments as the end of the contract is approached.

Since obsolescence and wear do not have the same impact on all equipment, a depreciated payment loan can be designed to provide steadily diminishing payments over the duration

of the loan. At the start, the contractor may be in a better position to make escalated payments, which might not be the case later on when the equipment slows down through natural wear and tear, and the capital cost allowance (depreciation) is much lower with its attendant adverse affect on cash flow.

The uncertainty of prime interest rates can have a devastating affect without some form of long range planning. Minimizing such a financial problem is a floating interest program with equal payments. This is not a common plan. Under it, the duration of the loan can be extended without affecting the payments. Depending upon the prime interest rate, extra or fewer payments may be required, but sharp adjustments in the contractor's budget are not necessary. Figure 2.5 contains a graph of the Canadian bank prime interest rate from I974 to I979, indicating the affect on the contractor if he took a large loan in early I977 hoping interest rates would stabilize. Instead, the prime rate increased at a formidable rate. Some lending sources also permit the contractor to switch from one method of payment to another. With a loan running from five to eight years, business and tax situations change. Flexibility in financing is important under these circumstances. The contractor must examine the many payment plans offered, and select the option most suited to his operation.

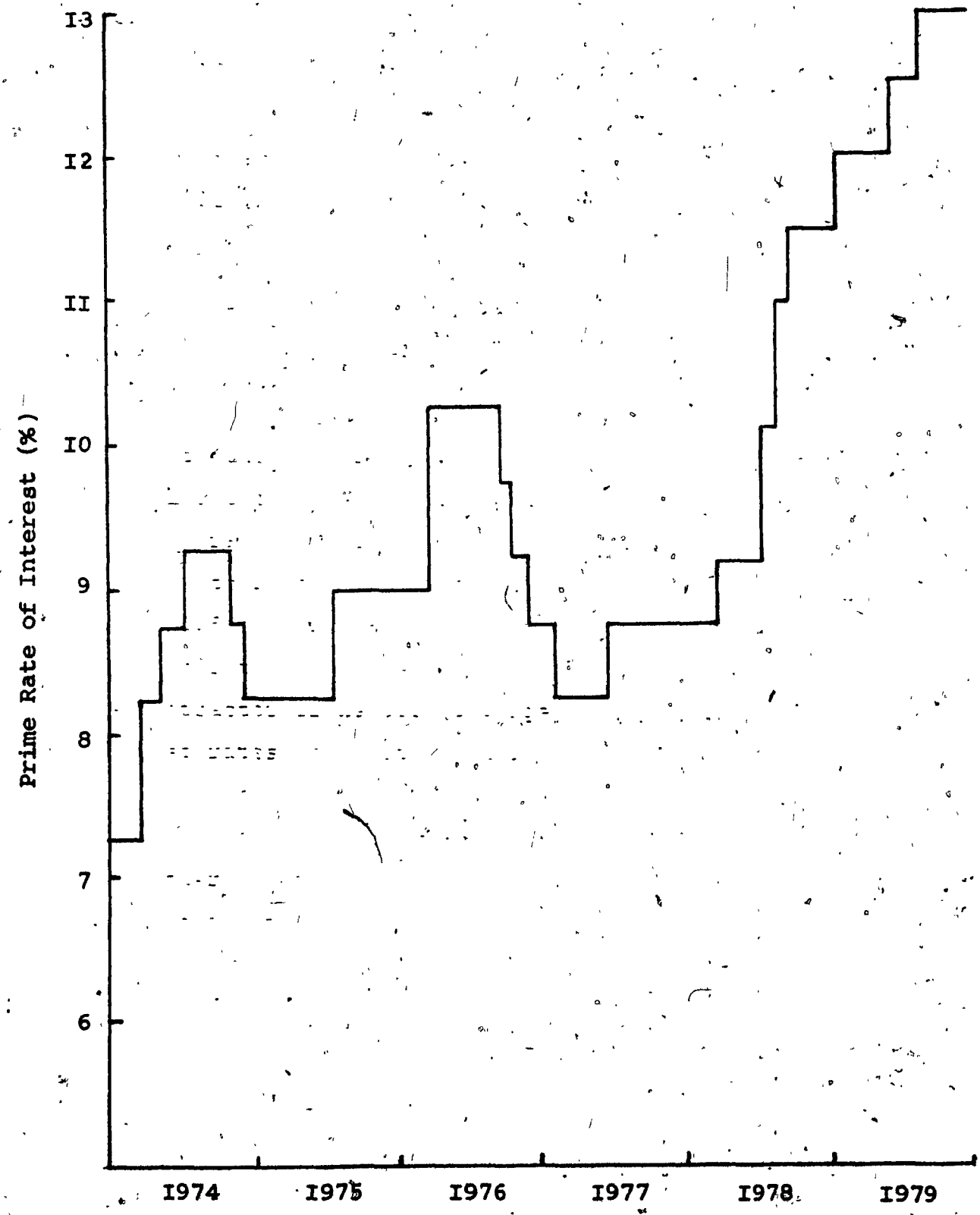


Figure 2.5: Canadian bank prime rate from I974 to I979 (48)

2.4 RENTING

Month-to-month rentals are generally the best way to get a special piece of equipment on a short-term project, or to fill a gap created by a mechanical breakdown. Short-term rental should be considered to meet a tight schedule or to make up for lost time due to strikes or inclement weather. Long-term rental rates are lower than short-term rates since rental charges are based on a percentage of machine utilization during the rental period. Long-term rates are calculated for each customer individually, based on the dealer's analysis of the contractor's operations and required maintenance program. Rental rates are based on 100% machine utilization for an extended rental period. Short-term rates usually assume 50% to 80% utilization and complete maintenance. An illustrative price list and general conditions for one of the largest construction equipment rental companies in Eastern Canada is included on the following three pages.

There are no uniformly established rental rates for construction equipment. Several organizations publish their own recommended rental rate calculation formulae (5) (6) (12) (39). Each tries to persuade the contractor to use its method of calculation. The unsuspecting contractor who does not analyze what each rate includes could be subject to severe financial consequences. This problem will be examined in Section 3.6.

Most contractors only own equipment they can keep working for at least 60% of its life, otherwise it is rented or

armand guay inc.

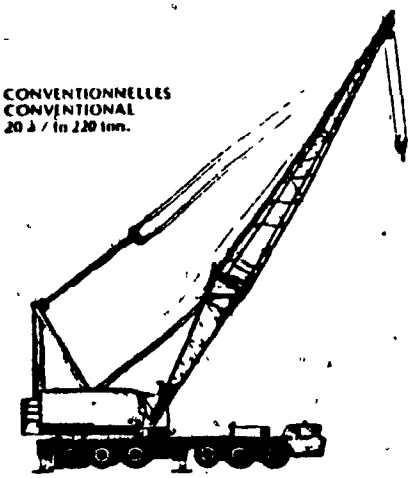
JUIN
JUNE 1, 1979

LISTE DE PRIX ET CONDITIONS GÉNÉRALES — PRICE LIST AND GENERAL CONDITIONS

GRUES
CONVENTIONNELLES
SUR CHENILLES

CONVENTIONAL CRAWLER
CRANES
35 à / to - 200 ton.

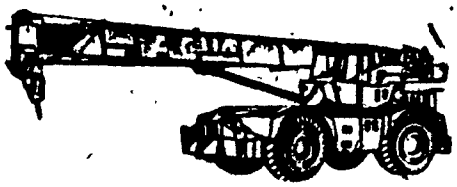
CONVENTIONNELLES
CONVENTIONAL
20 à / to 220 ton.



GRUES À TOUR
DE DIFFÉRENTS TYPES, MODÈLES ET CAPACITÉS

TOWER CRANES
OF VARIOUS TYPES, MODELS AND CAPACITIES

TÉLESCOPIQUES AUTOMOTRICES 12 à / to 50 ton.
TELESCOPIC SELF-PROPELLED



TÉLESCOPIQUES 6 à / to - 100 ton.
TELESCOPIC

1160, RUE BOUVIER,
C.P. 7240,
CHARLESBOURG, QUÉBEC
G1G 5R6

SERVICE
JOUR ET NUIT
DAY AND NIGHT
RADIO - TÉLÉPHONE

JONQUIÈRE: (418) 548-3192
MONTRÉAL: (514) 354-4420
QUÉBEC: (418) 628-8460
TROIS-RIVIÈRES: (819) 377-4343

1er JUIN 1979
Taux sujets à changements sans avis

JUNE 1st, 1979
Rates subject to change without notice

TÉL.: (418) 628-8460

TAUX DE SERVICE PAR GRUE — SERVICE RATE PER CRANE

QTÉ QTY	DESCRIPTION	CAPACITÉS CAPACITIES	HAUTEUR MÂT ET FLÈCHE BOOM JIB HEIGHT	HOMME VAN	PRIX RÉGULIER - REGULAR PRICE L'HEURE HOURLY	TEMPS½ TIME½	DOUBLE DOUBLE
GRUES CONVENTIONNELLES SUR CHENILLES / CONVENTIONAL CRAWLER CRANES							
2	Manitowoc 4000	130 Ton	210 + 60	1		sur demande / on request	
1	P & H 1015	110 Ton	210 + 50	1		sur demande / on request	
1	American 7250	60 Ton	150 + 40	1		sur demande / on request	
1	Link Belt	60 Ton	100 + 20	1		sur demande / on request	
1	American 5299	50 Ton	140 + 40	1		sur demande / on request	
1	P & H	50 Ton	100 + 30	1		sur demande / on request	
2	Dominion	15 Ton	80	1	$ 60 (0)	$ 69 (0)	$ 78 (0)
GRUE CONVENTIONNELLES SUR CAMION / CONVENTIONAL TRUCK CRANES							
1	American 9530	220 Ton	290 + 100	2	$275 (0)	$292 (0)	$309 (0)
2	American 9520	200 Ton	290 + 100	2	255 (0)	272 (0)	289 (0)
1	American	175 Ton	280 + 70	2	245 (0)	262 (0)	279 (0)
2	Manitowoc	155 Ton	280 + 60	2	225 (0)	242 (0)	259 (0)
2	American	150 Ton	260 + 80	2	220 (0)	237 (0)	254 (0)
2	Manitowoc	140 Ton	220 + 60	2	200 (0)	217 (0)	234 (0)
3	American	125 Ton	220 + 80	2	185 (0)	202 (0)	219 (0)
1	Lorain (Moto-Tower)	115 Ton	150 + 145	2	166 (0)	182 (0)	199 (0)
2	American	100 Ton	200 + 60	2	155 (0)	172 (0)	189 (0)
2	American	80 Ton	200 + 50	2	135 (0)	152 (0)	169 (0)
1	P & H	70 Ton	180 + 50	2	125 (0)	142 (0)	159 (0)
1	Bay-City	65 Ton	150 + 50	2	115 (0)	132 (0)	149 (0)
1	P & H	60 Ton	150 + 50	2	110 (0)	127 (0)	144 (0)
1	Bucyrus	50 Ton	130 + 40	2	100 (0)	117 (0)	134 (0)
1	Link-Belt	50 Ton	150 + 40	2	100 (0)	117 (0)	134 (0)
1	Unit	30 Ton	110 + 30	2	70 (0)	87 (0)	104 (0)
1	Lorain	30 Ton	90 + 30	1	60 (0)	69 (0)	78 (0)
2	Unit	25 Ton	90 + 30	1	55 (0)	64 (0)	73 (0)
GRUE TELESCOPIQUES SUR CAMION / TELESCOPIC TRUCK CRANES							
2	Grove	100 Ton	172 + 56	1	$160 (0)	$169 (0)	$178 (0)
1	Grove	80 Ton	114 + 74	1	140 (0)	149 (0)	158 (0)
1	P & H	75 Ton	105 + 45	1	130 (0)	139 (0)	148 (0)
2	P & H	65 Ton	105 + 45	1	115 (0)	124 (0)	133 (0)
1	Grove	65 Ton	90 + 74	1	115 (0)	124 (0)	133 (0)
1	Grove	55 Ton	105 + 44	1	105 (0)	114 (0)	123 (0)
1	Grove	50 Ton	115 + 32	1	95 (0)	104 (0)	113 (0)
1	Grove	45 Ton	105 + 25	1	90 (0)	99 (0)	108 (0)
1	Grove	45 Ton	95 + 30	1	90 (0)	99 (0)	108 (0)
4	Sargent	40 Ton	100 + 25	1	85 (0)	94 (0)	103 (0)
2	P & H	30 Ton	100 + 25	1	72 (0)	81 (0)	90 (0)
2	Pettibone	30 Ton	80 + 20	1	72 (0)	81 (0)	90 (0)
4	Grove	25 Ton	80 + 20	1	68 (0)	77 (0)	86 (0)
2	Bantam	18 Ton	60 + 20	1	63 (0)	72 (0)	81 (0)
3	Grove	15 Ton	60 + 20	1	57 (0)	66 (0)	75 (0)
1	Pettibone	15 Ton	60 + 20	1	57 (0)	66 (0)	75 (0)
4	Boom Truck R.O.	10 Ton	60 + 14	1	50 (0)	59 (0)	68 (0)
7	Boom Truck	8 Ton	45 + 6	1	45 (0)	54 (0)	63 (0)
2	Boom Truck	7 Ton	45 + 6	1	45 (0)	54 (0)	63 (0)
1	Boom Truck	6 Ton	45 + 6	1	43 (0)	52 (0)	61 (0)
GRUES TELESCOPIQUES AUTOMOTRICES / TELESCOPIC SELF-PROPELLED CRANE (ROUGH TERRAIN)							
8	Grove cabine pivotante	50 Ton	115 + 32	1	$ 95 (0)	$104.00	$113 (0)
2	Grove swing cab	35 Ton	104 + 32	1	80 (0)	89 (0)	98 (0)
2	Pettibone	35 Ton	65 + 20	1	77 (0)	86 (0)	95 (0)
1	Grove cabine pivotante	30 Ton	92 + 24	1	72 (0)	81 (0)	90 (0)
2	Grove swing cab	25 Ton	75 + 20	1	68 (0)	77 (0)	86 (0)
3	Grove	20 Ton	70 + 24	1	67 (0)	76 (0)	85 (0)
1	P & H	20 Ton	60 + 20	1	65 (0)	74 (0)	83 (0)
2	Pettibone	18 Ton	60 + 20	1	63 (0)	72 (0)	81 (0)
3	P & H	18 Ton	60 + 15	1	63 (0)	72 (0)	81 (0)
1	Grove	15 Ton	60 + 20	1	60 (0)	69 (0)	78 (0)
1	Pettibone	12½ Ton	56 + 15	1	55 (0)	64 00	73 (0)

	PAR JOUR PER DAY	SEMAINE WEEKLY
Godet à béton - Bucket	$ 40 (0)	$ 360 (0)
Petits matériaux (1 nombre de 4) - Small mats (1 set of 4)	$ 65 (0)	$ 260 (0)
Gros matériaux - 40' x 8' x 1' (1 nombre de 4) - Big mats (1 set of 4)	$ 100 (0)	$ 400 (0)
Benne preneuse, 1 verge cube ou moins - Clam, 1 cubic yard or less	$ 75 (0)	$ 600 (0)
Benne preneuse, plus de 1 verge - Clam, more than 1 cubic yard	$ 125 (0)	$ 900 (0)
Cage à déménagement - Aerial cage (Capacité 1000 lbs - Capacity 1000 lbs)	$ 40 (0)	$ 360 (0)
Panier fibre de verre - Fiberglass personnel bucket	$ 80 (0)	$ 320 (0)
Nacelle d'acier - Metal basket	$ 80 (0)	$ 320 (0)
Fourchette - Fork	$ 35 (0)	$ 280 (0)
Élingues - Slings	Sur demande / on request	
Tenvel hydraulique (Avant) - Hydraulic wrench (Front)	$ 35 (0)	$ 140 (0)

PLUS:
Transport $1.50 du mille (aller-retour par déplacement)
Transport $1.50 per mile travelled per move

$ (Minimum $ 300 (0))

*pour travaux spéciaux tels que homme pompeur, homme traîneur, etc. un supplément de quatre (4) heures au taux horaire de la grue sera chargé pour la préparation de la grue

*For special work such as Lamboll, dragliner, etc. an additional charge for four (4) hours based on the hourly rate of the crane will be made for the preparation required

GENERAL CONDITIONS OF EQUIPMENT SERVICE AGREEMENT

Armand Guay Inc (hereinafter called "the owner") undertakes to supply to the customer, who agrees thereto, the service described on the face of the present contract, subject to the conditions hereinafter set out

SPECIAL CLAUSE 1 Except for any express stipulation to the contrary contained in the written tender, the present document constitutes the whole agreement between the parties and replaces any prior agreement, written or verbal

HOURLY RATE 2 The "hourly rate" includes the services of one crane operator and one apprentice, except for the four following categories, for which it includes only one crane operator, a) conventional cranes of less than 35 tons / b) all telescopic cranes / c) crawler cranes / d) tower cranes

An extra charge will be made for each additional apprentice at the basic rate of $16 00 per hour, when requested by customer or Decree respecting Construction Industry in the Province of Quebec.

MINIMUM SERVICE TIME 3 For conventional cranes (crawlers or truck mounted), in addition to the time required for transport, rigging, installation and unrigging, a minimum number of hours will be charged for each service order, as follows:
cranes of 100 tons and less 6 hours / cranes of 101 tons and over: 8 hours.

For telescopic cranes (truck mounted or self-propelled), the following minimum number of hours will be charged, including the time required for transport:
crane of 50 tons or less· 5 hours / cranes of 51 tons and over 8 hours

4 In addition to the service time there will be a supplementary hourly charge for the time necessary to transport both ways, (including loading time), between the owner's business place to which the crane concerned is attached and the jobsite, a crane similar to the one rented

5 For each day of adverse weather, a charge will be made for the time effectively done by the crane, or for a minimum of four (4) hours each day, the higher of the two, plus additional charges to complete an 8 hours day for each man based on $18 00 an hour for each crane operator and $16 00 an hour for each apprentice, and pay for his pension if applicable.

ADDITIONAL CHARGES 6 In every case, there will be an additional charge at the hourly rate applicable for the crane concerned for the time required for the setting up, rigging and unrigging of the crane and its accessories

7 a) The cost of transportation of the crane operator and his helpers and the time taken thereby at the rate of $18 00 per hour for each crane operator and $16 00 per hour for each helper, for their trips between

1. The jobsite and the owner's place of business, when the crane remains on the jobsite
2. The jobsite and their residence when the applicable decree respecting construction imposes similar charges on the owner in favor of employees requested to work out of their place or residence.

b) The delivery, to the jobsite, of the booms, counterweights, mats and other required accessories, also the delivery of any self-propelled crane (rough terrain) where the distance is more than ten (10) miles, the charge being based on the distance between the jobsite and the owner's place of business to which the crane concerned is attached

Straight-body trucks· $1 50 per mile travelled, minimum $100 00 per move / semi-trailers· $2.20 per mile travelled, minimum $125.00 per move / low-bed, 3 axle and special trailers· $3 00 per mile travelled, minimum $150.00 per move The return of this equipment and those accessories will be charged for at the same rate The loading, when leaving and returning to owner's business place, is included in these rates

8 Bridge, ferry and autoroute tolls, the cost of weighing tickets, vehicle special transport permits and others permits, board and lodging of crane operators and helpers, travelling expenses and travelling time of employees (unless included in the service rate) and other incidental expenses will be charged extra

BOARD AND LODGING 9. If applicable, the customer shall pay the board and lodging of crane operators and helpers at the rate of $35.00 per person per day, including Saturdays and Sundays, or at the rate of $125 00 per person per week where it is foreseen that their services will be required for more than 15 consecutive days, or the expenses actually incurred up to a weekly maximum of $145.00, or more, when requested by the Decree respecting Construction Industry in the Province of Quebec.

OVERTIME 10 The customer shall pay extra for any overtime, determined as hereinafter provided of the crane operator and any helper, beyond the regular hours of work, on the basis of a hourly salary of $18 00 for a crane operator and $16 00 for each helper. Such charge for overtime includes salaries, fringe benefits, overhead and other expenses and is in addition to the regular service rate for the crane.

11 Overtime shall be defined and calculated in accordance with the Decree respecting the Construction Industry in the Province of Québec and any other law, regulation, collective agreement or other decree applicable to the jobsite where the services are rendered.

COMPUTATION OF TIME 12 A week shall be made up of "five days" from Monday to Friday inclusive, comprising 40 hours from 8·00 a.m. to 4:30 p m or 5·00 p.m., depending on whether the noon-meal break is of half an hour or an hour

A month shall be made up of 176 hours spread over 22 consecutive regular working days from Mondays to Fridays inclusive comprising 8 hours per day from 8 00 a.m. to 4 30 p m or 5 00 p m, depending on whether the noon-meal break is half an hour or an hour

APPLICATION OF CONTRACT 13 The present contract shall govern any service performed on the jobsite described on the face hereof after the execution hereof.

LIABILITY 14 The customer alone shall be liable for any damage caused to the equipment concerned where such damage may be said to be due to a false statement or inaccurate representation about the nature of the work to be performed or the weight of things to be moved of lifted, or to wrong directions given by an employee of the customer acting as signalman or to any wrong move on the part of any other employee of the customer

The customer shall furthermore save the owner harmless from any claim by any third party for damage sustained by the claimant and caused as aforesaid in the above paragraph

15 The customer warrants that the soil, pavement and any structure of the jobsite or the neighbourhood can withstand the weight of the crane, loaded or not and moving or not, as well as any vibration or shaking that may come therefrom

CAPACITY LIMIT 16 The customer shall never require the crane operator to exceed the crane's recognized load capacity, to use other counterweights than those supplied by the owner or to fasten or anchor the crane in order to lift a load exceeding the maximum weight specified herein.

EXTRA PERSONNEL 17. At the owner's request, the customer shall supply all competent and experienced personnel required for the proper performance of the service described on the face hereof, but such personnel shall remain under the customer's sole responsibility and full control.

PUBLIC PLACES 18 Where the service is to be performed in a public place, the customer shall, at his own cost, secure in advance the necessary permits from the appropriate authorities and provide traffic control on the approaches to the jobsite and install an adequate number of warning signs, flashers and barricades.

INTERRUPTIONS AND DELAYS 19. The owner reserves the right to interrupt at any time the operation of the equipment concerned when he deems it advisable for the protection of the persons involved or the preservation of the equipment and property, in which event neither the customer nor anyone shall be entitled to any compensation in respect of such interruption

Should the service be hindered, interrupted or delayed by any mechanical breakdown or defect of the crane, by any accident, fortuitous event, act of God or other cause beyond the owner's control, such as a strike, a labour dispute, the impossibility of or a delay in securing a replacement part, civil strike or some other such cause, the owner shall be relieved of his obligations under the present contract for the duration of such hindrance, interruption of delay and the customer shall have no right to claim damages from the owner in respect of any loss, including, without restricting the generality of the foregoing, deprivation of use of the crane, waiting time of the customer's employees, also similar claims by other persons.

WAIVER AND RELEASE 20 The customer waives any right he may have under articles 1674 and 1675 of the Civil Code and, more particularly, any claim he may have against the owner in respect of any delay or of any loss or damage, direct or indirect, as a result of the crane not being adapted to the use to which it is put by or for the customer under this contract.

The customer warrants the tensile strength and resistance of all lines, cables, accessories and parts anchored or tied to anything to be moved or lifted.

INSURANCE 21 The customer shall, at his own cost to the benefit of the owner as co-insured, insure all things to be moved or lifted against every loss or damage whatsoever for an amount equal to the difference between their value and the maximum legal liability insurance coverage of the owner on such things.

TAXES, INTEREST AND ELECTION OF DOMICILE 22 The customer shall pay any tax that the present contract may give rise to.

Any amount due hereunder shall be payable within thirty (30) days after the date on which the service is performed. Interest at 18% per annum calculated and compounded monthly shall be payable on any amount remaining unpaid after such thirty (30) day period.

For the purposes of this contract, pursuant to article 85 of the Civil Code, the parties elect domicile at 1160, Bouvier Street, Québec.

SPECIAL WORKS 23. For special works such as clamshell, dragline, etc an additional charge for four (4) hours based on the hourly rate of the crane will be made for the preparation required

INTERPRETATION 24. The provisions of the present contract shall apply mutatis mutandis where the service of any equipment other than a crane is supplied hereunder.

leased (I6). This is a general rule of thumb within the industry and should not be used as the only factor in the contractor's decision. Peurifoy (40) has developed an equation which may be used to determine the "breakeven point" between purchase and rental. The equation, shown in Table 2.3, gives the approximate number of hours of use per year for which the cost of owning or renting the equipment will be the same. An example is contained in Table 2.3. Peurifoy's equation contains several assumptions, namely:

I. Normal working year for equipment consists of 2000 hours of operation.

2. If equipment is used 2000 hours per year, then the most economical decision is to purchase rather than rent it.

3. The hourly cost of owning equipment varies inversely with the number of hours that it is used.

4. Depreciation and investment costs are independent of use.

5. Maintenance, repairs, fuel, lubrication, greasing costs vary directly according to equipment's use.

6. List of symbols and constants in equation:

P = delivered cost of equipment
S = estimated salvage value
N = number of years of useful life

p = ratio of annual cost of maintenance and repairs divided by annual cost of depreciation (using equipment 2000 hours per year)

n = number of hours used per year

q = factor equal to "p" if n = 2000
less than "p" if n = 2000

i = sum of annual cost of interest, insurance, taxes and storage expressed as % of "P".

Q = factor to be multiplied by original cost of equipment in order to determine its average value during its useful life

D = depreciation

$= \frac{P-S}{N}$

C = cost per month for renting equipment, excluding costs of fuel, lubrication, labour

$\frac{p}{3}$ = average cost per hour for maintenance and repairs for rented equipment.

There is a no explanation of how each constant was developed or what it consists of. The reader of Peurifoy is left to arbitrarily select his own numbers, and substitute them into the equation.

7. The formulae developed in Peurifoy's book include the following:

a) Owning and operating

Maintenance and repairs = qD

Investment = iQP

Cost per hour = $\frac{D}{n} + \frac{qD}{n} + \frac{iQP}{n}$

Depreciation = $\frac{P - S}{N}$

b) Renting equipment

Hourly cost to rent = $\frac{C}{I75}$

Cost of repairs = $\frac{pD}{3n}$

Total rental cost per hour = $\frac{C}{I75} + \frac{pD}{3n}$

c) Equating owning & renting costs

$$\frac{D}{n} + \frac{qD}{n} + \frac{iQP}{n} = \frac{C}{I75} + \frac{pD}{3n}$$

$$525\ (D + qD + iQP) = 3Cn + I75pD$$

$$n = \frac{525\ (D + qD + iQP) - I75pD}{3C}$$

According to Peurifoy's equation, from Table 2.3 it is more economical to rent for less than 1257 hours, and to purchase the 35 ton rough terrain crane that will be used more than I257 hours. Table 2.4 summarizes the results of a sensitivity analysis of changes in certain variables in Peurifoy's equation. The outcome is very sensitive to changes in the value "N". Other variable changes produced far fewer an affect on the number of hours.

Peurifoy's relationships are not easily justified when examined closely. A more common sense analysis of the rental / purchase decision may be performed by the contractor using "break-even" production theory.

TABLE 2.3: Decision of whether to purchase or rent 35 ton rough terrain crane using formulae from reference (40)

Assumptions

$P = \$170,000$ $\quad i = 18\%$

$S = \$28,000$ $\quad Q = 60\%$

$N = 5$ years $\quad C = \$8,800.$

$p = \frac{136,500 \div 5}{28,400} = \frac{27,300}{28,400} = 0.96$ $\quad D = \frac{P - S}{N} = \$28,400.$

$q = 0.90$ (estimate)

Calculation

$$n = \frac{525\,(D + qD + iQP) - 175pD}{3C} \quad \text{(Peurifoy's equation)}$$

$$n = \frac{525\,(28,400 + 25,560 + 18,360) - 4,771,200}{26,400}$$

$n = 1257$ hours

TABLE 2.4: Results of sensitivity analysis of changes in variables in Peurifoy's equation.

Variables / Case	P $*10^3$	S $*10^3$	N years	p %	q %	i %	Q %	C $*10^3$	D $*10^3$	n hours
Base case	I70	28	5	96	90	I8	60	8.8	28.4	I257
Variation in S	I70	35	5	96	90	I8	60	8.8	27.0	I2I3
Variation in N	I70	28	8	96	90	I8	60	8.8	I7.8	923
Variation in p	I70	28	5	85	90	I8	60	8.8	28.4	I278
Variation in q	I70	28	5	96	85	I8	60	8.8	28.4	I229
Variation in i	I70	28	5	96	90	I5	60	8.8	28.4	II96
Variation in C	I70	28	5	96	90	I8	60	II.0	28.4	I005
Variation in D	2I5	36.5	5	96	90	I8	60	8.8	35.7	I583

Contained in Figure 2.6 is a graphical illustration of the breakeven point between renting the 35 ton rough terrain crane or purchasing it with cash. The basic assumptions are listed below. For a more detailed description of breakeven production theory, the reader is referred to Grant and Ireson (24) or Anthony (4).

Owning curve

$$\frac{P - S}{N \times n} + \frac{MR}{n} + \frac{iP}{n} - \frac{t(P - S)}{N \times n} = \text{owning cost at "n" hours of operation}$$

Where: P = delivered cost of equipment = $I70,000.
S = estimated salvage value = $28,000.
N = number of years of useful life = 5
n = number of hours used per year.
MR= maintenance and repair costs per year =
$25,000 in year I (first I800 hours)
$26,000 in year 2 (I800 to 3600 hours)
t = tax rate = 50%

Renting curve

The data presented was obtained from an equipment rental company. The machine is rented "bare", with no operator or fuel costs included.

From Figure 2.6, it may be concluded that for less than approximately 950 hours it is more economical to rent the crane, and to purchase the machine if it will be used more than 950 hours. This differs significantly with the value

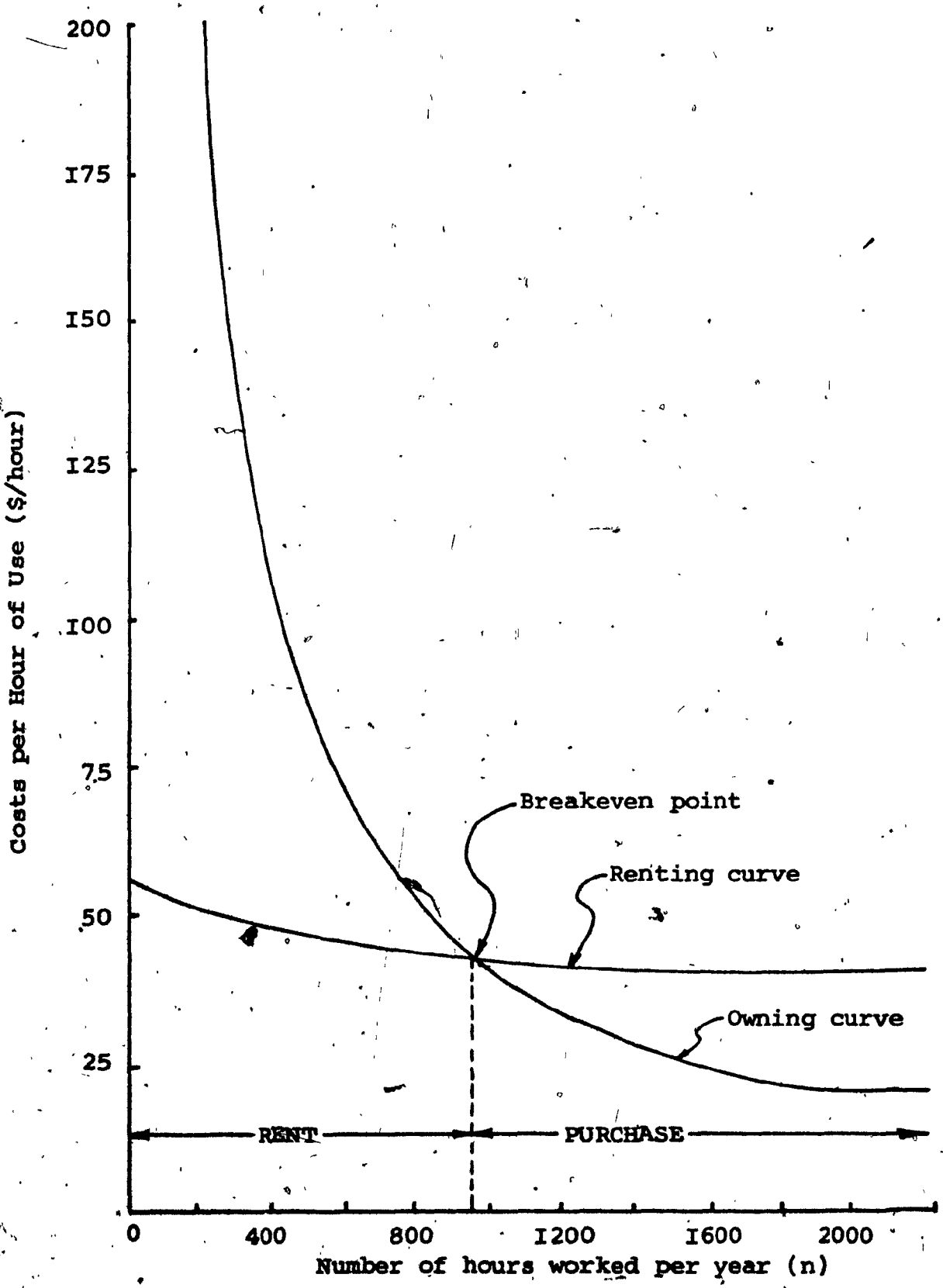


FIGURE 2.6: Graphical analysis of breakeven point between renting 35 ton rough terrain crane or purchasing with cash.

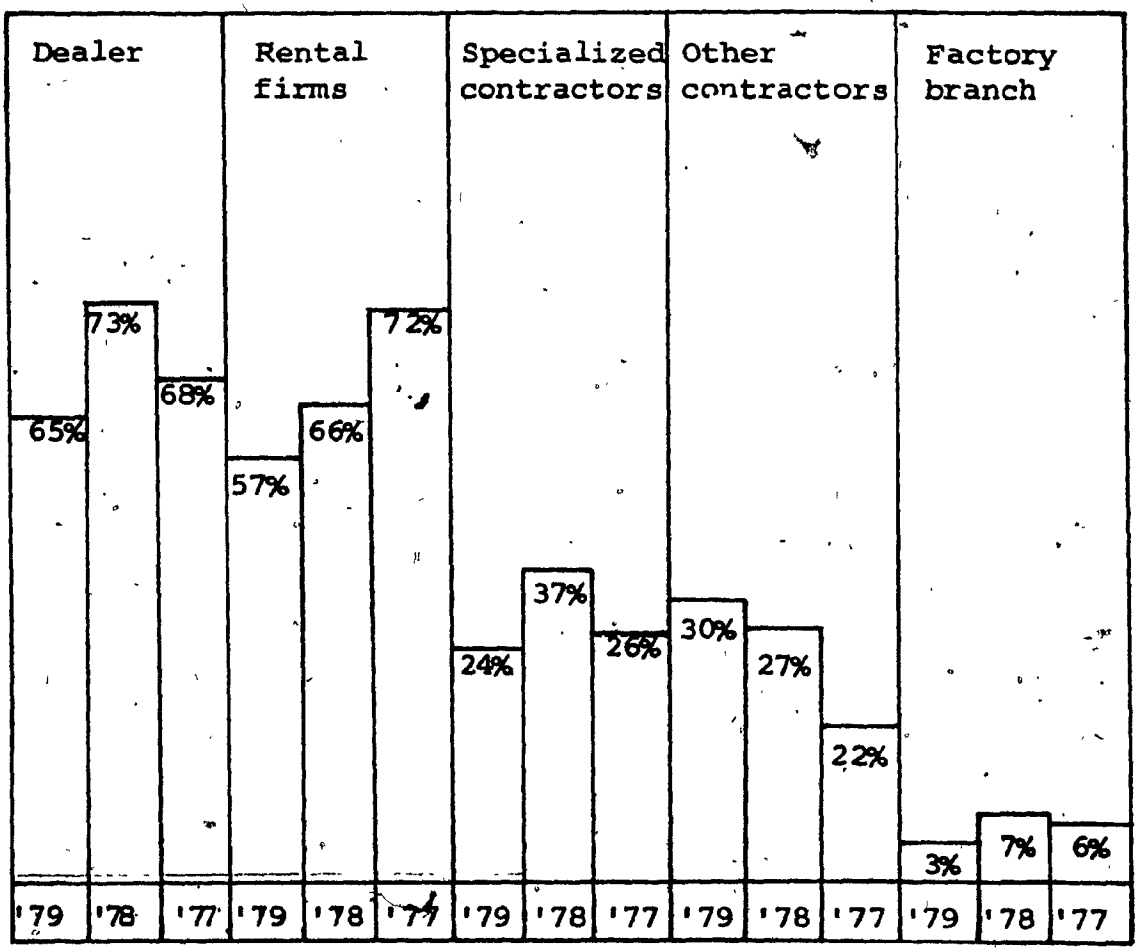
of 1257 hours found using Peurifoy's formulae, with its somewhat vague basis.

Another popular rule of thumb in the construction industry is "rent equipment that will be used less than one year". Again, this is a general rule to be applied with caution. Business consultants agree that contractors should have to rent equipment periodically, otherwise they own too much equipment. Some contractors who work all across Canada on relatively short term projects prefer to rent equipment locally, when considering the expense of transporting heavy equipment long distances.

There are several other advantages in renting. It can improve business ratios since there is no major capital expenditure. All rental payments are tax deductible. Modern, efficient and well maintained equipment is most always available. The contractor can use specialized or high capacity equipment and different makes and models without building up parts inventories. Renting eliminates or sizably reduces storage costs, repair costs, and administrative overhead. It provides a hedge against disposal losses on obsolete equipment. Renting can increase estimating accuracy since all but emergency repair and associated downtime costs are collected and known in advance.

Table 2.5 contains the recent ECR survey results (23) for Canadian contractors' preferred rental sources. The key factor behind the contractor's decision to rent equipment or acquire it by some other means is competitiveness. If the contractor feels that he can pass on the high cost of

TABLE 2.5: Preferred Rental Sources (23)



Percentages may total more than 100 per cent because some respondents gave more than one answer

rental to his client and still remain competitive with other contractors, then this may be the best mode of acquisition for him.

2.4.I RENTAL-PURCHASE OPTION (RPO)

RPO is becoming a popular acquisition plan among contractors today. It is also the most disliked by rental firms, as it interferes with their long term equipment planning. Using RPO, a contractor can rent a new and unfamiliar machine and then, if he likes it, apply most of his rental payments to the purchase price. Monthly RPO payments go as low as 3% of the purchase price.

2.5 LEASING

Lease terms last up to 80% of a machine's useful life but the type of lease, and not its terms, is the most important consideration. Leasing contracts may be divided into two categories: financial and operating (II).

2.5.I FINANCIAL LEASING

The primary objective of this type of lease is to finance the contractor's exclusive use of the equipment over its effective life, allowing the asset to pay for itself as real benefits are derived. A financial lease is defined as a contract under which the lessee (contractor) agrees to make a series of payments to the lessor which, in total, exceed the purchase price of the equipment. The lease is thus

structured on a "full payout" basis, which means that the total payments will return the cost of the leased equipment plus the lessor's financing and other expenses. Payments are spread over a period of time equal to the major portion of the useful life of the machine. During the lease, the contract is noncancellable by either party.

Financial leases are "open-ended", as opposed to the "closed-end" leases typically found in automobile, truck and railcar leasing. Closed end leases are fixed in term and not truly full payout in nature. As with any lease, legal title to the equipment remains with the lessor, but under a financial lease the benefits and incidents of ownership as examined in Section 2.2 (possession, use, risk) are transferred to the lessee.

2.5.2 OPERATIONAL LEASING

Operational leases may be defined as all other leasing contracts, and are cancellable by the lessee without penalty. Operational leasing, or "full service" leasing as it is also termed, traditionally involves shorter term rental of equipment for periods considerably less than the equipment's useful life. The lessor supplies the equipment on a monthly or annual basis to a number of successive lessees over time. The lessee acquires the equipment for temporary needs and returns it to the lessor, who will then lease it to others.

In contrast to the financial lease, the lessor rather than the lessee bears all the incidents of ownership and usually absorbs most, if not all, the ownership costs. The lessor's profit depends on the demand for the equipment and a constant turnover of successive rentals. The operational lessor may be regarded as providing lessees with a convenient rental service, not an equipment financing service.

Depending on the requirements of the contractor, leasing can offer a number of advantages over other acquisition methods. Of all the long term financing methods, leasing leaves the most cash for other ventures and bonding capacity. The timing of lease payments compared with the timing of depreciation recoveries is where the main advantage of leasing lies. Leasing allows the contractor to save the cash flow for other uses within the business. Lease obligations do not affect business ratios as much as loans or cash purchases. Leases are preferred over other loans by most stockholders and lenders, particularly when the lease is cancellable or when the balance due cannot be demanded by the lessor.

Leasing permits the user to equip his projects with specific equipment, yet does not burden him with extra equipment once the project is completed. Relative to purchasing, leasing represents a temporary rather than a permanent commitment of capital. Accounting is simplified and direct administrative costs are reduced. The contractor appears to avoid problems of obsolescence and disposal of the equipment, but he has already paid for obsolescence by the inclusion of the dealer's safety factor.

With any leasing proposal, the contractor has many factors to consider. One of the most important factors is the overall lease cost. In most cases leases are quoted in terms of a fixed rate per thousand (ie $22 per month per $1000 of equipment cost). Leasing rates will vary depending on whether payments are made in arrears or in advance, and on how often they are to be made. The example in Table 2.6 illustrates that there is a significant difference in the interest charged, depending on the timing of payments (in advance or in arrears), lease term (3,4,5, or 7 years) and on the frequency of payment (monthly, quarterly or annually).

It should be noted that lease payments in advance are always lower than payments in arrears. The reason for this is that the first payment in advance is, in effect, a down payment to the lessor, which immediately reduces the balance due. A lower balance will reduce the total interest element, thereby reducing the overall payment required.

Another main concern in evaluating a lease is the effective rate of interest implicit in the rental payments. The rates charged by the lessor will depend on a number of factors, including:

1. Rates charged by competing lessors
2. Lease term
3. Lessor's cost of borrowed funds
4. Nature of the equipment

TABLE 2.6: Schedule of total lease costs comparing advanced and arrears payment structures under varying lease terms and payment frequencies.

Assumptions: Cost of equipment = $I00,000
Interest rate = I2%

Payment Frequency	Lease term in years	Lease payments in advance	Lease payments in arrears
Monthly	7	I46,832	I48,260
	5	I32,I20	I33,440
	4	I25,I36	I26,384
	3	II8,404	II9,556
Quarterly	7	I44,872	I49,2I2
	5	I30,520	I34,440
	4	I23,664	I27,376
	3	II7,048	I20,552
Annually	7	I36,948	I53,384
	5	I23,845	I38,705
	4	II7,584	I3I,692
	3	III,522	I24,905

Longer lease terms lengthen the period in which the lessor recovers the original investment. Consequently, there is an element of financial risk.

Generally, the contractor can determine whether a reasonable rate is being charged. Essentially, the implicit lease rate is the discount rate which, when applied to the stream of lease payments, will equal the purchase cost of the equipment being leased. The example in Table 2.7 illustrates how this can be done for a typical lease.

The overall lease cost should not be the only deciding factor between lease plans or other methods of acquisition. For example, while the overall cost may be lower under a shorter term, the cash outflow will be significantly higher than under a longer term arrangement. This might be of concern to a contractor with a cash flow problem in the early years of the machine's service life.

Flexibility within a lease agreement can also provide advantages to the contractor. A full service lease frees the contractor from parts and service responsibility, an important factor on projects where support equipment, plant and personnel must be kept to a minimum. Most leases extend for at least one year. Some cover the entire economic life of the machine, whereby the contractor pays the full value of the machine over the lease period. Whatever the length of the lease, it presumably suits the contractor and helps him avoid having unneeded equipment. Another feature of leasing concerns the equipment itself. The contractor can specify the machine

TABLE 2.7: Calculation of implicit lease rate

Assumptions: Cost of equipment = $I00,000

Term of lease = 3 years

Monthly payments = $2986 (in arrears)

$$\frac{\text{fixed lease rate}}{\$I \text{ of equipment cost}} = \frac{2986}{I00,000} = 0.02986$$

$$\text{inverse of lease rate factor} = \frac{I}{0.02986} = 33.500 \left\{\begin{matrix}\text{present}\\\text{value}\\\text{factor}\end{matrix}\right.$$

The present value factor of 33.500 may be found in published financial tables (ie for the present day value of $I.00 payable, compounded monthly) to correspond to an effective interest rate of approximately I5%.

and attachments he needs as if he were purchasing the equipment. Since leasing involves longer periods of time than renting, the distributor or leasing company can afford to order specific equipment for a qualified customer.

There are other economic considerations associated with leasing that directly affect the contractor's cash flow. Contractors who must make, or have recently made, large payments without much current income will turn to leases to acquire needed equipment. Leasing requires no large down payment - the contractor pays for the machine as he uses it, not in advance. Lease payments are deductible for the year in which they are made, which of course decreases the contractor's tax liabilities. However, care must be taken to ensure the validity of the lease. To qualify as a legitimate expense, payments must be made for the lease of the machine, not its purchase. If the machine is eventually purchased by the contractor, then the original lease may be interpreted as a conditional sale. That is, the payments could be viewed as equity investments, not expenses. Tax advantages are complex and should be discussed with income tax consultants when equipment leasing is being considered.

Within the framework outlined in Figure I.I, Chapter 2 has completed the analysis of the four major methods of equipment acquisition. Purchasing with cash, financing through a loan, renting and leasing are the most common ways to acquire construction equipment in North America. Each has its own particular advantages and disadvantages, both from an economic point of view and otherwise. Each must be analyzed and evaluated carefully by the contractor before proceeding on to the next step in the acquisition problem.

CHAPTER 3

3.1 ANALYSIS OF FINANCIAL FACTORS

The objective of this chapter is to describe in detail the various financial factors involved in the equipment acquisition problem. As shown in Figure 1.1, an analysis of financial factors involves basically two groups: equipment expenses and equipment revenues. These two groups of economic factors will be examined in detail, in order that a more accurate financial analysis of the acquisition problem may be performed.

3.2 EQUIPMENT EXPENSES

Equipment expenses or costs have been examined and well defined in many excellent references (5) (6) (12) (30) (39) (52). In all the references consulted, there were no complete tabulations found of the various equipment costs. Table 3.1 contains a list of such costs, in the form of a performance attribute matrix (45). Each cost attribute listed for a specific acquisition method must be investigated by the contractor, before deciding upon which mode to use to acquire the required equipment.

3.2.1 FIXED COSTS

Ownership or fixed costs are those items that come from owning a machine, as differentiated from those costs in connection with actually operating it. They are incurred by simply having the machines, whether they are working or are idle due to lack of work. Such costs include

TABLE 3.1: Performance attributes interface matrix for equipment costs and acquisition methods.

Description of Cost	Cash Purchase	Finance (Borrow)	Rent	Lease
Fixed Costs				
List price	x	x		
Freight charges	x	x		
Initial unloading & assembly	x	x		
Depreciation	x	x		
Interest	x	x		
Insurance	x	x		
Sales taxes (where applicable)	x	x		
Federal	x	x		
Provincial	x	x		
Foreign exchange	x	x		
Licence	x	x		
Storage	x	x		
Operating Costs				
Repair	x	x		x
Maintenance	x	x		x
Supplies	x	x		x
Fuel	x	x		x
Oil	x	x		x
Labour	x	x		x
Transportation	x	x	x	x
Breakdown	x	x		x
Set-up	x	x		x
Overhauls	x	x		x
Inspection	x	x		x
Modifications	x	x		
Rental			x	
Lease				x
Indirect Costs				
Supervision	x	x		x
Overhead	x	x		x
Other Costs				
Obsolescence	x	x		
Inflation	x	x		x
Improper selection or replacement	x	x		x

depreciation, interest charges, taxes, insurance, licences and storage. Fixed costs are frequently expressed as a percentage of the total initial investment figure, comprised of:

List price F.O.B. factory
All standard equipment
Extra or specialized accessories and attachments
Sales taxes
Freight charges
Unloading and assembly

3.2.2 DEPRECIATION

Depreciation represents the decline in the original value of a machine throughout its life due to a combination of wear, weathering and obsolescence. From an accounting point of view there are two concepts which interest the contractor:

1. Accounting for depreciation to achieve an hourly ownership cost
2. Tax accounting

An estimated hourly charge for equipment depreciation may be determined by dividing the value to be depreciated by the anticipated hours of useful life (19). The value to be depreciated includes the following costs:

List price
Freight charges
Sales taxes
Less: cost of tires, if applicable

Tax accounting involves in part the calculation of the allowable depreciation expense, which is then deducted from gross income for the determination of taxable income. If all the depreciation is written off in the year the equipment is purchased, the machine is said to be expensed. If the equipment is written off over a useful service life of several years, it is said to be capitalized (18).

There are four methods of depreciation which will be examined in this report:

1. Straight line (S.L)
2. Sum of years digits (SOYD)
3. Declining balance
4. Capital cost allowance (CCA)

In Canada, only the CCA system may be employed, where the amount of depreciation expense allowable for income tax purposes depends on the class the contractor's equipment is placed. As the name indicates, the CCA system is designed to permit the contractor an allowance over a period of years in respect of the capital cost of the equipment. However, it is interesting to study the other three methods, which are permissable in the United States. Contractors who operate plants and equipment in both

countries may take advantage of the best of two worlds in calculating their depreciation.

1. Straight line method (S.L)

The S.L. method is the simplest and easiest to apply. Depreciation is charged off at an even rate per year from the equipment's initial value, to its salvage value at the end of its useful life. The salvage value of a piece of equipment will vary widely, depending upon its condition, its state of obsolescence and the general market for it. This may be as little as the machine is worth for scrap, or as much as 20% or more of its initial cost (5). Several contractors' associations (5) (6) (30) have recommended rates of depreciation to be charged in the hourly cost of the equipment, all based on the straight line method. Column (A) in Table 3.2 contains the depreciation calculations for tax purposes of a 110 ton crawler crane using the straight line method. The depreciation in any year is given by the formula:

$$D_j = \frac{C - S}{N}$$

$$B_j = C - j\left(\frac{C - S}{N}\right)$$

where:

D_j = depreciation charge during year j
C = initial cost of equipment
S = estimated salvage value
N = estimated service life
B_j = book value at end of year j

2. Sum of years' digits (SOYD)

The total amount of depreciation with this method is the same as the total in the S.L. method. However with the SOYD method, the amount of depreciation claimed each year varies, with a higher amount being taken in the machine's early life than at it's end. Table 3.2 column (B) contains an example of depreciation using SOYD as defined in reference (18). Expressed mathematically:

$$D_j = \frac{N - j + (C - S)}{\frac{N(N+1)}{2}} \quad \{\text{Depreciation in year } j\}$$

$$B_j = (C - S)\left(\frac{N - j}{N}\right)\left(\frac{N - j + 1}{N + 1}\right) + S \quad \{\text{Book value in year } j\}$$

3. Declining balance

Under the declining balance method, the estimated life of the equipment in years gives the average percent of depreciation per year. The percentage is doubled for the 200% declining balance method. Defined in detail in reference (18), column (C) in Table 3.2 contains an example of the double declining balance method on the same crane. The corresponding formulae used in this calculation are:

$$D_j = (R)\,(C)\,(1 - R)^{j-1} \quad \{\text{Depreciation in year } j\}$$

$$B_j = C(1 - R)^j \quad \{\text{Book value in year } j\}$$

$$R = \frac{200\%}{N} \quad \{\text{For double declining}\}$$

Where: R = fixed percentage of the book value at beginning of year j

4. Capital cost allowance

Depreciation in Canada is termed capital cost allowance, and is described in Sections 13 and 20 (1)(a) of the Income Tax Act (9). Equipment and other assets are categorized into classes, as shown in Table 3.3. Each class of equipment is treated as a pool of assets. CCA may be claimed each year in any amount the contractor chooses, up to a maximum percentage of the unclaimed capital cost of assets in the class pool. No recognition is given to equipment resale or scrap value until it is actually disposed of.

The 110 ton Linkbelt crawler crane previously studied falls into class 10 in Table 3.3. (Normal Contractor's Movable Equipment). This denotes a capital cost allowance rate of 30%, to be applied to the previous year's book value. Column (D) in Table 3.2 summarizes the calculations using the CCA method.

If a machine is physically depreciated at a slower rate than allowed for Canadian tax purposes, then the resulting differences will work out in the form of reduced allowances, or a recapture on disposal of the equipment. On the other hand, if the asset is sold for less than its depreciated value or it is scrapped before it has been fully written off, then the remaining undepreciated balance stays in its class to be further depreciated in future years.

Two of the American depreciation methods are used in calculating the capital cost allowance. They are the straight

TABLE 3.2: Analysis of four methods of depreciation on 110 ton crawler crane costing $425,000, with an estimated life of 12 years and residual value of $35,000.

Year	(A) Straight Line		(B) Sum of Years' Digits			(C) Declining Balance		(D) CCA	
	Annual Deprⁿ	Net Book Value Dec 31	Rate	Annual Deprⁿ	Net Book Value Dec 31	Annual Deprⁿ	Net Book Value Dec 31	30% Rate	Net Book Value Dec 31
0	—	425,000	—	—	425,000	—	425,000	—	425,000
First	32,500	392,500	12/78	60,000	365,000	70,847	354,153	127,500	297,500
Second	32,500	360,000	11/78	55,000	310,000	59,038	295,115	89,250	208,250
Third	32,500	327,500	10/78	50,000	260,000	49,195	245,920	62,475	145,775
Fourth	32,500	295,000	9/78	45,000	215,000	40,995	204,925	43,733	102,043
Fifth	32,500	262,500	8/78	40,000	175,000	34,161	170,764	30,613	71,430
Sixth	32,500	230,000	7/78	35,000	140,000	28,467	142,297	21,429	50,001
Seventh	32,500	197,500	6/78	30,000	110,000	23,720	118,577	15,000	35,001
Eighth	32,500	165,000	5/78	25,000	85,000	19,767	98,810	10,500	24,501
Ninth	32,500	132,500	4/78	20,000	65,000	16,472	82,338	7,350	17,151
Tenth	32,500	100,000	3/78	15,000	50,000	13,726	68,612	5,145	12,006
Eleventh	32,500	67,500	2/78	10,000	40,000	11,437	57,175	3,602	8,404
Twelfth	32,500	35,000	1/78	5,000	35,000	9,531	47,644	2,521	5,883

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line and declining balance methods. The method and specific provisions regarding the application of the CCA system are contained in the Income Tax Act. The rates reproduced in Table 3.3 are subject to change, since they are often used by the Federal Government to stimulate or slow down selected segments of the economy.

Figure 3.1 is a graph comparing the annual depreciation for each method over the life of the equipment, while Figure 3.2 contains a graph of the net book value of the crane under each depreciation method. The SOYD, declining balance and CCA methods permit the depreciation of equipment more rapidly in the early years of the machine's life, with lower depreciation in later years. Using one of these accelerated methods of depreciation shifts the tax burden to later years. The advantage of this lies in the time value of money, where today's dollars are worth more than future dollars.

If a machine is retained in service after the end of its depreciation period, no further depreciation is taken for tax purposes. If it is given a major overhaul or reconditioning that could be expected to lengthen its economic life, then the cost of this should be added to the value of the machine for calculating subsequent depreciation, and a new depreciation schedule may be set up to accommodate this. If the overhaul or reconditioning is written off as an operating expense, then it cannot also be depreciated.

Accelerated depreciation can result in a book value below

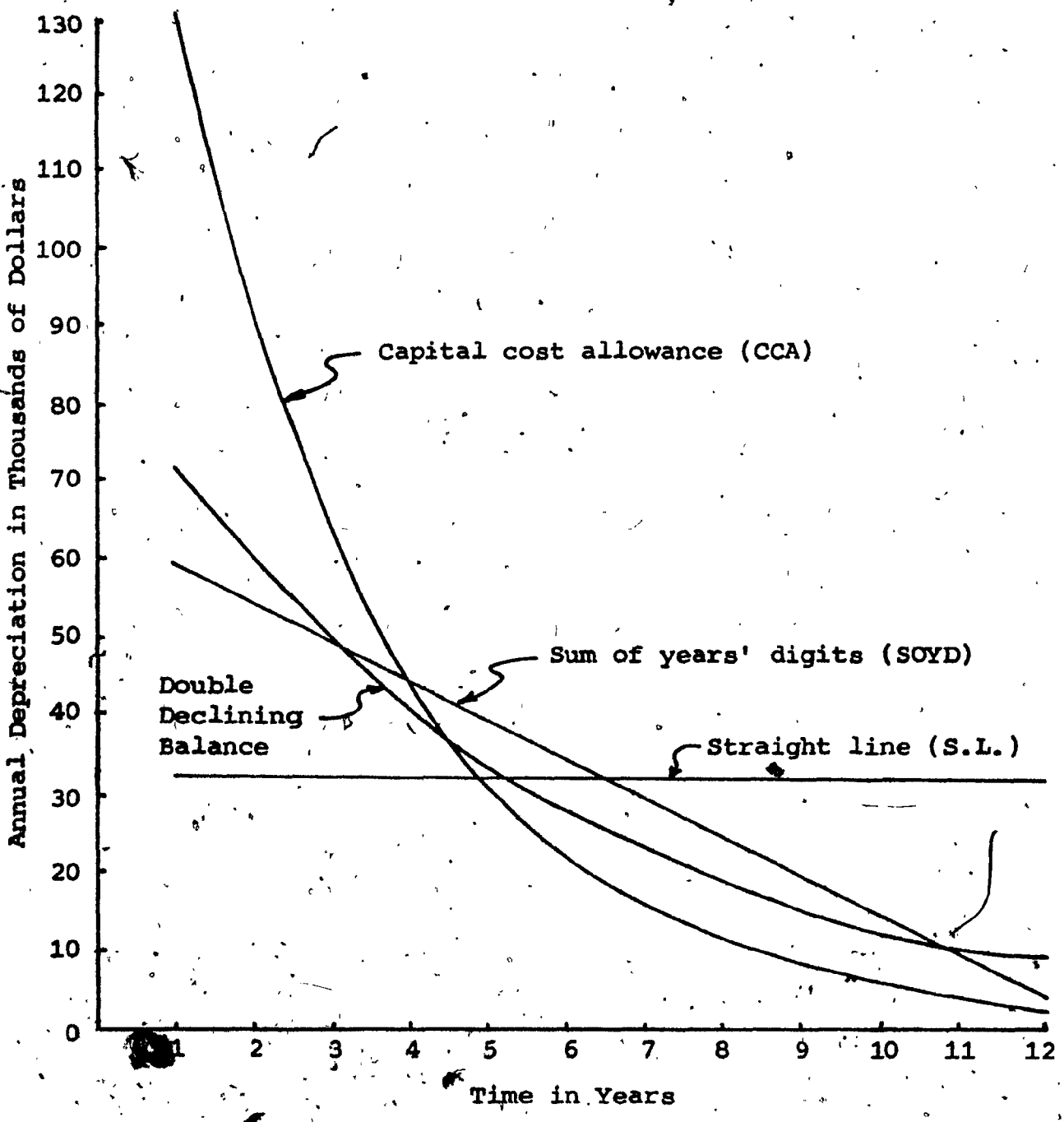


FIGURE 3.1: Comparison of annual depreciation of four methods

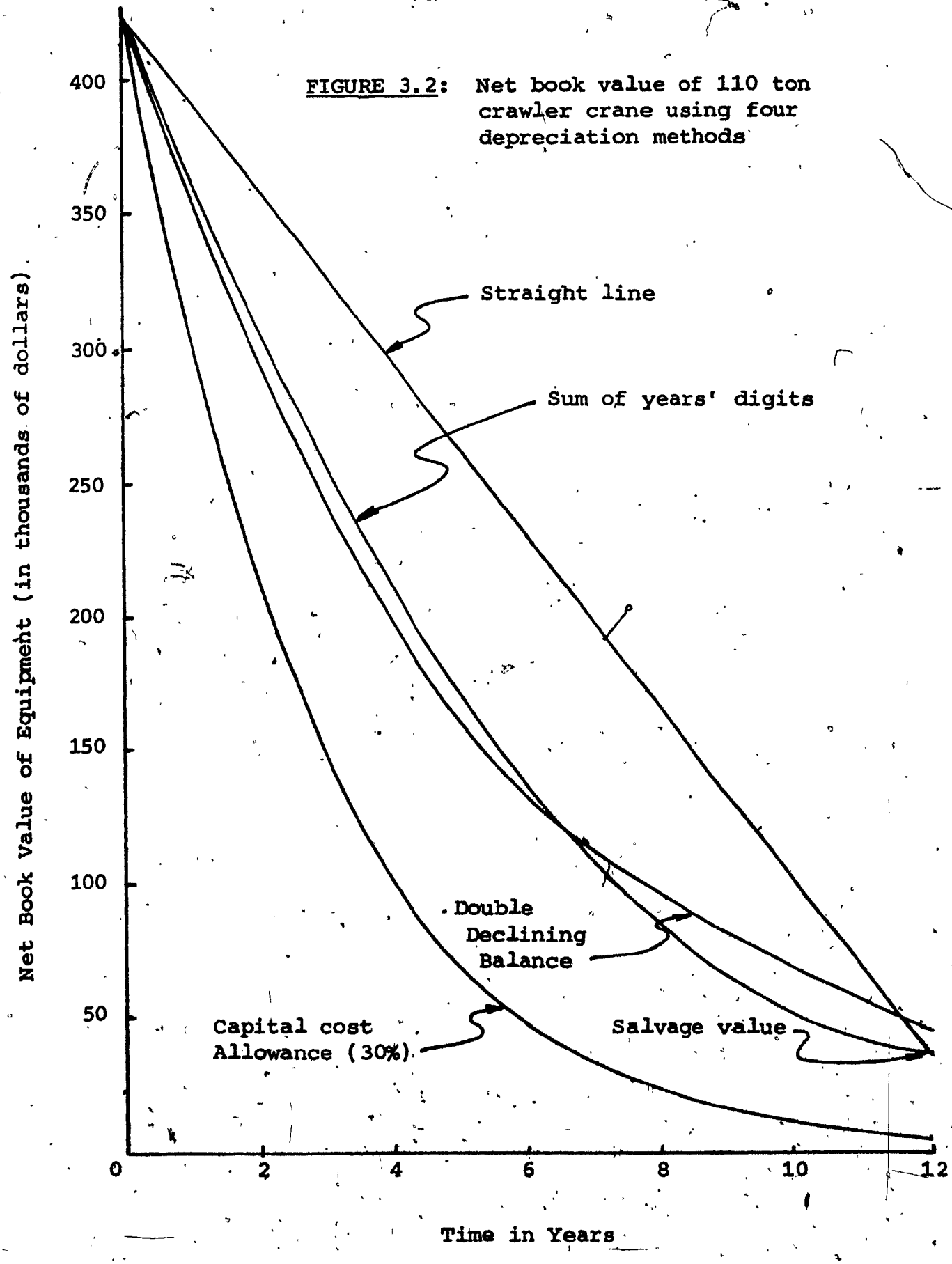


FIGURE 3.2: Net book value of 110 ton crawler crane using four depreciation methods

market value, giving a form of hidden net worth. In the event a machine is sold for more than its depreciated value, then the difference is taxed as income by the Government.

In terms of the current CCA system reference (9) suggests that the contractor should incorporate the following objectives in his equipment policy:

1. To qualify for the earliest and most rapid write-off of his equipment costs against taxable income, if he has enough income to absorb it.

2. To avoid increasing business losses with CCA claims if these losses cannot, with certainty, be carried forth and charged against taxable income in future years.

The first objective may be realized by acquiring equipment near the end of each fiscal period, and also by classifying it in the manner that will provide the greatest permissable CCA rate.

Cash Flow Analysis of Depreciation Methods

Table 3.4 contains a cash flow schedule for the proposed cash purchase of a 35 ton rough terrain crane. Figure 3.3 contains the net cash flow profiles for the four depreciation schemes in Table 3.4. The assumptions made in this example are:

1. Initial cost of $170,000., including list price, freight charges, and sales tax.

2. Useful life is 5 years.

3. Expenses increase as the machine ages, due to increased cost of repairs and maintenance.

4. Yearly revenues decrease as the crane becomes older, due to increased downtime for repairs and maintenance.

5. Income tax rate is 50%

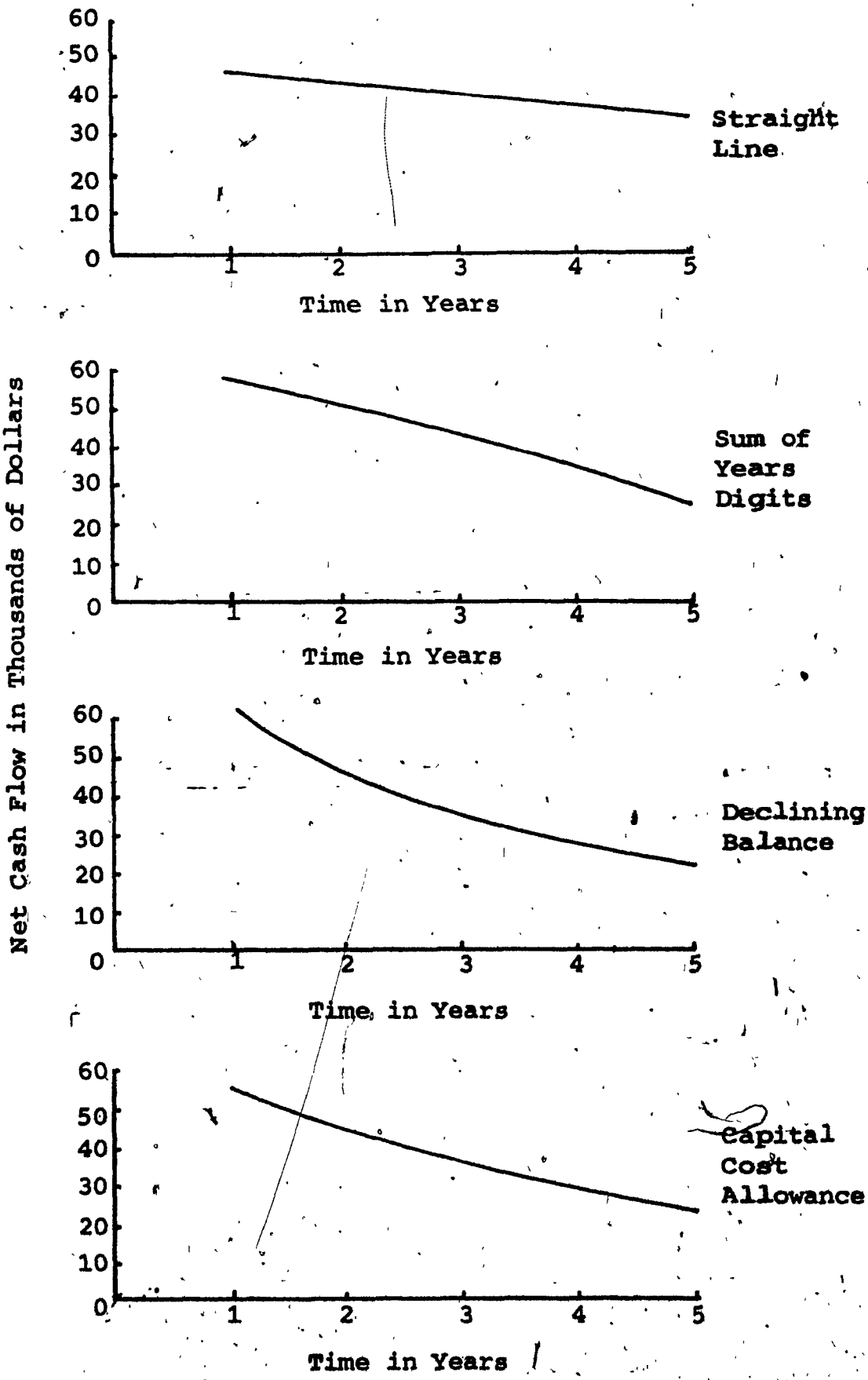
Under the straight line method, more income tax is paid in the early years of the crane's use. The SOYD's method produces an income tax payment pattern in the exact opposite order to the stream of income tax payments with the straight line method. The declining balance and CCA methods provide an even more attractive stream of payments, where the heaviest tax burden is incurred in the last two years of service. Depreciation is seen to have no affect on the pre-tax cash flow of a company, since it is a non-cash or non-fund item. However, it does have an affect on income taxes and therefore on the net cash flow. With the declining balance and CCA methods, the high annual depreciation amounts in the machine's early years reduces profits considerably, thus reducing income taxes in those years. Thus, for income tax purposes, accelerated depreciation methods are preferable to the straight line method.

TABLE 3.4: Cash flow schedule for proposed cash purchase of 35 ton rough terrain crane

Year	Revenue	Expenses	Pre-Tax Cash Flow	Straight Line					Sum-of-Years' Digits				
				Deprn	Taxable Income	Income Tax	Net Income	Net Cash Flow	Deprn	Taxable Income	Income Tax	Net Income	Net Cash Flow
0	—	—	—	—	—	—	—	(170,000)	—	—	—	—	(170,000)
1	85,000	25,000	60,000	34,000	26,000	(13,000)	13,000	47,000	56,000	4,000	(2,000)	2,000	58,000
2	82,000	26,000	56,000	34,000	22,000	(11,000)	11,000	45,000	46,000	10,000	(5,000)	5,000	51,000
3	77,000	27,000	50,000	34,000	16,000	(8,000)	8,000	42,000	34,000	16,000	(8,000)	8,000	42,000
4	72,500	28,500	44,000	34,000	10,000	(5,000)	5,000	39,000	22,000	22,000	(11,000)	11,000	33,000
5	68,000	30,000	38,000	34,000	4,000	(2,000)	2,000	36,000	12,000	26,000	(13,000)	13,000	25,000
Total	384,500	136,500	248,000	170,000	78,000	(39,000)	39,000	$39,000	170,000	78,000	(39,000)	39,000	$39,000

Year	Pre-Tax Cash Flow	Declining Balance					Capital Cost Allowance				
		Deprn	Taxable Income	Income Tax	Net Income	Net Cash Flow	Deprn	Taxable Income	Income Tax	Net Income	Net Cash Flow
0	—	—	—	—	—	(170,000)	—	—	—	—	(170,000)
1	60,000	68,000	(8,000)	4,000	64,000	64,000	51,000	9,000	4,500	4,500	55,500
2	56,000	40,800	15,200	(7,600)	7,600	48,400	35,700	20,300	10,150	10,150	45,850
3	50,000	24,480	25,520	(12,760)	12,760	37,240	24,990	25,010	12,505	12,505	37,495
4	44,000	14,688	29,312	(14,656)	14,656	29,344	17,493	26,507	13,254	13,253	30,746
5	38,000	8,813	29,187	(14,593)	14,594	23,407	12,245	27,755	12,878	12,877	25,122
Total	248,000	156,781	91,219	(45,610)	113,610	$32,391	141,428	106,572	53,287	53,285	$24,713

Figure 3.3: Cash flow profiles for four depreciation schemes



3.2.3 EQUIPMENT LIFE

The estimated economic life, or average useful life as it is sometimes called, is an important technical factor to be considered by the contractor during the acquisition analysis. The life assumed has an effect on the rate at which the capital value of a machine is repossessed by the owner in the three American depreciation methods. According to reference (18), it is to the contractor's best interest to use the shortest useful service life that he can defend in the calculation of depreciation for income tax purposes. However, in terms of competitiveness, it is to the contractor's advantage to choose the longest service life in order to spread ownership costs and reduce the hourly rental rate.

In Canada, the economic life has no direct affect on the Capital Cost Allowance, although the government has considered the useful equipment life in establishing the various rates and classes. There is also the option to fully expense equipment, provided it meets the Federal Government's guidelines (9). The economic life does have a similar affect on equipment operating costs in both countries. Equipment used on a certain job is charged directly to that job. The amount charged is determined using the equipment's average useful life. Several organizations in Canada and the United States have developed hourly equipment ownership costs (5) (6) (12) (39). All of these figures are based on one common factor: the equipment's most likely economic life. The calculation of

these figures will be examined in Section 3.6.

The economic life varies widely from one owner and one job to another, and is subject to many influencing factors, such as:

1. Degree of severity with which equipment is operated
2. Wear
3. Care and degree of mechanical efficiency maintained by equipment maintenance programs
4. Capacity and quality of maintenance support facilities
5. Physical conditions that exist at job site
6. Climatic conditions
7. Obsolescence
8. Specific type of equipment
9. Number of shifts worked
10. Length of construction season

Table 3.5 from reference (40) contains illustrative useful life figures for cranes. In comparison, Table 3.6 summarizes useful life figures recommended by the Power Crane and Shovel Association (43). As may be seen, there is no correlation between the two, and the data contained in Peurifoy (40) is incorrect. The U.S. Treasury Department Revenue Procedure Guideline 72-10 recognizes the following useful life figures (37):

Contract construction	4 to 6 years
Mining	8 to 12 years
Logging	5 to 7 years

TABLE 3.5: Useful Life Figures for Cranes * (40)
Source: Construction Planning, Equipment and Methods, R.L. Peurifoy

Capacity in Tons	Estimated Useful Life			
	Crawler Mounted		Rubber-tire Mounted	
	Years	Working Hours	Years	Working Hours
0-18	12	21,600	13	23,400
18-35	14	25,200	15	27,000
35-60	16	28,800	17	30,600
60-90	18	32,400	18	32,400
90-120	19	34,200	19	34,200
over 120	20	36,000	20	36,000

TABLE 3.6: Useful Life Figures for Cranes * (43)
Source: Power Crane and Shovel Association (PCSA)

Capacity in Tons	Estimated Useful Life	
	Years	Working Hours
0-15	5-7	9,000-12,600
15-35	6-8	10,800-14,400
35-60	7-9	12,600-16,200
60-100	8-10	14,400-18,000
100-150	9-11	16,200-19,800
150-200	10-12	18,000-21,600
200-300	11-13	19,800-23,400

* Total working hours based on 1800 working hours per year

The Associated General Contractors of America (5) carried out a comprehensive survey of its members in 1978, in order to establish an average economic life to use in their rental rate booklet. The results of these interviews with contractors throughout the United States, and from individuals involved in equipment management provided data which is consistent with the PCSA data in Table 3.6. It was noted that the term "average" assumed that the unit was not abused in accomplishing its intended function, and that regular maintenance and servicing was provided. Climatic conditions and severity of job related working conditions also had an affect on these figures. Thus, it is important that the contractor use caution in determining the useful life figure used. The figures in Peurifoy, for example, are not correct, and the contractor would be mislead if the data in Table 3.5 was employed.

Smaller cranes have lower useful lives than larger cranes due to the quality of parts used in their construction. Small cranes must remain as light and compact as possible. As a result, equipment manufacturers cannot take advantage of the same heavy duty components used in the construction of larger machines.

While 1800 is used as the average number of working hours per year in references (40) and (43), this too is subject to wide variations, as seen from the figures used in Table 2.5. Equipment working hours depends on the following influencing factors:

1. Average weather conditions
2. Average construction work markets
3. Average construction documents
4. Average equipment downtime
5. Operational efficiency during scheduled overtime and multiple shifts
6. Availability of construction materials, supplies and equipment parts
7. Labour premium time

Weather affects equipment earning hours due to the inability of the equipment to function efficiently. Conditions of weather that must be considered are temperature, moisture, wind and air pressure, all of which affect equipment in their various ways. Weather conditions also affect labour's ability to run the equipment efficiently.

The dollar volume of work contracted for can vary considerably and affect equipment earning hours. In average construction markets a decrease in earning hours per month and earning hours per year is generally proportional to the decline in dollar volume of work (6). Moreover, in markets with a declining dollar volume, there is a proportionate increase in standby units. This is caused by lack of work, and puts construction equipment on a standby basis. In "up" markets, the average earning hours and months remain the same as in "average" markets, since the extra or increased volume of work is taken care of by increasing the number of machines on a temporary or permanent basis. In "average" markets, the equipment needed to do the work has

become stabilized in number and along with a steady dollar volume, the average earning hours and months will stabilize.

Construction documents, plans and specifications affect earning hours in several ways. There may be temperature working ranges during which work is allowed to be done. The contractor may be limited to certain periods of the day, with possibly no night work permitted. There may be moisture requirements related to soils, frozen materials, or certain density requirements, all of which could restrict the contractors working hours.

Equipment downtime consists of four types of time required for:

1. Average maintenance
2. Repairs and replacement of component parts
3. Warranty maintenance
4. Unexpected breakdowns.

The availability of equipment is consequently affected during downtime.

Operational efficiency during scheduled overtime also has an effect on earning hours and months. The loss of efficiency extends to the entire day, not only the overtime hours. As the hours per day and days per week increase, efficiency decreases (46). Figure 3.4 shows the relative efficiencies of four typical overtime schedules. Extended overtime is necessary on certain project sites to

attract labour for reasons such as remote location, severe job site conditions, or the nature of work. Scarcity of skilled labour will also force the institution of scheduled overtime. Figure 3.5 reveals the extended affect on productivity of two overtime schedules. Multiple shifts result in a loss in efficiency of between 5 to 10% (46). Where equipment is operated two or three shifts instead of one, this also must be taken into account in establishing the equipment's economic life. In a two-shift operation, a machine is expected to last roughly half as many years, but probably about the same number of total working hours as with a single-shift operation.

The availability of construction materials, supplies and equipment parts has an important affect on equipment working hours. Serious shortages cause interruptions in construction activities which affect the productivity on the site. Scheduling and coordinating become difficult. Labour becomes increasingly restless, with higher turnover rates resulting.

Before deciding to make up lost time and increase the number of equipment hours worked, the labour premium time payable must be considered. Premium time in Canada is paid for:

1. Work shifts over 8 hours per day
2. More than 40 hours per week
3. Work on holidays, saturdays and sundays
4. Multiple work shifts and split shifts.

Figure 3.4: Affect on productivity of various overtime schedules (46)

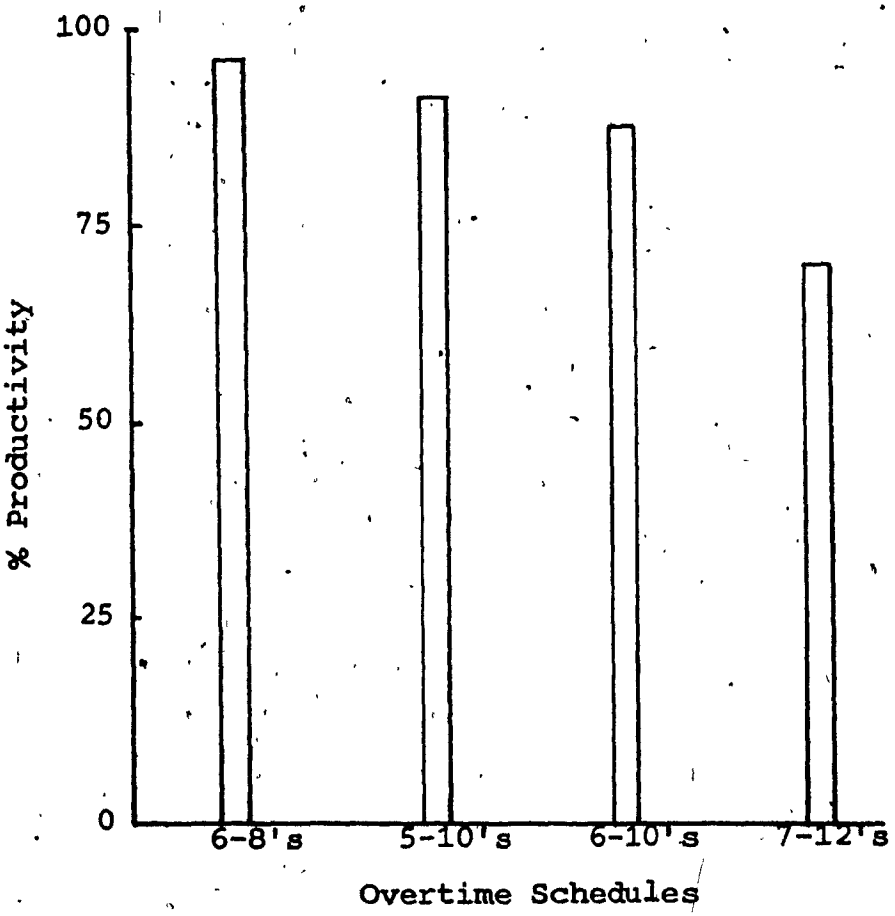
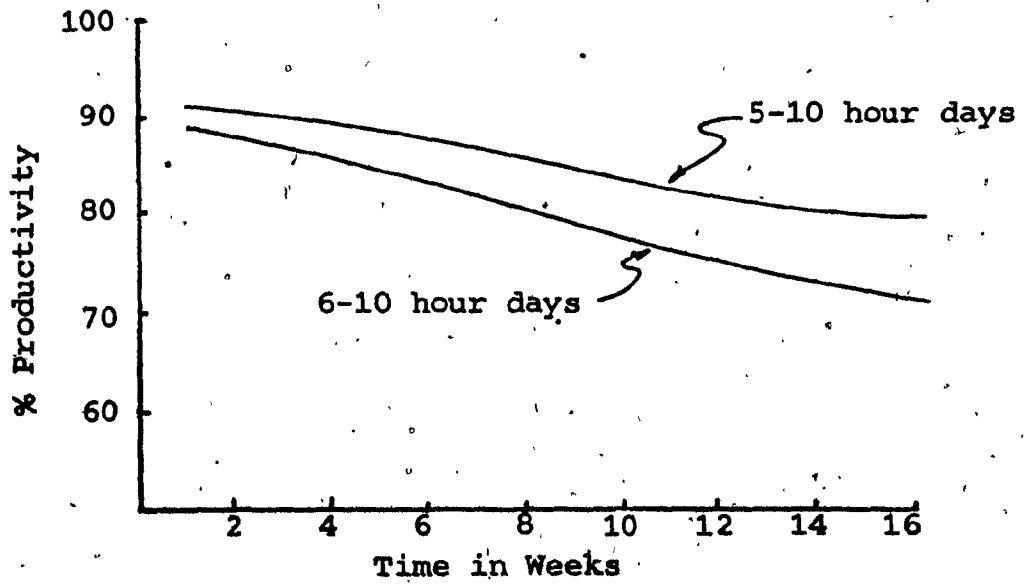


Figure 3.5: Extended affect on productivity of two overtime schedules (46)



The contractor must consider the benefits to be gained, compared to the high costs and lower productivity associated with overtime.

It is apparent that the factors discussed have a significant effect on the amount of time construction equipment may be utilized. All of these factors must be taken into account by the contractor during the equipment acquisition analysis. In this report, equipment is assumed to operate an average of 1800 hours per year, unless noted otherwise.

3.2.4 OTHER FIXED COSTS

Interest, insurance, taxes, licences and storage costs are frequently estimated as a percent of the total investment figure defined in Section 3.1.1. However, each item can vary considerably from one area and from one contractor to another. Where possible, the contractor should gather his own data. As a last resort, data in references (5) (6) (12) or (39) could be used.

Interest is the contractor's cost of obtaining a loan, or the opportunity cost of using his own capital for the investment. Interest is the price paid to lenders and a cost incurred by investors, for the use of the lender's money. It is one of the fundamental practices of modern business and is based on the principle that a person who lends or invests money is entitled to some return for it. The lender is entitled to interest because he gives up, for a certain period, his right to make a profit on his money elsewhere.

The interest rate in borrowing money is composed of four elements (36):

1. A risk element for the lender
2. A premium for inflation
3. An element of government economic policy
4. A real return, which is the price of foregoing or postponing consumption

Examining historical interest rates in Canada in the context of inflation, the real interest rates for selected financial instruments are estimated in Table 3.7. Table 3.8 includes the forecasted interest rates for I980.

TABLE 3.7: Real Canadian interest rates for selected financial instruments (36)

Bank Rate	2.50%
Prime Loan Rate	3.25%
Yield on Industrial Bonds	3.75%
Rate on Conventional Mortgages	5.50%

TABLE 3.8: Forecasted 1980 interest rates for selected financial instruments (36)

Bank Rate	14.25%
Prime Loan Rate (chartered banks)	15.00%
Yield on Industrial Bonds	13.75%
Rate on Conventional Mortgages	14.00%

Short term and long term interest rates differ due to the affect of inflation. Short term rates tend to respond to the current annual rate of inflation, where long term rates reflect a concensus regarding what the average long term annual rate of inflation is likely to be. Long term rates tend to be less volatile than those of short term. Long term rates decline relative to short term rates during periods of accelerating inflation. During periods of decelerating inflation, long term rates rise relative to short term rates. This different response to inflation underlies the recent situation which has seen short term rates at levels higher than long term rates. The construction industry requires a large amount of short term financing. Evidence of this in Canada is outstanding bank loans of contractors during 1979 being $3.2 billion (36). The interest cost on these loans now is $88 million more than in October 1978, and $176 million more than in October 1977.

The influence on interest rates of Government economic policy is shown for the Bank Rate and the Conventional Mortgage Rate in Table 3.9. Government policy was relatively neutral in the 1960's, and was motivated to low interest rates during the 1970's. However in 1979, government economic policy moved towards higher interest rates.

Insurance charges include all comprehensive and liability policy premiums that apply to the machine, and the annual rate can range from 1 to 3% of the acquisition cost. It may be actual premium payments to an insurance company, or allocations to a self-insurance fund maintained by the

TABLE 3.9: Influence of Inflation and Government Economic Policy on Certain Interest Rates (36)

Years	Bank Rate			Conventional Mortgage Rate		
	Actual	Inflation Corrected	Govern-ment Policy	Actual	Inflation Corrected	Govern-ment Policy
1960-64	3.99	3.95	0.04	7.02	6.75	0.27
1965-69	6.36	6.35	0.01	8.83	8.72	0.11
1970-74	6.98	9.93	(2.95)	9.98	10.71	(0.73)
1975-79	9.04	10.96	(1.92)	11.21	14.29	(3.08)
1979	11.80	10.90	0.90	11.91	12.28	(0.37)

All values are expressed as percent (%)

contractor in which case the annual percentage should be higher. If a blanket insurance policy covers several machines, the premium is prorated against each piece of equipment, based on the market value of the assets covered by the policy.

Taxes vary according to local and provincial requirements. Such taxes cover property and use of equipment, and can range from 1½ % of the acquisition cost to perhaps three times that figure, or possibly none at all, depending upon the contractor's location. The Quebec Government collects more than $2 million in revenue from the province's construction industry by taxing all equipment used both on and off the highways (21). Police and other agencies also use the collected information in their work.

Storage expense includes the costs associated with storing equipment between successive jobs or work seasons. It includes the occupancy and maintenance costs for storage yard or warehouse, watchman, handling and transporting equipment in and out of storage, and all other costs and incidentals pertaining to equipment storage. On average, the rate varies between 1 to 5% annually of the acquisition cost for mobile and crawler cranes (43). Storage costs include:

1. Unloading and dismantling
2. Preparation for storage - blocking, tie downs, draining
3. Covering, protection, crating, boxing, fences

4. Periodic maintenance
5. Wages of watchmen
6. Removal of components adversely affected by weather.
7. Preparation for use
8. Assembly and loading

3.3 OPERATING COSTS

Operating costs represent items consumed as a machine is operated. Costs vary greatly from one machine, contractor or job to another, depending on work conditions, care given equipment, and so on. Table 3.10 contains a summary of several of these factors.

Although operating costs vary more or less directly with the severity of operation of a machine, for convenience some contractors organizations have estimated them as if they were fixed costs rather than variable ones (5) (12) (40). A contractor's own figures, based upon actual experience, should be used where possible to develop costs for repairs, maintenance and supplies. However, these three major operating costs can be estimated as a percent of a machine's depreciation spread over its economic life. Several values are given in Table 3.11. These percentages are fairly representative for each type of machine classified according to the front end attachment and severity of service or application.

TABLE 3.10: List of Factors Affecting Magnitude of Operating costs

Not Controllable by Contractor

- Physical conditions that exist at the job site (soil, dust, access roads, layout)
- Wear and tear on equipment parts
- Climatic conditions
- Length of construction season
- Inflation, government policy
- Interest costs
- Obsolescence (replacement parts)
- Transportation costs to site
- Fuel, oil, labour costs
- Equipment durability, reliability, productivity

Controllable by Contractor

- Degree of severity with which equipment is operated
- Degree of mechanical efficiency maintained by equipment maintenance programs
- Competence of equipment operators and maintenance support personnel
- Capacity and quality of maintenance support facilities
- Number of shifts worked (hours of operation)
- Assembling (set-up) costs and dismantling costs
- Frequency of inspection
- Modifications to equipment as need arises (versatility)
- Compatibility of equipment with existing fleet. (standardization of repair and maintenance procedures and spare parts)

TABLE 3.11: Theoretical Percent that Repairs, Maintenance and Supplies are of Straight Line Depreciation for Cranes and Excavators (43)

Machine	Type of Application or Service		
	Moderate	Average	Severe
Cranes	40%	45%	50%
Draglines and Clamshells	60%	65%	70%
Shovels and Backhoes	65%	70%	75%

Assumptions:

1. Percentages represent total for labour and materials.
2. Material costs include repair and replacement parts for normal operation as well as for seasonal overhauls, hydraulic oil and grease.
3. Not included are the costs of engine fuel or lubricating oils.
4. Labour costs include only labour related to maintenance and repair.
5. Proper and regular maintenance as recommended by equipment manufacturer is carried out on equipment.
6. Equipment is used within its specified rating.
7. Costs are estimated averages. When equipment is new, amount of repairs, maintenance and supplies will be less than when the equipment is older.

3.4 INDIRECT COSTS

Indirect costs are incurred by all contractors in their daily operations. They include overhead and supervision costs, for providing the necessary support equipment, vehicles, buildings, tools and land required to operate construction equipment. Table 3.12 contains a summary of the items included in indirect costs. These items must be considered by the contractor in establishing both internal (contracts) and external (to other contractors or customers) rental rates.

3.5 OTHER COSTS

There are several costs associated with construction equipment which are frequently overlooked by the contractor in the equipment acquisition analysis. From the literature search it is evident that several of these costs are having a profound affect on the contractor's operations, and yet they are given only a cursory examination by one of the five North American contractors' organizations referenced in this report.

3.5.1 OBSOLESCENCE

Obsolescence is a cost which is created by modern technology. As defined in reference (6), it is caused by a decrease in value in equipment which becomes outmoded or non-current. Obsolescence occurs as a result of a reduction in value of the equipment in the market place. This loss in value is

TABLE 3.12. Summary of items to be included in indirect cost of operating construction equipment

1. Yards, Repair Shops, Storage and Maintenance Facilities
   - Temporary
   - Permanent - building, grounds and maintenance
   - Shop equipment and tools

2. Inventories
   - Component assemblies and repair parts
   - Expendable operating supplies - direct and indirect

3. Maintenance Trucks and Vehicles
   - Mechanics trucks
   - Lubrication trucks
   - Fuel and supply trucks
   - Supervisor's vehicles

a result of:

1. Equipment design changes
2. Replacement parts availability
3. Downtime maintenance availability
4. Operator, user acceptance.

For every year that a piece of equipment has been superseded by a newer model with a higher rate of production, it must operate additional hours to achieve the same production. This causes a loss of competitiveness, and usually increases rapidly as the machine ages. Table 3.13 contains an example of how obsolescence can affect the costs of a contractor with a 35 ton rough terrain crane.

Equipment may also become obsolete due to changing safety or environmental protection regulations. If the machine is not safe to operate as the CSA or provincial safety organizations require, the contractor may find himself unable to put it to work on a contract - at least not until valuable time is lost and substantial costs are incurred correcting the violation.

3.5.2 INFLATION

Inflation is an all-pervasive problem which affects every contractor's decisions. As defined in reference (49) inflation occurs when some representative average of prices is rising in terms of money. Many economists believe that the rate of inflation is a cyclical phenomenon, as explained by

TABLE 3.13: Affect of obsolescence on 35 ton rough terrain crane (6)

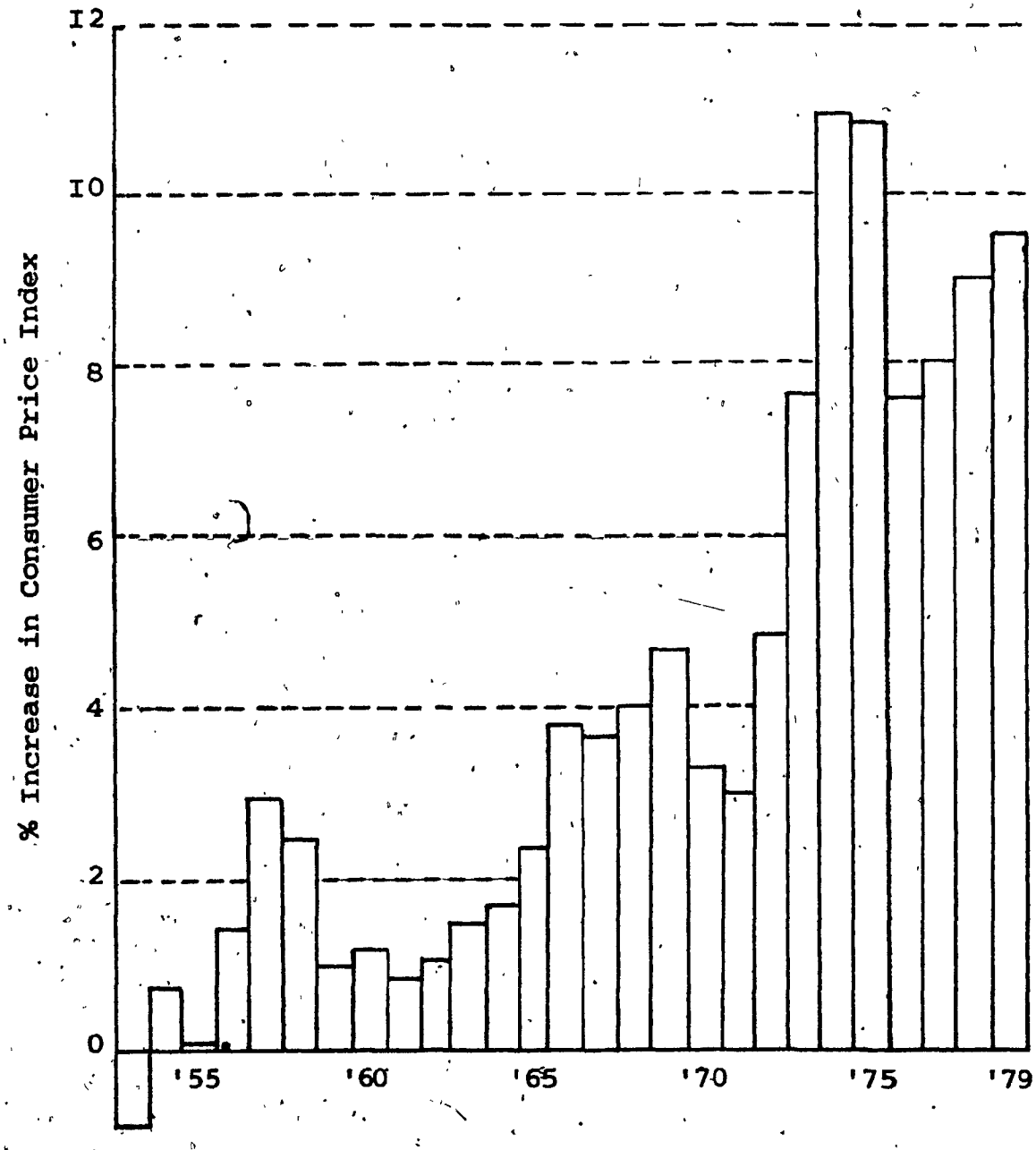
Year	Additional Hours required to match production of newer model	Internal cost per year ($35/hr)	Average yearly cost
1	0	0	0
2	0	0	0
3	100	3500.	1167.
4	150	5250.	2188.
5	200	7000.	3150.
Total	450	15,750.	$3150.

Kellner (34), falling during recessions and rising as the economy approaches a cyclical peak. Figure 3.6 shows the inflation rate in Canada over the past quarter century. There been three distinct inflationary periods:

1. A long period in the fifties and early sixties of what today seems to be low inflation.
2. A middle phase from the mid-sixties to the early seventies of moderately severe inflation.
3. The most recent seven year stretch of high, unsatisfactory price performance which peaked in 1974 and 1975 with double digit inflation.

Figure 3.6 almost seems to suggest that inflation soars up approximately every seven years at a rather stable level double the previous average level. Inflation affects all aspects of the contractor's operations, including revenues, expenses and the current replacement value (CRV) of equipment. Revenues must remain in line with inflation if the contractor is to maintain his profits. During periods of high inflation, the depreciable value of a machine could be adjusted for internal use, in order to reflect changes in the value of the dollar. One way of doing this is to revalue the exact same machine, of the same age and condition, and use this in refiguring depreciable value for determining ownership costs. Another way of adjusting a machine's value to reflect current inflation is to increase its value each year by applying the current generally accepted percentage rate of inflation. In terms of computing depreciation for income tax purposes, neither method is permissable. The impact of inflation on the acquisition analysis will be studied further in Chapter 4.

FIGURE 3.6: Inflation rate in Canada over the past quarter century (48)



3.5.3 IMPROPER REPLACEMENT OR SELECTION

Improper selection or replacement of construction equipment can be two of the main causes of excessive equipment costs. Selection and replacement are subjects for study in themselves, however they will be briefly examined in order to study how these costs develop, and how the acquisition problem is affected. It is also interesting to briefly examine both of these areas of equipment management, in order to point out where certain short-comings exist and where possible future research work may be directed.

As noted in Figure 1.1, the replacement decision is made just prior to the equipment selection decision. Equipment replacement and selection must be carried out using a thorough analysis, similar in scope and depth as the rigorous acquisition analysis being explained in this report. Failing to perform such thorough investigations at any point in Figure 1.1, will result in extra equipment costs being incurred within the contractor's organization.

Several excellent references concerning the subject of construction equipment replacement do exist (1) (2) (10) (18) (19) (25) (32) (33) (44) (51). In deciding whether to keep an old machine in service, or retire it and replace it with a newer model, there are many factors the contractor must evaluate. Table 3.14 contains a summary of several important factors affecting the equipment replacement decision. Table 3.15 includes a comparison of nine financial methods of analyzing the replacement decision. The methods are

TABLE 3.14: List of Factors Affecting Construction Equipment Replacement Decision

- Existing equipment costs (refer to Table 3.1)
- Condition of existing equipment
- Capacity, power, speed, productivity, accuracy of equipment
- Obsolescence
- Competition's actions - equipment
- Safety and reliability of equipment
- Maintainability of equipment
- Contractor's needs - current and future
- Salvage value of existing equipment
- Effect of continued use on equipment costs
- Competitiveness of existing equipment.

Note: Factors are not necessarily listed in order of importance.

economic based only, and do not reflect all of the non-economic factors identified in Table 3.14. The necessary assumptions for the nine financial methods shown in Table 3.15 are listed in Table 3.16.

In all of the economic replacement methods in Table 3.15, existing equipment is referred to as the "defender", while the selected (proposed) new equipment is called the "challenger". The financial advantages and disadvantages of each challenger is compared with the defender. All methods only deal with how to make the decision at a particular point in time. No method indicates what is the appropriate replacement time. The contractor is left on his own to decide what the optimum replacement period is. It is at this point that the contractor may incur unnecessary costs due to untimely replacement.

Peurifoy (40) attempts to quantify the costs of untimely replacement, and the example is summarized in Table 3.17. In this reference, the contractor has purchased the equipment with cash, and is interested in obtaining the lowest possible cost per hour of operation. Included in Figure 3.7 is a graph of the costs per hour of use. The economic life as calculated by Peurifoy for this particular machine occurs after approximately 10,000 hours of operation. According to Peurifoy, if the contractor replaces the equipment before that point, an unnecessary capital loss will be incurred. Continued use after the brief optimum replacement period will result in extra operating costs being absorbed due to higher maintenance and repair costs as the machine ages.

Table 3.15

Comparison of main features of methods for capital replacement decisions

Method	Parameters considered: Defender	Parameters considered: Challenger	Assumptions made*	Criterion used	Reliability: Poor	Reliability: Mediocre	Reliability: Good	Simplicity: Poor	Simplicity: Mediocre	Simplicity: Good
Payback	Annual operating costs; remaining service life	Purchasing price; annual operating costs	1, 2, 3, 4, 5, 6, 7, 8 and 9	Challenger's purchasing price divided by its estimated annual savings over the defender's remaining service life	X					X
Uniform Annual Cost	Annual operating costs, current market value, salvage value; remaining service life	Purchasing price, annual operating costs, salvage value, service life	6,** 7, 9, 10, 11 and 12	Difference between total annual costs of challenger and defender		X			X	
Present Worth	Annual operating costs; current market value; salvage value, remaining service life	Purchasing price; annual operating costs; salvage value; service life	6,** 7, 9, 10, 11 and 12	Difference between present worth of total costs of challenger and defender		X			X	
Compromise	Annual operating costs; current market value; salvage value, remaining service life	Purchasing price; annual operating costs; salvage value, service life	6,** 7, 9, 10, 11, 12, 13 and 14	Difference between total average annual costs of challenger and defender		X†				X
Comparative Annual Cost	Annual operating costs; current market value; salvage value; deterioration and obsolescence; remaining service life	Purchasing price; annual operating costs; salvage value; deterioration and obsolescence; service life	7, 9, 10, 11, 12 and 15	Difference between comparative annual costs of challenger and defender			X			X
MAPI	Annual operating costs; current market value; salvage value; deterioration and obsolescence	Purchasing price; annual operating costs; salvage value, deterioration and obsolescence; service life	7, 9, 10, 11, 12, 15, 16 and 17	Difference between challenger's and defender's adverse minima	X				X	
Incremental Cost	Annual operating costs, decline in salvage value; remaining service life	Purchasing price; costs of operation; salvage value; service life	6,** 7, 9, 13 and 18	Cost of maintaining capacity during the planning horizon		X				X
Cost-Flow	Annual operating costs; salvage value; remaining service life; deterioration and obsolescence	Purchasing price; salvage value; annual operating costs and service life of a machine unit in the chain of future replacements; deterioration and obsolescence	7, 19, 20, 21, 22 and 23	Annual service charge which is necessary to meet all operating and investment expenses associated with maintaining a unit of equipment in production during the planning horizon			X	X		
Dynamic Programming	Annual operating costs; salvage value; remaining service life; deterioration and obsolescence	Purchasing price; salvage value; annual operating costs; service life; deterioration and obsolescence	7, 19, 20, 21, 22 and 23	The present worth of all capital and operating costs associated with a facility of age of t years			X	X		

*The numbers refer to the numbered assumptions of Table

**This assumption can be easily relaxed (see text).

†Provided there is no great disparity in the expected service lives of the alternatives and a significant difference between their respective total annual costs exists.

Table 3.16: Assumptions (10)

1. Expected service lives and salvage values of both defender and challenger are ignored.
2. Savings after the payback period are ignored.
3. Current market value of the defender is ignored.
4. Interest rate is ignored.
5. There is no economic justification for the predetermined number with which the payback period is compared.
6. Differences in utilization rates of defender and challenger are ignored.
7. The effects of technological changes on demand for the challenger's output are ignored.
8. Deterioration and obsolescence are ignored.
9. A single machine is treated in isolation from each machine in the chain of future replacements extending as far into the future as a firm's profit horizon.
10. Differences in service lives of the challenger and defender are ignored.
11. The salvage values of defender and challenger are constant.
12. The expected service lives of defender and challenger are constant.
13. The time value of money is ignored.
14. The equipment decreases in value at a uniform rate.
15. The deterioration and obsolescence gradient increases as an arithmetic progression.
16. The defender has a one-year service life.
17. The challenger will accumulate operating inferiority at a constant rate over its service life.
18. The choice of the expected remaining service life of the defender has no influence on the purchasing price, salvage value and service life of the challenger.
19. The service lives of successive units in the replacement chain are equal.
20. The utilization rates of the defender and future replacement equipment are constant and the same.
21. The purchasing price of future equipment remains constant.
22. The salvage values of the defender and all the future replacement machines are constant and amount to S_o and S respectively.
23. The operating expense functions of the defender and future replacement machines are linear functions.

TABLE 3.17: Losses resulting from improper equipment replacement (40)

Year	Depreciation & Investment Cost*	Maintenance Repairs & Downtime*	Total Hourly Cost*	Minimum Hourly Cost*	Extra Cost ($/HR)	Total Loss ($/YR)
1	4.50	0.62	5.12	4.36	0.76	1520
2	3.82	0.90	4.72	4.36	0.36	1440
3	3.35	1.14	4.49	4.36	0.13	780
4	3.01	1.36	4.37	4.36	0.01	80
5	2.78	1.58	4.36	4.36	0.00	0
6	2.58	1.79	4.37	4.36	0.01	120
7	2.40	2.04	4.44	4.36	0.08	1120
8	2.26	2.32	4.58	4.36	0.22	3520

* Units are dollars per hour of operation

Assumptions:

1. Initial cost of equipment is $20,000.

2. Hourly costs include depreciation, investment (interest, insurances and taxes), maintenance and repairs, down-time.

3. Machine is operated 2000 hours per year.

4. Sum of years digits depreciation is used.

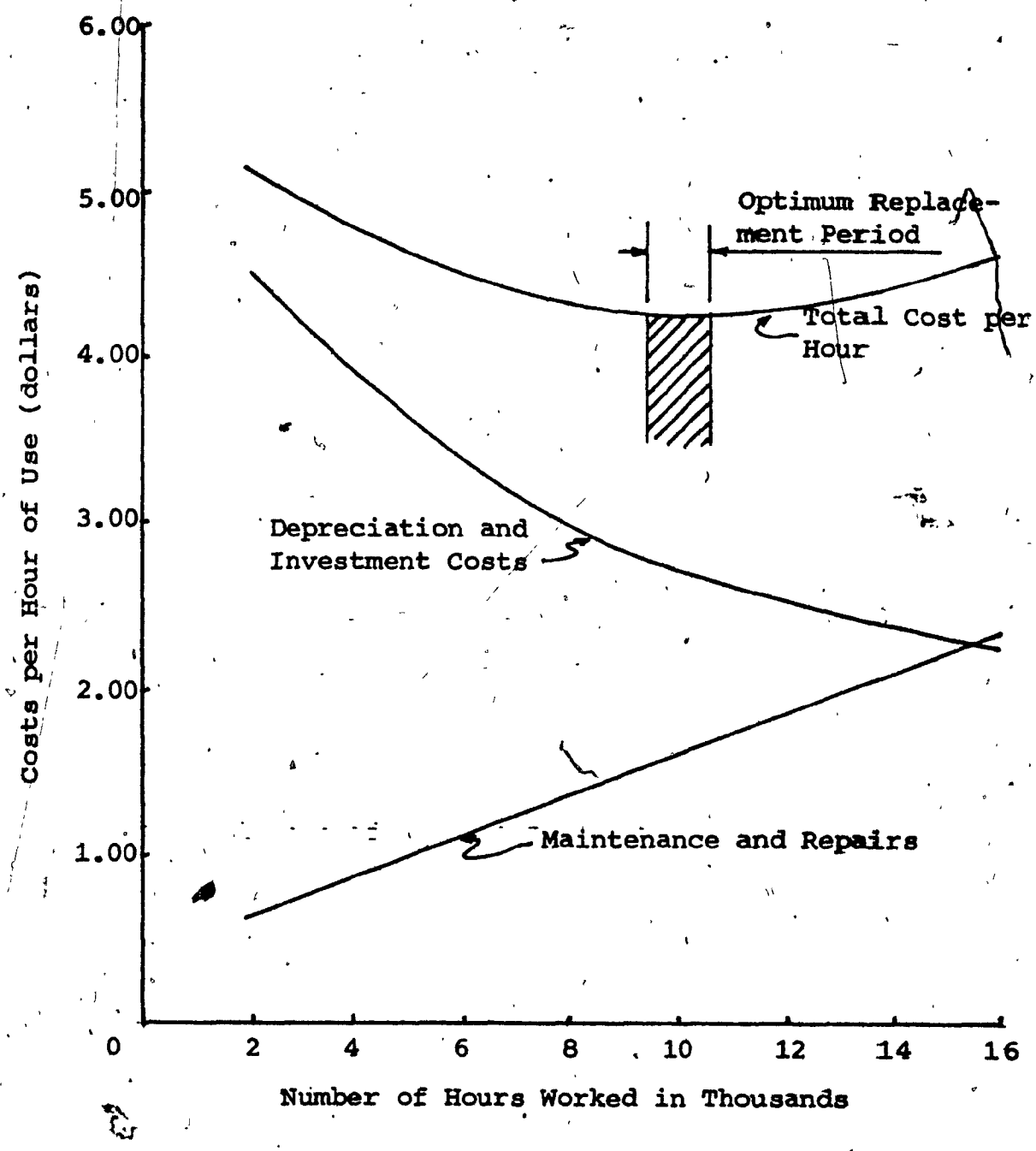


FIGURE 3.7: Graph of Hourly Costs of Operating a Machine, Showing its Economic Life
(Refer also to data in Table 3.17)

Peurifoy's analysis is crude and superficial, and does not consider the fact that the contractor could have decided originally to depreciate the equipment over a five year period. If it is kept after this period (year six and seven) then the depreciation cost would be zero. At this point, the machine is a sunk cost. On the other hand, Douglas (18) becomes involved in a more precise analysis of economic life of construction equipment. Douglas uses net present value theory to develop a computer program consisting of 68 variables, used to accurately determine the year in which the average annual cumulative profit of the machine is maximized. The reader is referred to Douglas' book for a thorough explanation of his method. Figure 3.8 contains a graph of equipment economic life as defined by Douglas. The time to replace the equipment is when the next year's annual profits for the present machine falls below the average annual cumulative profit of the replacement machine for the same year.

A considerable cost may also result form the improper selection of equipment. A well planned selection analysis provides a clearer understanding of equipment requirements and availability. Several contractors wait until the last minute before selecting equipment, when requirements are such that the first available unit must be selected, regardless of the manufacturer. The machine's place in the profit picture is often distorted. Work may seem too routine to warrant a careful selection analysis. Production costs are frequently ignored as long as the machine keeps on going. Table 3.18 consists of a list of the factors affecting the construction equipment selection decision.

Analytical tools available for the selection decision are

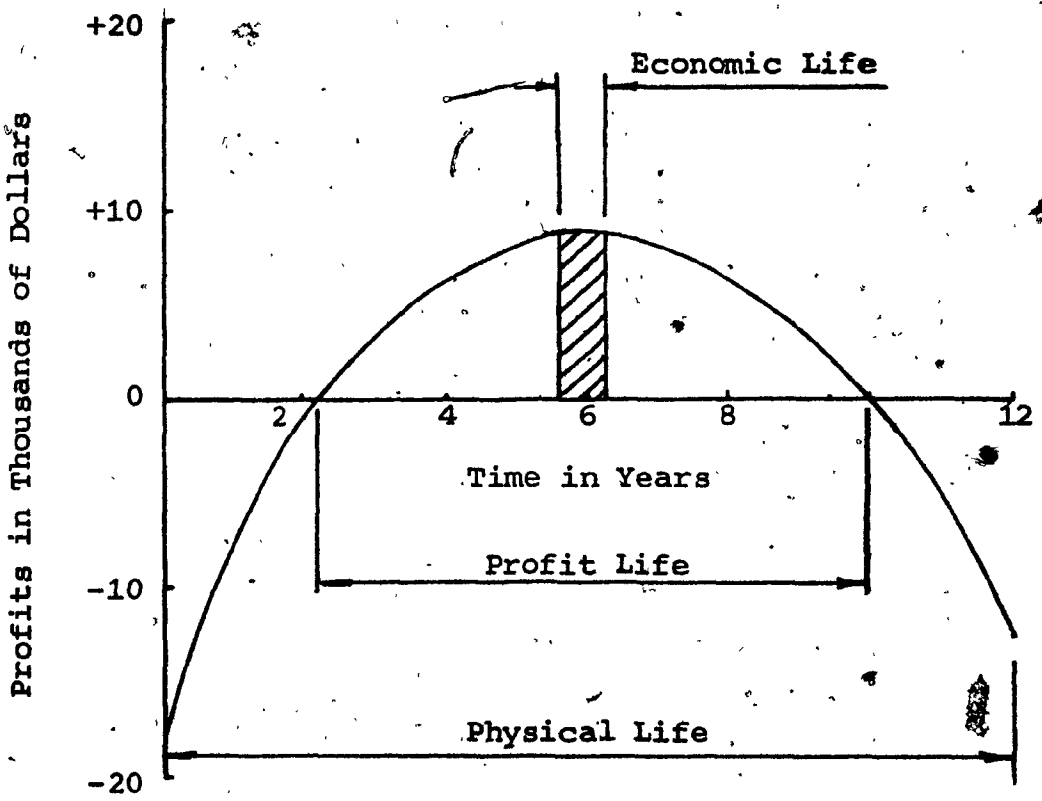


FIGURE 3.8: Graph of economic life as defined by Douglas (18)

Where: Physical life is the point where machine will not produce anymore

Profit life is the period during which it can earn a profit

Economic life is the period when the machine's profits are maximized.

TABLE 3.18: List of Factors Affecting Construction Equipment Selection Decision

- Equipment costs (refer to Table 3.1)
- Equipment productive capacity
- Equipment maintainability
- Availability of work - market analysis
- Availability of equipment and replacement parts
- Contractor's needs - specific requirements of current or future projects (long term planning)
- Mobility, versatility and adaptibility
- Transportability, assembly, dismantling - time, logistics
- Fuel consumption - energy policy
- Compatibility with existing fleet - balancing with interdependent equipment
- Influence of - climatic conditions, site conditions, time scheduled for project
- Expected economic life and obsolescence
- Equipment durability and reliability
- Operator skills required and training programs
- Company bidding strategy - equipment costs
- Backup dealer service and reputation
- Equipment brand name loyalty
- Equipment power and capacity
- Availability of trained service personnel
- Availability of proper support equipment and tools
- Safety and environmental protection standards
- Equipment options available
- Salvage value of new equipment
- Operator convenience

Note: Factors are not necessarily listed in order of importance

limited to financial factors only, and are similar to those in Table 3.15. No reference was found to contain a thorough method analyzing all of the factors influencing the selection problem.

The acquisition problem may be influenced by the costs of untimely replacement or improper selection. When these costs are considerable with respect to the other equipment costs in a cash purchase or financing acquisition plan, then the contractor may possibly have been economically better-off considering acquiring the equipment through either a rental or lease plan. Douglas has studied the problem of untimely equipment replacement, and the reader is referred to reference (18) for further information. Douglas' analysis is very detailed, and may be difficult for most contractors to understand. Additional research time would be well spent in simplifying Douglas' replacement analysis, in order that it may become more useful to the contractor - for whom it was originally intended. In terms of improper equipment selection, no method of quantifying these costs was found during the period of research for this report. Further work should be carried out to correct this problem.

More unnecessary costs may also result from the uneconomical mode of acquisition, as is being studied in this report. Acquiring construction equipment is a major business decision that deserves time and thought.

3.6 EQUIPMENT REVENUE

In the context of this report, equipment revenue may be defined as all positive (incoming) cash flow which results from the use of construction equipment. A complete analysis of the financial factors involved in the acquisition problem must incorporate a study of equipment revenues. Without the proper amount of revenue to cover all of the equipment expenses reviewed in this Chapter so far, the contractor can not remain in business very long. The purpose of this section will be to examine the various types and sources of construction equipment revenue, such that the complete financial picture within the acquisition framework may be placed in perspective. Certain potential pitfalls will be studied, in an effort to clearly outline areas where some contractors have failed to properly account for adequate equipment revenue in their operations.

Table 3.19 summarizes three types of equipment revenue and their respective sources. Internal revenue is an amount which the contractor actually pays to operate the equipment. If it is rented, than this amount includes the rental cost, and all operating costs as listed in Table 3.1. In terms of cash purchase, internal revenue must include all fixed, operating and indirect costs as detailed in this Chapter. A breakdown of lease and finance cost components in the internal rate is included in Table 3.19.

Once a contractor acquires a piece of equipment, he must recover the acquisition costs and return a profit by using

TABLE 3.19: Summary of types and sources of construction equipment revenue

Type	Source	Costs to be Recovered (refer also to Table 3.1)
Internal	From actual contracts, or internal use by contractor	1) Cash purchase - fixed costs + operating costs + indirect costs 2) Finance - same as above 3) Rent - rental + operating costs 4) Lease - lease + operating costs
External	Hourly work for client and other contractors	1) Cash purchase - internal rate + replacement cost + profit 2) Finance - same as above 3) Rent - internal rate + profit 4) Lease - internal rate + profit
Salvage Value	Auction Trade-in Equipment dealer Equipment broker Own contacts - private sale, advertize Junk yard	

the equipment and by realizing residual values when it is returned or sold. The contractor must, in effect, "rent" the equipment to his projects by charging for its use. The contractor must view his equipment investment in the same way that a renter of construction equipment views his.

No reference exists on how the contractor should determine the optimum internal rate. There do exist several references on the calculation of the external rate. Table 3.20 contains a comparison of five external hourly rate calculations as recommended by certain prominent North American construction organizations. As may be seen, there are very diverse opinions on the hourly external rate that should be charged for the 35 ton rough terrain crane. This fact, coupled with the contractor's option of not having to charge at all for the equipment he owns, lends itself to interesting bidding strategies. A contractor who owns his equipment is not obliged to charge it completely to any particular project. He may have paid off a major portion of the fixed costs on a previous contract, or he may wish to gamble that possible future work will be able to cover these costs. In any case the contractor who practices this equipment policy almost certainly has a competitive advantage over another contractor who does not. The ultimate loser is the small to medium sized contractor, who is frequently confused by the various rate schedules shown in Table 3.20, and is not sure what amount he should be charging for the equipment. The contractor may make a paper profit on individual projects, but overall the firm may be suffering drastically as it must pay for the equipment used.

TABLE 3.20: Comparison of Rental Rate Calculations for 35 ton rough terrain crane as recommended by five North American Construction Organizations

Association	Formula	Includes	Calculation	Recommended External Hourly Rate Excluding Operator
AGCA (5) Refer also To Table 3.21	$\frac{\text{CRV X AGCAF}}{\text{HRS/YR}}$ CRV = 170,000 HRS/YR = 1,700 HRS.	Depreciation = 10% Inflation = 7% Interest = 7% Taxes, ins, stor = 4½% 28½%	$\frac{170,000 \times 0.285}{1700}$	$28.50
AGCM (6) Refer also To Table 3.22	$\frac{\text{CRV X AGCMF}}{\text{HRS/YR}}$ CRV = 170,000 HRS/YR = 160 X 8.5 = 1360 HRS	Recovery rate = 20% Inter, ins, stor = 12% Taxes, licences = 1% Major repairs = 7% Operating exp's = 4% Support fac's = 2% 46%	$\frac{170,000 \times 0.460}{1360}$	$57.50
CCA (9) Refer also To Table 3.23 ORBA similar (25) Table 3.24	$\frac{\text{CRV X CCAF}}{\text{HRS/YR}}$ CRV = 425,000 HRS/YR = 200 X 6 = 1200 HRS	Depreciation = 9% Interest = 4% Major repairs = 11% Storage, insur., overhead = 6% 30%	$\frac{170,000 \times 0.300}{1200}$	$42.50
PCSA (48)	$\frac{\text{DV X PCSAF}}{\text{HRS/YR}}$ DV = 390,000 HRS/YR	Depreciation = 20% in interest, insur., storage, taxes = 14% repairs, maint = 4% 38%	$\frac{170,000 \times 0.380}{1800}$	$35.89
A. Guay	$77. /hour operated less $18. for operator			$59.00

EQUIPMENT	Average Economic Life In Hours	Average Use Hours Per Year	Average Annual Ownership Expense in % of New Acquisition Cost					Average Hourly Ownership Expense in % of New Acquisition Cost	Average Hourly Repair & Maintenance Expense in % of New Acquisition Cost	Combined Average Hourly Ownership and Repair & Maintenance Expenses in % of New Acquisition Cost	Contractor's Application of A.G.C. Schedules
			Depreciation	Replacement Cost Escalation	Interest on Investment	Taxes, Insurance and Storage	Total Ownership Expense				
Cranes											
Crawler											
Diesel											
4-12 tons	9600	1600	15.0	7.0	7.0	4.5	33.5	0.0209	0.0154	0.0363	
12-18 tons (to 1cy bucket)	9600	1600	15.0	7.0	7.0	4.5	33.5	0.0209	0.0154	0.0363	
20-50 tons (to 2-1/2cy bucket)	9600	1600	15.0	7.0	7.0	4.5	33.5	0.0209	0.0154	0.0363	
50-110 tons (to 4cy bucket)	13600	1700	11.3	7.0	7.0	4.5	29.8	0.0175	0.0093	0.0268	
110-150 tons (to 5-1/2cy bucket)	15300	1700	10.0	7.0	7.0	4.5	28.5	0.0167	0.0093	0.0260	
to 200 ton (to 6cy bucket)	15300	1700	10.0	7.0	7.0	4.5	28.5	0.0167	0.0093	0.0260	
Counter balancing type, to 300tns	15300	1700	10.0	7.0	7.0	4.5	28.5	0.0167	0.0093	0.0260	
Gasoline											
4-7 tons, 10 ft radius	8400	1400	15.0	7.0	7.0	4.5	33.5	0.0239	0.0187	0.0426	
7-10 tons, 12 ft radius	8400	1400	15.0	7.0	7.0	4.5	33.5	0.0239	0.0187	0.0426	
9-12 tons, 45 ft radius	8000	1600	18.0	7.0	7.0	4.5	36.5	0.0228	0.0187	0.0415	
13 - 24-1/2 tons, 45 ft radius	8000	1600	18.0	7.0	7.0	4.5	36.5	0.0228	0.0187	0.0415	
14-15 tons, 12 ft radius	8000	1600	18.0	7.0	7.0	4.5	36.5	0.0228	0.0187	0.0415	
15 tons, 20 ft radius	8000	1600	18.0	7.0	7.0	4.5	36.5	0.0228	0.0187	0.0415	
18-20 tons, 12 ft radius	10200	1700	15.0	7.0	7.0	4.5	33.5	0.0197	0.0187	0.0384	
25 tons, 20 ft radius	10200	1700	15.0	7.0	7.0	4.5	33.5	0.0197	0.0117	0.0314	
30-35 tons	10200	1700	15.0	7.0	7.0	4.5	33.5	0.0197	0.0117	0.0314	
45 tons	10200	1700	15.0	7.0	7.0	4.5	33.5	0.0197	0.0117	0.0314	
Locomotive											
Diesel/Electric											
15-20 tons, 10 ft radius	10200	1700	15.0	7.0	7.0	4.5	33.5	0.0197	0.0119	0.0316	

TABLE 3.21: Associated General Contractors of America (AGCA) Rental Schedule (5)

EQUIPMENT	Average Economic Life In Hours	Average Use Hours Per Year	Average Annual Ownership Expense in % of New Acquisition Cost					Average Hourly Ownership Expense in % of New Acquisition Cost	Average Hourly Repair & Maintenance Expense in % of New Acquisition Cost	Combined Average Hourly Ownership and Repair & Maintenance Expenses in % of New Acquisition Cost	Contractor's Application of A.G.C. Schedules
			Depreciation	Replacement Cost Escalation	Interest on Investment	Taxes, Insurance and Storage	Total Ownership Expense				
Crane, Hydraulic, self-propelled, diesel or gasoline											
5 to 9-3/4 tons	8000	1600	18.0	7.0	7.0	4.5	36.5	0.0228	0.0126	0.0354	
10-18 tons	10800	1800	15.0	7.0	7.0	4.5	33.5	0.0186	0.0126	0.0312	
20-30 tons	14400	1600	10.0	7.0	7.0	4.5	28.5	0.0178	0.0078	0.0256	
35-45 tons	14400	1600	10.0	7.0	7.0	4.5	28.5	0.0178	0.0078	0.0256	
Truck Crane, hydraulic lift, diesel or gasoline											
12-1/2 - 20 tons	9800	1400	12.9	7.0	7.0	4.5	31.4	0.0224	0.0126	0.0350	
25-30 tons	9600	1600	15.0	7.0	7.0	4.5	33.5	0.0209	0.0082	0.0291	
40-45 tons	13600	1700	11.3	7.0	7.0	4.5	29.8	0.0175	0.0082	0.0257	
55-70 tons	14400	1800	11.3	7.0	7.0	4.5	29.8	0.0165	0.0082	0.0247	
75-80 tons	15300	1700	10.0	7.0	7.0	4.5	28.5	0.0167	0.0082	0.0249	
Crane Accessories (see "Excavator Accessories")											
Crusher, Components, Without Power											
Jaw, to 1200 tph, 3/4-12 in.	11200	1600	12.9	7.0	7.0	4.5	31.4	0.0196	0.0118	0.0314	
Roll, all sizes, to 40 in. rolls	11200	1600	12.9	7.0	7.0	4.5	31.4	0.0196	0.0197	0.0393	
Cone	16000	1600	9.0	7.0	6.5	4.5	27.0	0.0168	0.0107	0.0275	
Gyratory	16000	1600	9.0	7.0	6.5	4.5	27.0	0.0168	0.0189	0.0357	

TABLE 3.21: Continued

30-40 tons, 12 ft radius	11900	1700	12.9	7.0	7.0	4.5	31.4	0.0184	0.0119	0.0303	
40-80 tons, 12 ft radius	12600	1800	12.9	7.0	7.0	4.5	31.4	0.0174	0.0119	0.0293	
50-90 tons, 12 ft radius	12600	1800	12.9	7.0	7.0	4.5	31.4	0.0174	0.0119	0.0293	
150 tons, 15 ft radius	12600	1800	12.9	7.0	7.0	4.5	31.4	0.0174	0.0108	0.0282	
Wrecker											
110-250 tons, 12 ft radius	13200	1100	7.5	7.0	6.5	4.5	25.5	0.0231	0.0184	0.0415	
Diesel/Hydraulic											
30-40 tons, 12 ft radius	12600	1800	12.9	7.0	7.0	4.5	31.4	0.0174	0.0271	0.0445	
40-75 tons, 12 ft radius	12600	1800	12.9	7.0	7.0	4.5	31.4	0.0174	0.0228	0.0402	
Revolver (Gantry), to 1000 tons	23400	1800	6.9	7.0	6.5	4.5	24.9	0.0138	0.0025	0.0163	
Stiffleg Cranes											
45-85 tons, 15-30 ft radius	15400	1400	8.2	7.0	6.5	4.5	26.2	0.0187	0.0210	0.0397	
100-500 tons, 35-50 ft radius	15400	1400	8.2	7.0	6.5	4.5	26.2	0.0187	0.0210	0.0397	
Tower Cranes											
Climber, all sizes	10800	1800	15.0	7.0	7.0	4.5	33.5	0.0186	0.0075	0.0261	
Stationary, all sizes	10800	1800	15.0	7.0	7.0	4.5	33.5	0.0186	0.0075	0.0261	
Traveler, all sizes	10800	1800	15.0	7.0	7.0	4.5	33.5	0.0186	0.0075	0.0261	
Truck Crane, cable control, diesel or gasoline											
4-12 tons, 10 ft radius	7000	1400	18.0	7.0	7.0	4.5	36.5	0.0260	0.0158	0.0418	
To 85 hp, 15-25 tons, 10 ft radius	8400	1400	15.0	7.0	7.0	4.5	33.5	0.0239	0.0158	0.0397	
To 150 hp, 30-50 tons, 10 ft radius	9600	1600	15.0	7.0	7.0	4.5	33.5	0.0209	0.0158	0.0367	
To 150 hp, 50-70 tons, 12 ft radius	12800	1600	11.3	7.0	7.0	4.5	29.8	0.0186	0.0158	0.0344	
To 185 hp, 80-100 tons, 12 ft radius	12800	1600	11.3	7.0	7.0	4.5	29.8	0.0186	0.0090	0.0276	
To 185 hp, 110-125 tons, 12 ft radius	14400	1600	10.0	7.0	7.0	4.5	28.5	0.0178	0.0090	0.0268	
To 250 hp, 125-200 tons, 16 ft radius	16200	1800	10.0	7.0	7.0	4.5	28.5	0.0158	0.0080	0.0238	
To 380 hp, 250 tons, 18 ft radius	16200	1800	10.0	7.0	7.0	4.5	28.5	0.0158	0.0068	0.0226	
To 500 hp, 300 tons	16200	1800	10.0	7.0	7.0	4.5	28.5	0.0158	0.0068	0.0226	

TABLE 3.21: Continued

VALUE RECOVERY RATE COST SCHEDULE

EQUIPMENT DESCRIPTION GROUPING BY CLASS	VALUE RECOVERY FOR ANNUAL FIXED COSTS AVERAGE ANNUAL COST Percent of New Replacement Value				VALUE RECOVERY FOR ANNUAL MAINTENANCE & SUPPORTING FACILITIES COSTS AVERAGE ANNUAL COST Percent of New Replacement Value					APPLICATION OF COST SCHEDULE Dollar Values			
	New Replacement Value Recovery Rate	Interest, Insurance, Storage	Freight Taxes, Licenses, and Sales Tax	Total Fixed Cost*	Major Components & Repairs Recovery	Operating Expendables	Supporting Facilities	Total Maintaining & Supporting Costs*	Average Number Earning Months Per Year	New Equipment Replacement Value*	Cost Per Earning Hr. each*	Hourly Use Rate*	Average Hours Each Earnings Month
	1	2	3	4	5	6	7	8	9	10	11	12	13
				*(1+2+3)=4				*(5+6+7)=8		F.O.B. Factory	*$\frac{10}{9}$=11	*11-13=12	
2.9 LIFTING & HOISTING EQUIPMENT (Includes standard accessories with all units)													
1) Cranes (Crawler, Rubber Tired, Cable and Hydraulic)	20%	+ 12%	+____%	=____%	7%	+ 4%	+ 2%	= 13%	8.5	$____	$____	$____	160
2) Cranes (Rubber Tired)	20%	+ 12%	+____%	=____%	5%	+ 4%	+ 2%	= 11%	8.5	$____	$____	$____	160
3) Hoists, Derricks & Tower Cranes	20%	+ 12%	+____%	=____%	4%	+ 4%	+ 2%	= 10%	8.5	$____	$____	$____	160
2.10 LOADERS													
1) Rubber Tired	20%	+ 12%	+____%	=____%	12%	+ 7%	+ 3%	= 22%	8	$____	$____	$____	160
2) Crawler	20%	+ 12%	+____%	=____%	16%	+ 6%	+ 3%	= 25%	7	$____	$____	$____	160
2.11 MARINE EQUIPMENT (Barge, Dredge, Tug, etc.)	20%	+ 17%	+____%	=____%	6%	+ 12%	+ 3%	= 21%	8	$____	$____	$____	160
2.12 PILE DRIVING EQUIPMENT (Air Compressors are not included.)													
1) Vibratory, air, diesel hammers and extractors – Includes leads and standard accessories	20%	+ 12%	+____%	=____%	11%	+ 3%	+ 3%	= 17%	6	$____	$____	$____	120
2) Drop Hammers, leads etc.	20%	+ 12%	+____%	=____%	5%	+ 4%	+ 3%	= 12%	6	$____	$____	$____	120
2.13 PUMPS & PUMPING EQUIPMENT (Includes 25 feet suction hose and 50 feet of discharge hose)													
1) Centrifugal & Diaphragm Up to 3-1/2"	33%	+ 12%	+____%	=____%	15%	+ 5%	+ 3%	= 23%	7	$____	$____	$____	160
4" and larger	25%	+ 12%	+____%	=____%	20%	+ 6%	+ 3%	= 29%	7	$____	$____	$____	160
2) Electric Submersibles Up to 3-1/2"	25%	+ 12%	+____%	=____%	18%	+ 3%	+ 3%	= 24%	7	$____	$____	$____	160
4" and larger	20%	+ 12%	+____%	=____	15%	+ 3%	+ 3%	= 21%	7	$____	$____	$____	160
2.14 ROAD AND SURFACE MAINTENANCE													
1) Motor Graders (Patrols)	20%	+ 12%	+____%	=____%	10%	+ 4%	+ 3%	= 17%	8	$____	$____	$____	160
2) Brooms and Sweepers	20%	+ 12%	+____%	=____%	12%	+ 6%	+ 3%	= 21%	6	$____	$____	$____	160

TABLE 3.22: Associated General Contractors of Minnesota (AGCM) Rental Rate Schedule (6)

Description of Equipment Description de l'équipement	Depreciation and Obsolescence Dépréciation et Désuétude	Overhaul Major Repairs Painting Remise en état Réparations Majeures Peinture	General Overhead Charges Frais Généraux	TOTAL % %	Average Use Months Per Year Utilisation Mensuelle Par An En Moyenne	Monthly Rental Rate Percent Pourcentage du Taux de Louage Mensuel	CURRENT REPLACEMENT VALUE VALEUR D'ECHANGE EN COURS $	MONTHLY RENTAL RATE TAUX DE LOUAGE MENSUEL $	WEEKLY RENTAL RATE TAUX DE LOUAGE HEBDOMADAIRE $	DAILY RENTAL RATE TAUX DE LOUAGE PAR JOUR $
CRANES & DRAGLINES										
Crawler Mounted — all sizes	9	11	10	30	6	5.0				
Mobile — all sizes	9	11	10	30	6	5.0				
Climbing Cranes — All Sizes	9	11	10	30	6	5.0				
Derricks —										
Circle Swing including hand winch, cable, load block. — all sizes	15	15	10	40	5	8.0				
Guy including guy cable and load block; without operating cables, hoist or swing. — all sizes	11	14	10	35	5	7.0				
Stiffleg, Steel including load block; without operating cable or hoist. — Up to 50 tons capacity	11	14	10	35	5	7.0				
Chicago Boom	11	14	10	35	5	7.0				
Tripod, Steel including hand winch, cable and load block. — all sizes	11	14	10	35	5	7.0				
Draglines & Clamshells										
Crawler Mounted — with Bucket										
½ - ⅝ cy. 10 - 12 ton	13	13	10	36	6	6.0				
¾ - ⅞ cy. 15 - 18 ton	13	13	10	36	6	6.0				
1 - 1¼ cy. 20 - 30 ton	13	13	10	36	6	6.0				
1½ - 1¾ cy. 35 - 45 ton	13	13	10	36	6	6.0				
2 - 2½ cy. 50 - 60 ton	9	11	10	30	6	5.0				
3 - 3½ cy. 60 - 80 ton	9	11	10	30	6	5.0				
4 - 4½ cy. 90 - 100 ton	9	11	10	30	6	5.0				
Boom Attachment — c w pendants, crossover, and lagging — no cable	15	15	10	40	5	8.0				
Buckets										
Clamshell — Excavating Type										
½ cy.	15	25	10	50	5	10.0				
¾ cy.	15	25	10	50	5	10.0				

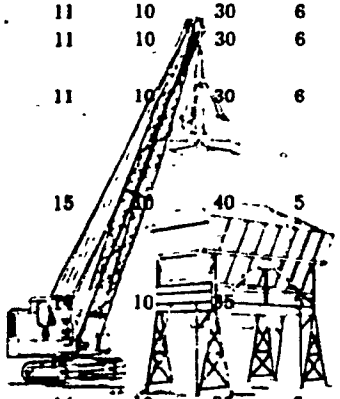


TABLE 3.23: Canadian Construction Association (CCA) Rental Rate Schedule (12)

Before applying figures read Foreword and Explanation. | Avant d'appliquer les chiffres sous-mentionés consultez l'Avant-Propos ainsi que les explications.

CRANES & DRAGLINES											
Lifting Cranes											
— with full boom, gantry, independent power boom											
12 - 15 ton	9	11	10	30	6	5.0					
18 - 25 ton	9	11	10	30	6	5.0					
30 - 35 ton	9	11	10	30	6	5.0					
40 - 45 ton	9	11	10	30	6	5.0					
50 - 60 ton	9	11	10	30	6	5.0					
60 - 80 ton	9	11	10	30	6	5.0					
90 - 100 ton	9	11	10	30	6	5.0					
Mobile — Cable											
— with full boom, jib, hyd. outriggers, power boom & load lowering											
15 - 18 ton	9	11	10	30	6	5.0					
20 ton	9	11	10	30	6	5.0					
25 ton	9	11	10	30	6	5.0					
30 ton	9	11	10	30	6	5.0					
35 ton	9	11	10	30	6	5.0					
40 - 45 ton	9	11	10	30	6	5.0					
60 - 65 ton	9	11	10	30	6	5.0					
80 - 100 ton	9	11	10	30	6	5.0					
Lifting Cranes											
Mobile — Hydraulic											
— with full boom & jib											
15 - 18 ton	9	11	10	30	6	5.0					
20 - 30 ton	9	11	10	30	6	5.0					
40 - 45 ton	9	11	10	30	6	5.0					
50 - 55 ton	9	11	10	30	6	5.0					
60 - 65 ton	9	11	10	30	6	5.0					
Self-Propelled — Hydraulic											
5 - 8 ton	9	11	10	30	6	5.0					
10 - 15 ton	9	11	10	30	6	5.0					
16 - 18 ton	9	11	10	30	6	5.0					
Boom Trucks											
Hydraulic											
4 - 5 ton, 20' boom	15	17	10	42	6	7.0					
7 - 8 ton, 60' boom	15	17	10	42	6	7.0					
9 - 10 ton, 90' boom	15	17	10	42	6	7.0					
Tower Cranes											
Fixed — all sizes	9	11	10	30	6	5.0					
Rail Mounted — all sizes	9	11	10	30	6	5.0					

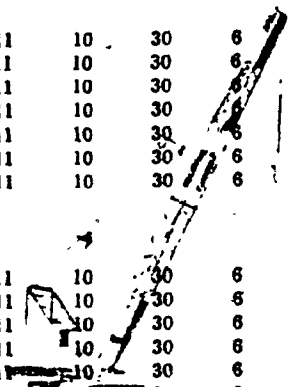


TABLE 3.23: Canadian Construction Association (CCA) Rental Rate Schedule (12)

TABLE 3.24: Ontario Road Builders' Association (ORBA) Rental Rate Schedule (39)

NOTE:
1. Rates do not include operator's wages
2. Weekly rates normally ½ of monthly
3. Daily rates normally 1/22 of monthly

	Canadian Price	Monthly Rental %	Monthly Rental Rate	Hourly Rental Rate
LIFTING CRANES				
Cable — Crawler Mounted				
—c/w Standard Boom & Gantry, independent power boom				
15 - 20 Tons	143,000	5	7,150	40.60
21 - 30 Tons	181,000	5	9,050	50.60
31 - 40 Tons	264,000	5	13,200	72.00
41 - 50 Tons	280,000	5	14,000	76.40
51 - 60 Tons	290,000	5	14,500	80.20
61 - 70 Tons	350,000	5	17,500	96.00
71 - 80 Tons	373,000	5	18,600	102.60
81 - 100 Tons	533,000	5	26,600	143.40
101 - 150 Tons	561,000	5	28,000	152.00
151 - 200 Tons	736,000	5	36,800	195.00
250 - 300 Tons	1,051,000	5	52,500	280.00
Cable — Truck Mounted				
—c/w Standard Boom, Jib & Hydraulic Outriggers				
25 Tons	237,000	5	11,850	62.80
35 Tons	264,000	5	13,200	70.00
40 Tons	277,000	5	13,850	73.60
50 Tons	378,000	5	18,900	99.60
60 Tons	389,000	5	19,450	103.00
70 Tons	402,000	5	20,100	107.00
90 Tons	449,000	5	24,500	120.00
115 Tons	502,000	5	25,100	134.00
140 Tons	583,000	5	29,200	156.00
300 Tons	1,119,000	5	55,900	295.00
Hydraulic — Truck Mounted,				
—c/w Full Boom, Jib & Hydraulic Outriggers				
15 - 20 Tons	167,000	5	8,350	49.40
25 - 35 Tons	212,000	5	10,600	61.00
50 - 60 Tons	299,000	5	14,950	83.60
75 - 85 Tons	386,000	5	19,450	107.80
100 - 120 Tons	550,000	5	27,500	150.00
130 - 150 Tons	711,000	5	35,500	195.00
Hydraulic — Rough Terrain, Self-Propelled				
—c/w Telescopic Boom & Hyd. Outriggers				
15 - 18 Tons	124,000	5	6,200	36.60
20 - 25 Tons	134,000	5	6,700	39.80
35 - 50 Tons	230,000	5	11,500	65.20
60 - 80 Tons	380,000	5	19,000	103.00

In order to determine the amount of revenue obtainable by acquiring a certain piece of construction equipment, the contractor must complete a thorough analysis of his market in order to determine how many hours and for what durations he will be able to occupy his machine. The construction industry covers many different markets, such as:

Commercial
Industrial
Institutional
Residential

Usually, the contractor's market is predetermined by the firm's previous experience or natural inclination. For example, if a contractor has concentrated on school construction, he may regard schools as his principal market out of habit, and overlook other lucrative markets such as commercial or industrial buildings.

The first step the contractor must do is sit down and analyze what his firm's capabilities are and what kind of markets can the firm operate in. It must be determined what kinds of business opportunities are available in construction, and how these needs can be met. This is the direct opposite of restricting the firm to the markets it has always operated in. Habit and personal disinclination to enter a new market may be curtailing new profit opportunities for the contractor.

The second step is to determine who pays for the contractor's services, or who influences the purchase. Developers and owners is the obvious response, however there are other individuals. Architects are frequently called upon to recommend a contractor for a specific project. Related to architects are consulting engineers and site planners who may also be involved in the project planning process. Another category of prospective clients is past or present customers.

Once the contractor determines the size of his market, he is able to set a realistic objective for the type and dollar volume of work his firm will attain over the next planning period. The next step, in terms of equipment management, is to begin the construction equipment replacement/expansion process to successfully complete the work. When there is certainty, or at least a high probability of work over the next couple of years, then the contractor is assured of a steady revenue from the equipment. Accurately predicting the market in this manner tips the balance in favour of cash purchase, finance through a loan or long term leasing, instead of short term rentals.

The revenue from its salvage is the last basic type of equipment revenue. As discussed in Section 2.2 the current market for used equipment is booming, due predominantly to inflated new equipment prices. Auctions are the heart of the used equipment business, and are one of the main mechanisms for establishing the worth, or salvage value, of used construction machinery. The trade-in can be used most effec-

tively when acquiring new equipment, since the contractor is is in a better bargaining position. Equipment dealers handle the greatest volume of buying and selling used equipment (13). The dealer buys outright, with no trade-in or other strings attached.

By means of the framework included in Figure 1.1, Chapter 3 has completed a study of the important financial factors in the acquisition analysis. Equipment expenses formed the bulk of the chapter, and the reader was referred to several more-detailed references if further study is required. Equipment revenues were also examined. Without sufficient equipment revenue, there is no need for an acquisition analysis - since the firm will, no doubt, soon cease to exist as a profitable entity. The optimum acquisition strategy must be based on accurate estimates of equipment revenues and expenses. In order to determine the best method of acquisition, the contractor must consider all of the financial items related to the use of his equipment.

CHAPTER 4

4.1 EVALUATING MODES OF EQUIPMENT ACQUISITION

Current return on investment methods are limited to factors than can be reduced only to monetary terms. Intangible considerations, such as the contractor's feelings and personal preferences, do not enter into the economic analysis. It is possible to set up a framework, wherein all criteria could be weighted relative to one another. The objective of this chapter is to examine certain ways of evaluating the mode of equipment acquisition. Section 4.2 will review in detail three financial methods of determining the optimum mode.

Section 4.3 contains an analysis of non-financial factors, and Section 4.4 will describe a framework for multi-attributed decision making, in order to evaluate both the financial and non-financial factors affecting the mode of equipment acquisition.

4.2 FINANCIAL ANALYSIS

As indicated in Chapter 1, many factors play a part in the evaluation of equipment acquisition alternatives. One of the most critical is the expected return on investment. No contractor willingly acquires a machine that will fail to return an acceptable profit. In an industry as competitive as heavy construction, the consequences of a poor acquisition decision can easily jeopardize the financial position of the contractor. The proper acquisition of construction equipment is to a large degree an investment decision, and must

be evaluated in the correct manner. Success in attaining the optimum acquisition plan is fundamental to the economic growth of the contractor.

There are essentially three financial tools which may be used to analyze the acquisition problem:

1. Cash flow method
2. Internal rate of return
3. Present value method.

4.2.1 CASH FLOW METHOD

The cash flow schedule is adaptable to all types of equipment acquisition problems, and is relatively simple to construct. A cash flow analysis of four depreciation methods on a 35 ton rough terrain crane was examined in Section 3.2.2. Before gathering information and prices on all equipment acquisition alternatives, many contractors check their projected cash flow to determine if it eliminates the possibility of cash purchase, short term loan payments, or another acquisition strategy. Next, some contractors check their business ratios and bonding capacity, measuring them against future needs to see if they dictate leasing or only certain types of loans.

When faced with an acquisition decision that could tie up capital or bank credit lines for several years, contractors must study very carefully their cash flow schedules. Table 4.2 contains such an example, with a cash flow schedule

presented for the proposed cash purchase of a 35 ton rough terrain crane. As detailed in Table 3.1, all relevant costs and revenues must be incorporated in the analysis. Table 4.2 shows the initial cash outlay, projected revenues and total operating expenses, estimated before tax cash flow, planned depreciation (CCA), income taxes and the after tax cash flow. The assumptions for this example are summarized in Table 4.1.

Depreciation and taxes are major economic factors that must be included in the acquisition analysis. When applied to estimated yearly revenues and expenses for the cash purchase and loan acquisition modes, depreciation and taxes completes the basic accounting picture (4). The cash flow schedule displays all incoming and outgoing funds, and helps in planning tax payments. In terms of the rental or lease modes the equipment's depreciation has no direct affect on the contractor's cash flow schedule.

Table 4.3 summarizes the cash flow schedule for the financing alternative, while that for leasing is included in Table 4.4. Rental of a 35 ton rough terrain crane was examined in Section 2.4, with the breakeven analysis between rental and cash purchase indicating that renting is economically feasible if the machine will be used less than approximately 950 hours.

Included in Table 4.5 is a summary of the cash flow formulae used in the calculations of Tables 4.2 to 4.4. The cash flow method is an important financial tool which must be used to

TABLE 4.1: Summary of three alternative modes of acquiring a 35 ton rough terrain crane

Mode of Acquisition	Conditions and Costs
Cash purchase	List price of $170,000. including freight charges, initial unloading, assembly & testing. Capital cost allowance depreciation rate of 30%, salvage value of $28,000. at beginning of year 6.
Finance	5 year bank loan at 12% interest on balance, list price of $170,000. as above Down payment of $38,000., remainder as a loan ($132,000.) Capital cost allowance depreciation rate of 30%, salvage value of $28,000. at beginning of year 6
Lease	$4,080. per month ($24. per $1,000. value) for 5 years, equal monthly payments Option to purchase for lessor's book value, all maintenance and repairs by lessee
General	Taxes - 50% of net income investment tax credit - 5% in year of acquisition

TABLE 4.2: Cash flow schedule for proposed cash purchase of 35 ton rough terrain crane

Year j	Revenue R_j	Expenses E_j	$BTCF_j = NOI_j$	Deprⁿ (CCA_j)	Taxable Income	Income Tax(T_j)	$ATCF_j$
0	—	170,000	(170,000)	—	—	—	(170,000)
1	85,000	25,000	60,000	51,000	9,000		60,000
2	82,000	26,000	56,000	35,700	20,300	10,150	45,850
3	77,000	27,000	50,000	24,990	25,010	12,505	37,495
4	72,500	28,500	44,000	17,493	26,507	13,254	30,746
5	68,000	30,000	38,000	12,245	25,755	12,878	25,122
6	28,000	—	28,000	—	—	—	28,000
Total	412,500	306,500	106,000	141,428		48,787	57,213

Note: 1) For the cash purchase mode, $BTCF_j = NOI_j$
2) Calculation of allowable investment tax credit in year 1:

Cost of equipment	170,000.
Maximum investment tax credit (5%)	8,500.
Income before CCA	60,000.
CCA in year 1	51,000.
Net income	9,000.
Federal tax (50%)	4,500.
Allowable investment tax credit	4,500.
Tax payable in year 1	0.

TABLE 4.3: Cash flow schedule for proposed financing of purchase of 35 ton rough terrain crane

Year j	Revenue R_j	Expenses E_j	NOI_j	Principle A_j	Interest I_j	$BTCF_j$	Deprⁿ CCA_j	Tax T_j	$ATCF_j$
0	—	38,000	—	—	—	(38,000)	—	—	(38,000)
1	85,000	25,000	60,000	26,400	15,840	17,760	51,000	(3,420)	21,180
2	82,000	26,000	56,000	26,400	12,672	16,928	35,700	3,814	13,114
3	77,000	27,000	50,000	26,400	9,504	14,096	24,990	7,753	6,343
4	72,500	28,500	44,000	26,400	6,336	11,264	17,493	10,086	1,178
5	68,000	30,000	38,000	26,400	3,168	8,432	12,245	11,293	(2,861)
6	28,000	—	28,000	—	—	28,000	—	—	28,000
Total	412,500	174,500	276,000	132,000	47,520	58,480	141,428	29,526	28,954

TABLE 4.4: Cash flow schedule for proposed leasing of 35 ton rough terrain crane

Year j	Revenue R_j	Expenses E_j	NOI_j	Lease L_j	$BTCF_j$	Tax T_j	$ATCF_j$
0	—	—	—	—	—	—	—
1	85,000	25,000	60,000	48,960	11,040	5,520	5,520
2	82,000	26,000	56,000	48,960	7,040	3,520	3,520
3	77,000	27,000	50,000	48,960	1,040	520	520
4	72,500	28,500	44,000	48,960	(4,960)	(2,480)	(2,480)
5	68,000	30,000	38,000	48,960	(10,960)	(5,480)	(5,480)
Total	384,500	136,500	248,000	244,800	3,200	1,600	1,600

TABLE 4.5: Summary of Cash Flow Formulae

$$BTCF_j = R_j - E_j - A_j - I_j - L_j$$

Where:

$BTCF_j$ ..... Before tax cash flow in year "j"
R_j ..... Revenue in year j
E_j ..... Expenses in year j, including operating costs, maintenance, repairs, and so on.
A_j ..... Payment on principle (amortization cost)
I_j ..... Interest
L_j ..... Lease cost

$$\begin{aligned} ATCF_j &= BTCF_j - T_j \\ &= (1 - T_r) \times BTCF_j - T_r(A_j - CCA_j) \\ &= NOI_j - A_j - I_j - T_j - L_j \end{aligned}$$

Where:

$ATCF_j$ = After - tax cash flow in year "j"
T_j = Tax paid by contractor in year "j"
$= (NOI_j - I_j - CCA_j - L_j)T_r$
CCA_j = Capital cost allowance as per schedule B (Table 3.3)
NOI_j = Net operating income = $R_j - E_j$

T_r = Tax rate of contractor

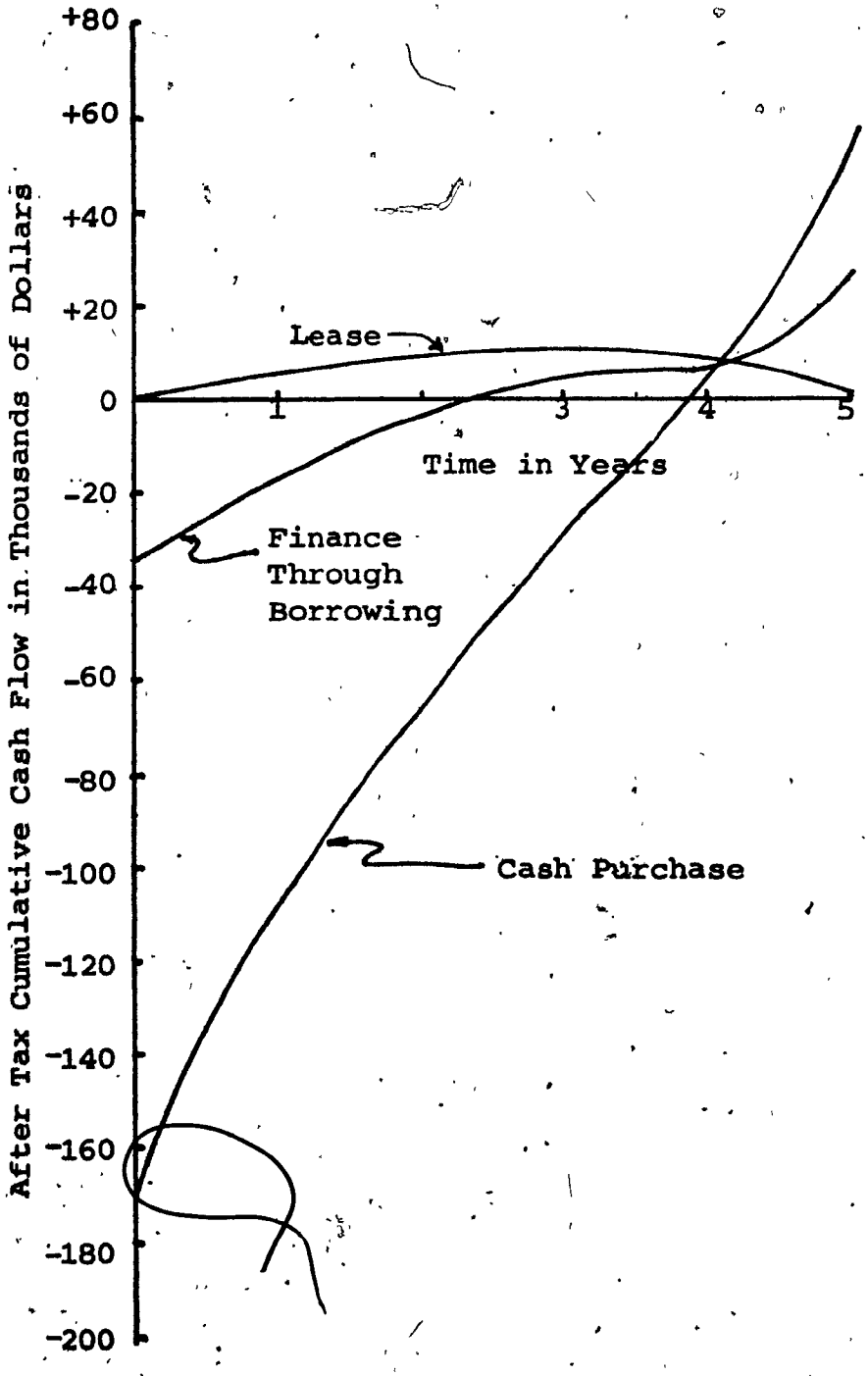


FIGURE 4.1: Cumulative cash flow profiles of three alternative acquisition modes, showing their respective payback periods.

analyze the key economic issues that face every contractor. It is a method which should be used in all acquisition decisions, and must be completed before further financial investigations are performed. Figure 4.1 contains a graphical analysis of the three cash flow schedules studied. The payback period for the financing alternative is approximately 2.25 years, while that for cash purchase is 3.75 years. The leasing mode has a positive after tax cumulative cash flow until into its fifth year.

4.2.2 INTERNAL RATE OF RETURN

The internal rate of return (IRR) is that rate of discount which will cause the present value of all cash inflows to equal the present value of all cash outflows. Viewed another way, it is that rate of discount which will cause the net present value of the investment to be zero. Expressed as a formula:

$$\sum_{j=1}^{n} \left[\frac{C_j}{(1+r)^j} \right] - C_o = 0$$

Where:

- n = Last period in which a cash flow is expected
- C_j = Net cash flow in time period j
- r = Unknown internal rate of return
- C_o = Initial cost of equipment

The theory states that any machine which has an internal rate of return greater than some specified minimum attractive rate of return will earn more than it will cost, and could

then be acquired. The IRR represents the percentage or rate of interest earned on the unrecovered balance of an investment. The unrecovered balance of the investment may be viewed as the portion of the initial investment that remains to be recovered, after revenues and expenses have been added and deducted respectively, up to the point in time being studied. It is not necessary that the best mode of acquisition have the greatest IRR. What is important is that each incremental cash flow from the new machine obtain an internal rate of return at least equal to the MARR.

Choice of Minimum Attractive Rate of Return (MARR)

The contractor must determine himself what the minimum attractive rate of return (MARR) ought to be. It must be chosen with the objective of making the best possible use of a limited resource. This resource consists of the money that can be made available for investment in construction equipment. If a proposed investment fails to satisfy this requirement, the proposal is rejected. For instance, a contractor may consider an after tax return of 15% to be the cut-off point for certain types of equipment. The decision to acquire a new machine would be based on its performance with respect to this rate.

The principle is explained in detail in reference (24). If the consequences of making an investment yielding 10% is to forego some other investment that would yield 20%, it is not sensible to make the 10% investment. The high figures for the MARR that so often are used in the construction industry

are based in part on this principle. It is prospective differences among alternatives that are relevant in their comparison. The prospective rate of return from a proposed investment should be based on the difference between making the investment, or some other one. In deciding whether or not to undertake this particular investment, the contractor must compare the prospective returns with the prospective return obtainable from alternative investments that are of comparable risk. Also a factor in determining the MARR will be the previous performance of the firm. The after tax return on equity capital may be used as a measure of performance. Assuming that this rate is satisfactory, it would provide a minimum level for MARR. Anything less than this amount will bring down the contractor's return on equity.

The minimum attractive rate of return is viewed as a rate at which the contractor can always invest, since he presumeably has a fair number of opportunities that yield such a return. Thus, when a contractor commits money to the acquisition of a machine, an opportunity to invest that money at the MARR has been foregone. It is for this reason that the MARR is also called the contractor's "opportunity" cost of money. The MARR must not be confused with the cost of capital. A firm's cost of capital is a composite rate that represents the cost of providing money from external sources through the sale of stock, bonds or by direct borrowing. Where a contractor's cost of capital may be 11%, his MARR may be 18%. The difference occurs since few contractors are willing to undertake investments that are expected to earn

only slightly more than the cost of capital, due to the risk elements and because of uncertainty about the future.

Every capital investment involves some degree of risk. The reason for this is that the return on the initial cash outlay lies in the future, over a period of several years. Equipment decisions must therefore be based on estimates of revenues and costs that incorporate all factors which may affect the machine's ability to return a profit. Table 3.1 contained a complete list of such factors.

There are adjustments in the acquisition analysis that the contractor may make, in order to account for risk. These adjustments are to:

1. Adjust the rate of return required from the machine
2. Adjust the expected revenue
3. Use probability distributions
4. Use sensitivity analysis

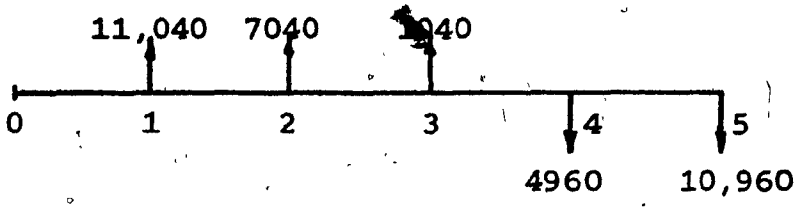
The contractor's attitude toward risk and uncertainty plays a major role in determining the type of adjustment he will be content in carrying out in the equipment acquisition analysis. The first two adjustments are simple, and may be completed following a short period of reflection on the part of the contractor. Probability analysis is complicated, and requires a considerable amount of knowledge and understanding on the contractor's part. Reference (24) contains an excellent introduction and discussion on the subject of probability. Sensitivity analysis is less complicated, but just

as tedious. As an example, Table 2.4 summarizes the brief sensitivity analysis of Peurifoy's purchase/rental equation. It is an analysis performed by the contractor in order to determine the variables in real life which have the maximum impact on the acquisition analysis, in order that additional care may be directed towards these items during the equipment acquisition process.

The comparison of the three alternative modes on an incremental basis before taxes is included in Table 4.6. The alternatives are arranged in order of increasing capital cost (ie lease < financing < cash purchase). The contractor is willing to invest in the financing alternative only if the IRR on the increment of the investment exceeds his MARR. The before tax cash flow profiles are contained on the following page. The data for the lease (A) and finance (B) profiles was obtained from Table 4.4 and 4.3 respectively. Profile (C) is the difference between profiles (B) and (A). The data for the cash purchase (D) profile comes from Table 4.2. Profile (E) summarizes the various increments on the investment between the cash purchase and finance modes. A similar analysis may be performed for the after tax cash flows. Table 4.7 contains the comparison of the IRR of the three modes on an incremental basis after taxes.

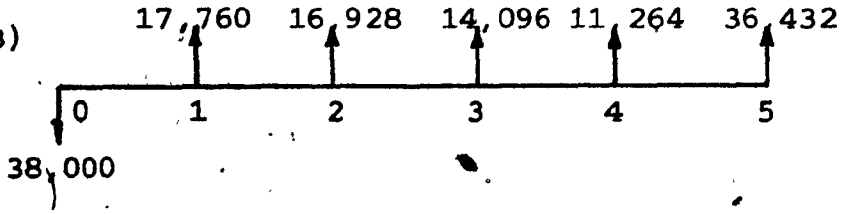
On an after tax basis, the contractor would chose the finance mode, since it provides a 19% IRR on the increment of the investment over leasing. The cash purchase mode provides only a 6% IRR on the increment of the investment over the finance mode, which is below this contractor's after tax MARR of 8%.

(A)



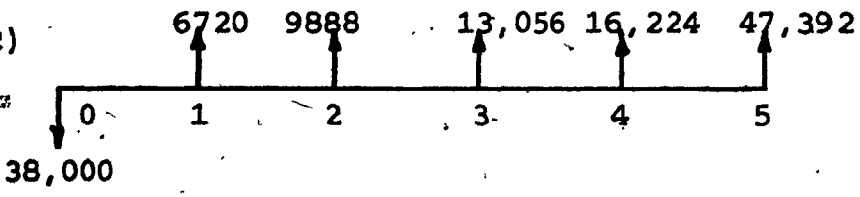
Lease BTCF

(B)



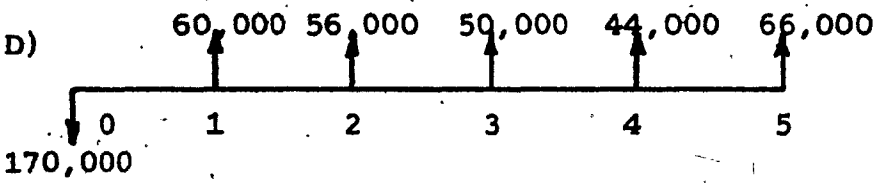
Finance BTCF

(C)



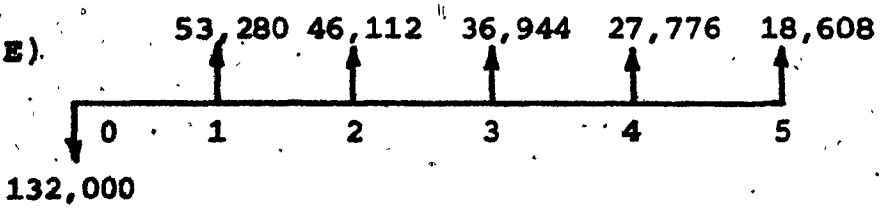
(Finance-Lease) BTCF

(D)



Cash Purchase BTCF

(E)



(Cash-Finance) BTCF

TABLE 4.6: Comparison of IRR of three alternative modes of acquiring 35 ton crane on an incremental basis before taxes

Comparison of	Difference in down payments	Year 1	2	3	4	5	IRR on increment
Finance-Lease	$38,000	$\frac{6720}{(1+r)} + \frac{9888}{(1+r)^2} + \frac{13,056}{(1+r)^3} + \frac{16,224}{(1+r)^4} + \frac{47,392}{(1+r)^5}$					28%
Cash-Finance	$132,000	$\frac{53,280}{(1+r)} + \frac{46,112}{(1+r)^2} + \frac{36,944}{(1+r)^3} + \frac{27,776}{(1+r)^4} + \frac{18,608}{(1+r)^5}$					12%

TABLE 4.7: Comparison of IRR of three alternative modes of acquiring 35 ton crane on an incremental basis after taxes

Comparison of	Difference in down payments	Year 1	2	3	4	5	IRR on increment
Finance-Lease	$38,000	$\frac{15,660}{(1+r)} + \frac{9594}{(1+r)^2} + \frac{5820}{(1+r)^3} + \frac{3658}{(1+r)^4} + \frac{30,619}{(1+r)^5}$					19%
Cash-Finance	$132,000	$\frac{38,820}{(1+r)} + \frac{32,736}{(1+r)^2} + \frac{31,152}{(1+r)^3} + \frac{29,568}{(1+r)^4} + \frac{27,983}{(1+r)^5}$					6%

4.2.3 PRESENT VALUE METHOD

A precise economic evaluation procedure that emphasizes return on investment is the present value (PV) method. This is an effective method since expected cash flow earnings are discounted by the rate of return which the contractor considers acceptable. The proposed acquisition is judged on its ability to pay for itself in discounted earnings over a given service period.

By definition, the concept of present value centers on the expectation of receiving a given amount of money sometime in the future, and that the investment has a present value that is somewhat less than the future value, depending on the earnings rate. For a proposal to be acceptable, the total present value of cash flow earnings must equal or exceed the amount of the initial investment.

The formula for calculating the present value of $1 expected "n" years in the future at a rate of return "i" is:

$$\frac{1}{(1 + i)^n}$$

For example, an investor expecting $1000. after one year with an interest rate of 10% need only invest $909. today. At 20%, only $833. is required.

To implement the present value method, the contractor must find the present value of the expected net cash flows of the acquisition mode, discounted at a certain predetermined discount rate, and subtract from this the initial cash outlay for the equipment. Expressed mathematically:

$$NPV = \sum_{j=1}^{n} \frac{C_j}{(1 + i)^j} - C_o$$

Where: n = Last period in which a cash flow is expected

C_j = Net cash flow in time period j

i = Specific discount rate

C_o = Initial cost of equipment

When the initial capital outlay is spread over an interval of several periods, it too must be discounted. If the net present value for a certain acquisition mode is positive, then it should be accepted. If two or more different modes are compared, then the one with the highest NPV should be selected.

In choosing the discount rate, the contractor must keep in mind one important rule. The selected discount rate which yields a positive net present value must exceed, or at least be equal to, some minimum attractive rate of return (MARR). The choice of the minimum attractive rate of return was discussed in the previous section. For the case study in this report, the contractors before tax and after tax MARR's are assumed to be 15% and 8% respectively.

Table 4.8 contains a comparison of the before tax present values of three methods of acquiring a 35 ton rough terrain crane, while Table 4.9 includes the comparison after taxes. As noted in reference (24), the best choice before taxes (finance) is not necessarily the best one after taxes. It is to the contractor's advantage to obtain the best possible return after income taxes rather than before income taxes. Tax rates vary from country to country and from time to time in any given country. The contractor must be aware of what amount of depreciation he is allowed to claim when calculating income tax payable. Also, the investment tax credit has an affect on the final amount payable in the year of acquisition.

Figures 4.2 and 4.3 show a graphical analysis of the discounted before tax and after tax cumulative cash flows respectively for the three acquisition modes studied. The cash purchase curve starts at the initial cash payment and gradually climbs to the final result. The finance curve starts at the down payment cost and rises slowly to the end of the term loan. The lease curve starts at zero, rises to a maximum in the third year, then decreases to the final value. The final analysis favors the financing arrangement, since the cumulative after tax cash flow at the end of the fifth year, in Figure 4.3, is the highest of the three modes. Also, the payback period for the financing mode is shorter (4.1 years) compared to 4.7 years for the cash purchase alternative. As concluded in reference (18), the shape of the curves will remain fairly stable, even though some variables change.

TABLE 4.8: Comparison of before tax present values of three methods of acquiring 35 ton rough terrain crane

Year	BTCF (non-discounted)			Present Value Factor (15%)	Present value of BTCF		
	Cash Purchase	Finance	Lease		Cash Purchase	Finance	Lease
0	(170,000)	(38,000)	0	1.000	(170,000)	(38,000)	0
1	60,000	17,760	11,040	0.870	52,200	15,451	9,605
2	56,000	16,928	7,040	0.756	42,336	12,798	5,322
3	50,000	14,096	1,040	0.658	32,900	9,275	684
4	44,000	11,264	(4,960)	0.572	25,168	6,443	(2,837)
5	66,000	36,432	(10,960)	0.497	32,802	18,107	(5,447)
Total	106,000	58,480	3,200		15,406	24,074	7,327

TABLE 4.9: Comparison of after tax present values of three methods of acquiring 35 ton rough terrain crane

Year	ATCF (non-discounted)			Present Value Factor (8%)	Present value of ATCF		
	Cash Purchase	Finance	Lease		Cash Purchase	Finance	Lease
0	(170,000)	(38,000)	0	1.000	(170,000)	(38,000)	0
1	60,000	21,180	5,520	0.926	55,560	19,613	5,112
2	45,850	13,114	3,520	0.857	39,293	11,239	3,017
3	37,495	6,343	520	0.794	29,771	5,036	413
4	30,746	1,178	(2,480)	0.735	22,598	866	(1,823)
5	53,122	25,139	(5,480)	0.681	36,176	17,120	(3,732)
Total	57,213	28,954	1,600		13,398	15,874	2,987

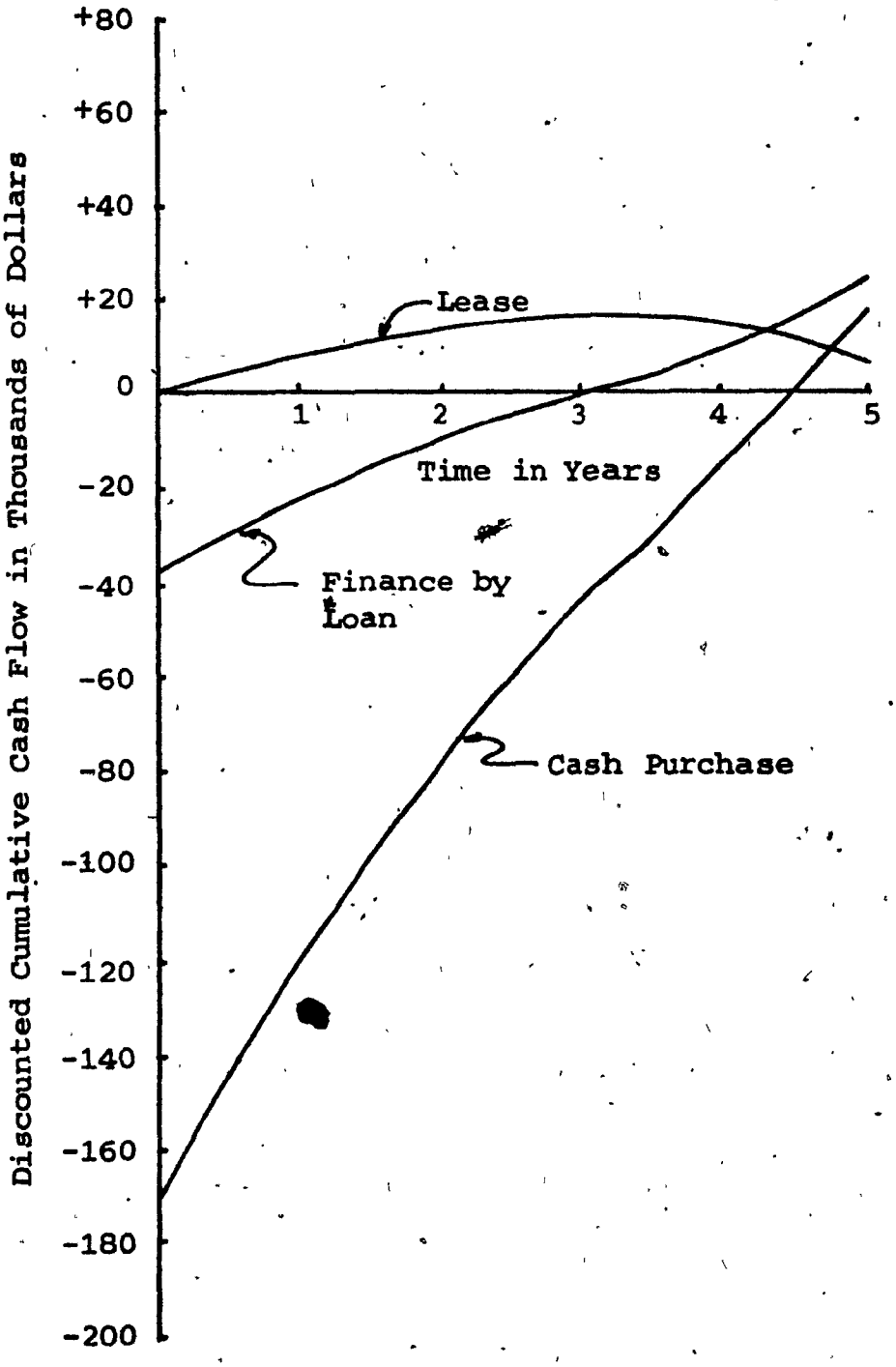


FIGURE 4.2: Graph of discounted before tax cumulative cash flows for three modes of acquisition

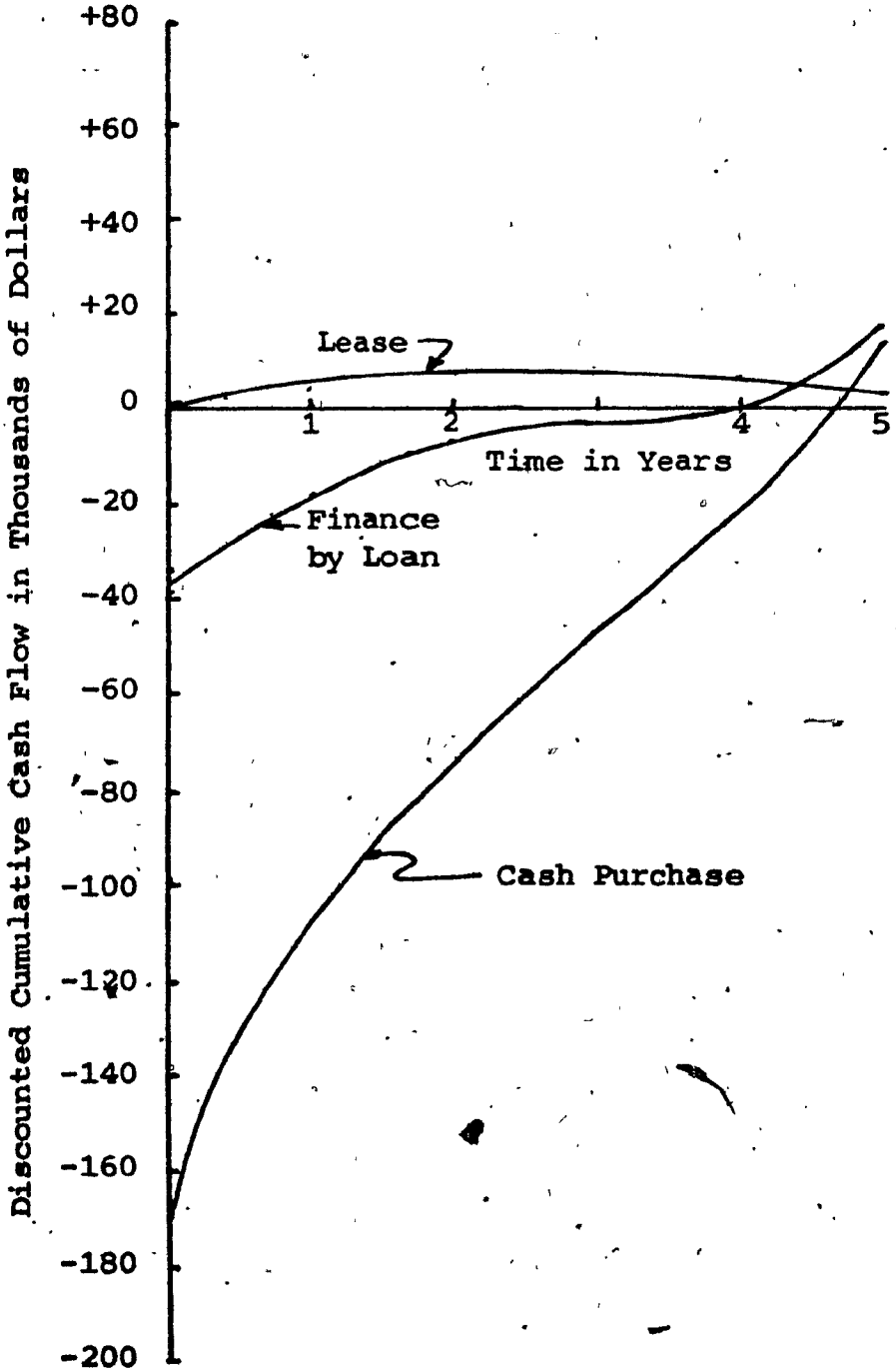


FIGURE 4.3: Graph of discounted after tax cumulative cash flow for three modes of acquisition

There is one major disadvantage to be considered by the contractor when using the present value method. The accuracy of the present value analysis is directly dependent upon the contractor's estimate of his firm's MARR. It may appear to be a difficult and complicated process for the contractor to determine his MARR. On the other hand, he should not select this figure too quickly either, for his action would introduce another unwanted element of risk into the acquisition problem. For further discussion of this problem the reader should consult reference (50).

Through the use of the case study in this chapter, two of the more common discounted cash flow methods have been examined. Any method for guiding the contractor in economically acquiring construction equipment is of little value if it requires difficult and extensive computations. One of the main virtues of the methods reviewed is simplicity. It should be noted that the cash flows examined were characterized by an initial disbursement, or a series of disbursements starting at the present followed by a series of positive receipts. In general, the flows had a monotonically decreasing net present value function, with an increasing discount rate that intersected the abscissa at some positive point such that the NPV was zero. This relationship is shown graphically in Figure 4.4. When the discount rate is zero, the NPV is the total of all cash inflows less all cash outflows. Assuming that total inflows exceed total outflows, and that outflows are followed by inflows, then the acquisition mode will have the highest NPV when the discount rate is zero. As the discount rate

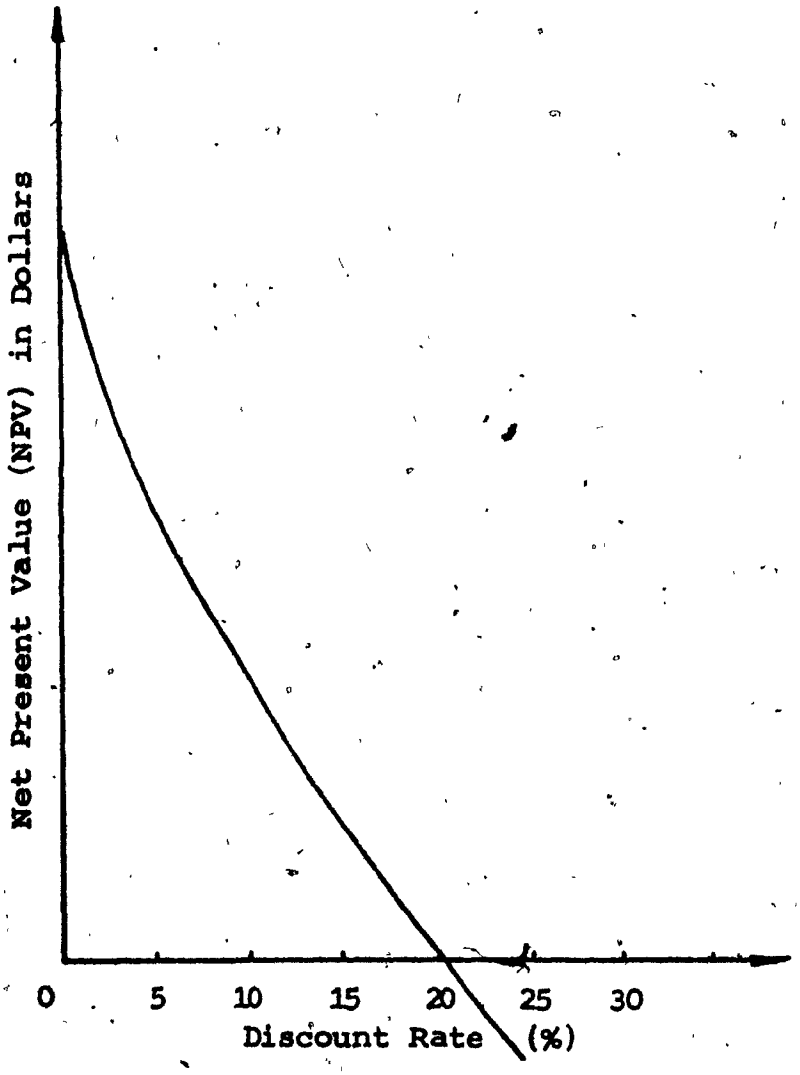


FIGURE 4.4: Relationship between discount rate and net present value

increases, the present value of the future cash inflows decreases relative to the present value of cash outflows.

Should further information on either method be required, the reader is referred to references (24) and (50). Ahuja (7) also becomes involved with an application of net present value in analyzing the optimum mode of construction equipment acquisition. Figure 4.5 contains a flow chart summarizing the mechanics of making an acquisition decision using NPV as presented by Ahuja. However, the elements of his cost analysis are incomplete. The reader is also left somewhat discouraged when Ahuja suggests that the results obtained following a very laborious analysis, should only be used as indicators, and that other non-economic factors must also be considered. However, no method of obtaining a final solution was proposed by Ahuja.

Figure 4.5 makes reference to the present worth of the rental mode. Ahuja's procedure for calculating the present worth of equipment rental is summarized in Figure 4.6. Even before doing all of the work suggested by Ahuja, it is obvious that the rental mode is only feasible for relatively short periods of use. It is this author's view that before contemplating the analysis suggested by Ahuja, the contractor is better off spending his time on a breakeven form of analysis, as outlined in Section 2.4.

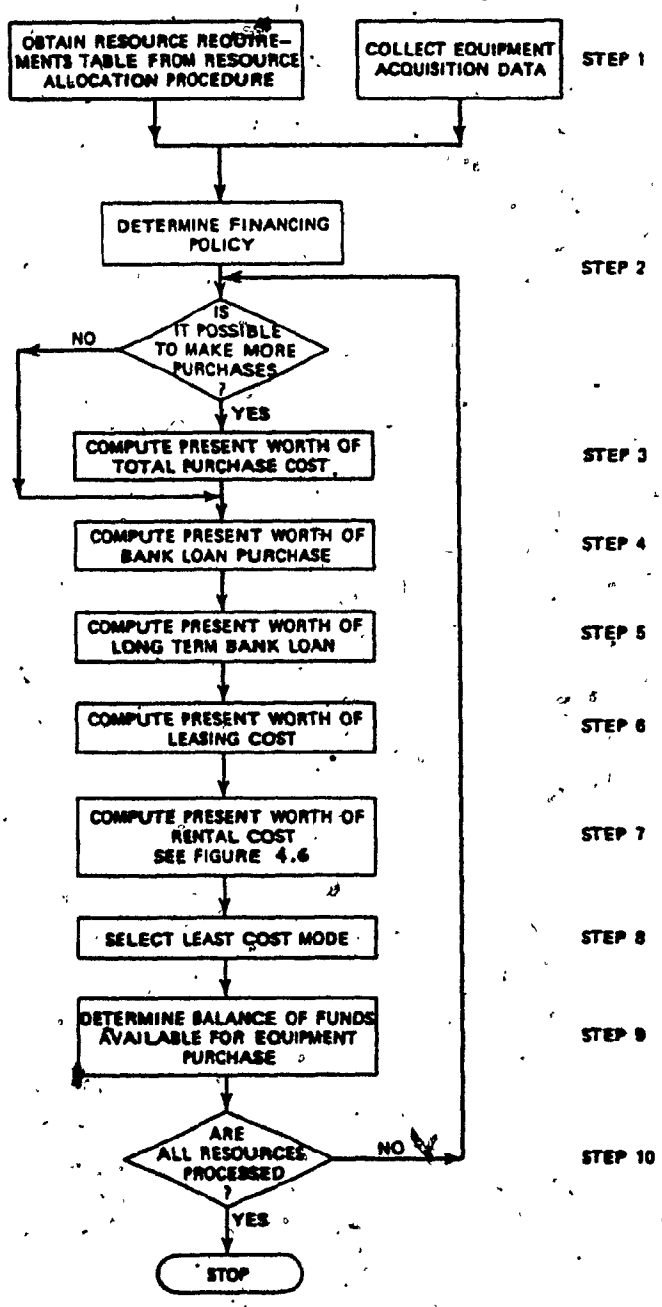


FIGURE 4.5: Flow chart of methodology for selecting equipment acquisition mode (7)

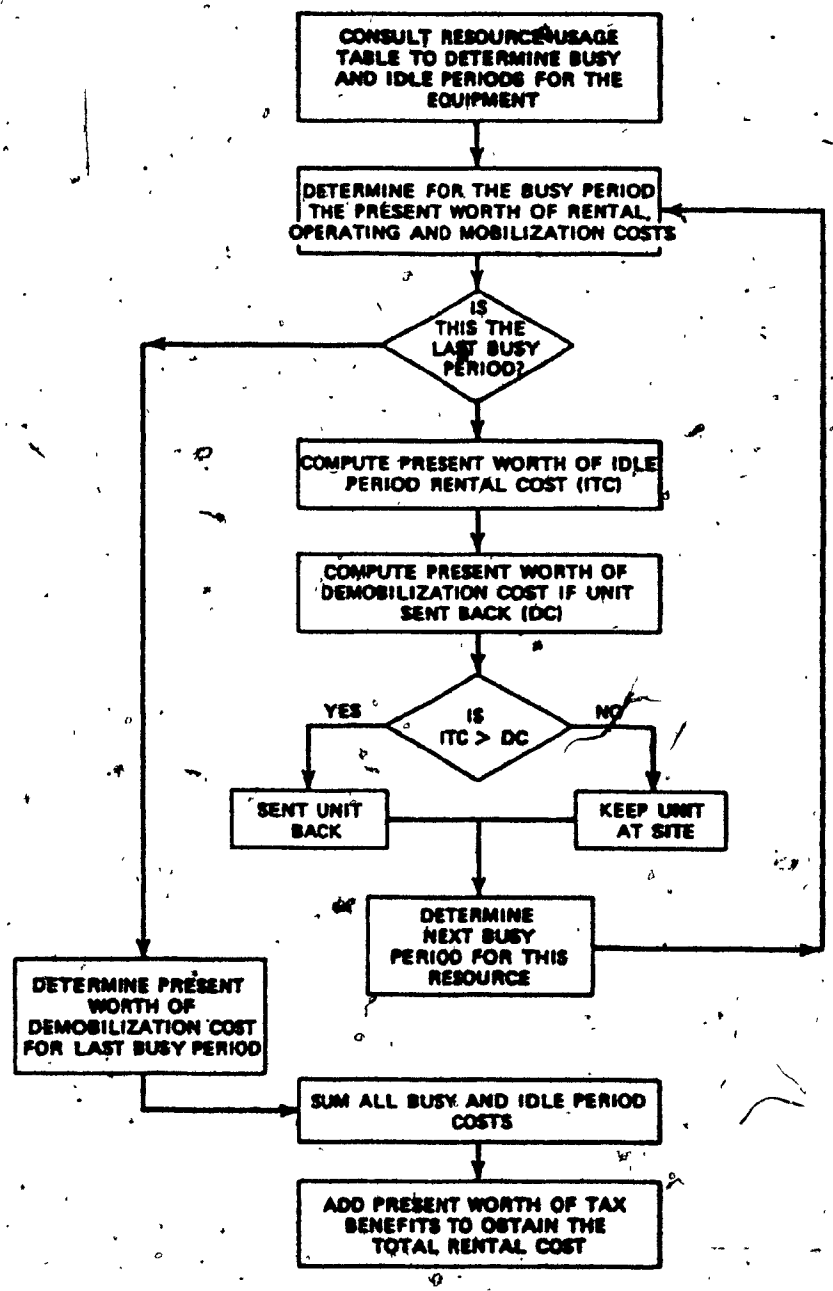


FIGURE 4.6: Procedure for calculating cost of equipment rental (7)

4.2.4 INFLATIONARY AFFECT

Inflation and its affect on the acquisition analysis is an important factor which the contractor must consider. With the equipment investment covering several years, increases in revenues and expenses must be accurately forecast and incorporated into the analysis. A major problem is that revenues and expenses will most likely inflate at different rates, and both rates will probably differ from the annual inflationary increases in the consumer price index. The objective of this section will be to determine how sensitive the acquisition problem studied so far is to inflation.

Douglas (18) studies the affect of inflation on profits and the economic life of a crawler tractor. The example is reproduced in Figure 4.7. Since inflation is a variable which is difficult to determine with precision, Douglas uses a sensitivity analysis to analyze the affect of various inflation rates on his model. The annual inflation rates vary from 0% to 20%, in 5% increments. It is assumed that revenues and expenses inflate at the same rate. This may not be an accurate assumption. Further research work should be carried out in this area, in order to determine whether equipment revenues are keeping up with expenses, and to determine the actual inflation rates for both. One interesting conclusion Douglas does reach from his analysis is that as inflation increases, equipment profits are depressed and economic life is lengthened. However, the increase in economic life from 5.4 years (0% inflation) to 6.3 years (20% inflation) is not a dramatic increase.

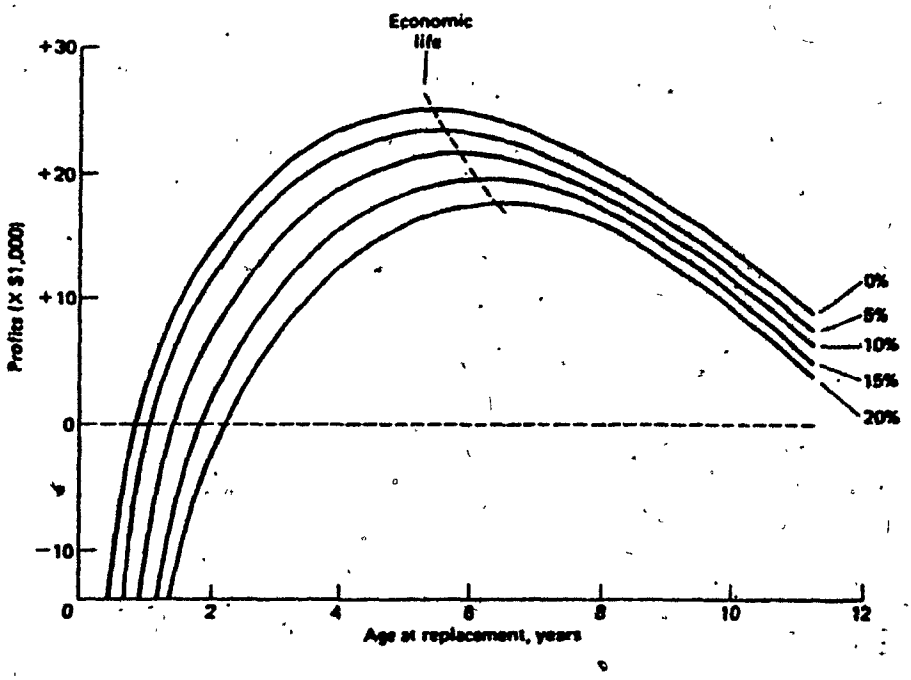


FIGURE 4.7: Affect of inflation on equipment economic life and profits (18)

Tables 4.10 to 4.12 contain cash flow schedules similar to those developed in Tables 4.2 to 4.4, however the affect of inflation has been included in this revised set of schedules. The following assumptions were made:

1. Equipment revenues and expenses inflate the same relative amount according to the following schedule:

   Year 1 ..... 9%
   Year 2 ..... 10%
   Year 3 ..... 12%
   Year 4 ..... 10%
   Year 5 ..... 10%

   As indicated in the previous paragraph, the assumption that revenues and expenses inflate at the same rate is not particularly correct. However, to assume otherwise would require considerably more research and study, and is recommended for future work.

2. Lease contract is drawn up for a five year period, and is not subject to inflation.

Figure 4.8 graphs the discounted after tax cumulative cash flow profiles for the data in Tables 4.10 to 4.12. Comparing the affect of inflation in this figure with the curves shown in Figure 4.3 shows that the cash flows increase under inflation. The resultant positive upward trend in all curves is favourable from the contractor's point of view, with the payback periods being somewhat shorter than those shown in Figure 4.3.

TABLE 4.10: Cash flow schedule for proposed cash purchase of 35 ton rough terrain crane, with affect of inflation included

Year j	Inflation	Revenue R_j	Expenses E_j	$BTCF_j$	Deprn (CCA_j)	Taxable Income	Income Tax	$ATCF_j$
0	—	—	170,000	(170,000)	—	—	—	(170,000)
1	9%	92,650	27,250	65,400	51,000	14,400	0	65,400
2	10%	98,318	31,174	67,144	35,700	31,444	15,722	51,422
3	12%	103,402	36,258	67,144	24,990	42,154	21,077	46,067
4	10%	107,095	44,315	62,780	17,493	45,287	22,644	40,136
5	10%	110,492	48,747	61,745	12,245	49,500	24,750	36,995
6	—	45,497	—	45,497	—	—	—	45,497
Total		557,454	357,744	199,710	141,428	182,785	84,203	115,507

Notes: Allowable investment tax credit in year 1 is $7,200.

TABLE 4.11: Cash flow schedule for proposed financing of purchase of 35 ton rough terrain crane, with the affect of inflation included

Year j	Inflation	Revenue R_j	Expense E_j	NOI_j	Principle A_j	Interest I_j	$BTCF_j$	Deprn CCA_j	Tax T_j	$ATCF_j$
0	—	—	38,000	—	—	—	(38,000)	—	—	(38,000)
1	9%	92,650	27,250	65,400	26,400	15,840	23,160	51,000	(720)	23,880
2	10%	98,318	31,174	67,144	26,400	12,672	28,072	35,700	9,386	18,686
3	12%	103,402	36,258	67,144	26,400	9,504	31,240	24,990	16,325	14,915
4	10%	107,095	44,315	62,780	26,400	6,336	30,044	17,493	19,476	10,568
5	10%	110,492	48,747	61,745	26,400	3,168	32,177	12,245	23,166	9,011
6	—	45,497	—	45,497	—	—	45,497	—	—	45,497
Total		557,454	225,744	369,710	132,000	47,520	152,190	141,428	67,633	84,557

TABLE 4.12: Cash flow schedule for proposed leasing of 35 ton rough terrain crane, with the affect of inflation included

Year j	Inflation	Revenue R_j	Expense E_j	NOI_j	Lease L_j	$BTCF_j$	Tax T_j	$ATCF_j$
0	—	—	—	—	—	—	—	—
1	9%	92,650	27,250	65,400	48,960	16,440	8,220	8,220
2	10%	98,318	31,174	67,144	48,960	18,184	9,092	9,092
3	12%	103,402	36,258	67,144	48,960	18,184	9,092	9,092
4	10%	107,095	44,315	62,780	48,960	13,820	6,910	6,910
5	10%	110,492	48,747	61,745	48,960	12,785	6,392	6,393
Total		511,957	187,744	324,213	244,800	79,413	39,706	39,707

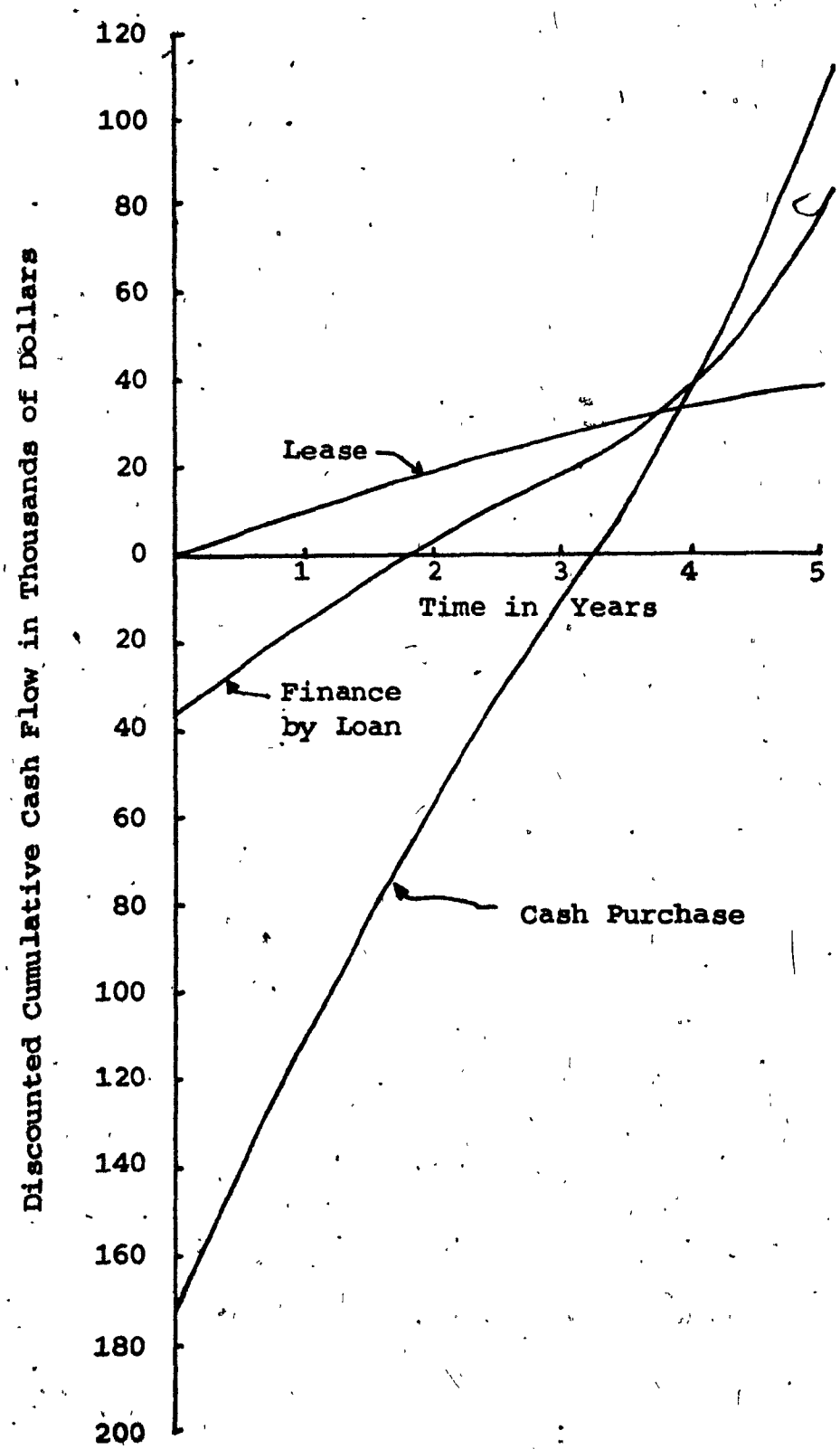


FIGURE 4.8: Discounted after tax cumulative cash flow profiles for three acquisition modes with inflationary affect included

Using the data from Tables 4.10 to 4.12, Table 4.13 includes the affect of inflation on the after tax net present values of the three methods of acquiring the 35 ton rough terrain crane. Cash purchase has the highest NPV, and should be selected by the contractor. Compared to the analysis performed without inflation in Table 4.9, it may be seen that the financing alternative had the highest NPV. The net present values were all increased significantly when inflation was considered.

Table 4.14 contains a comparison of the IRR's of the three modes on an incremental basis after taxes. The contractor would select the cash purchase alternative here also, since the IRR of the increment of the cash purchase investment over the finance investment is greater than his MARR of 8%. It may be concluded that inflation has a significant affect on the acquisition analysis, and should be considered seriously for further research.

TABLE 4.13: Comparison of after tax present values of three methods of acquiring 35 ton rough terrain crane, inflation included

Year	ATCF (non-discounted)			Present Value Factor (8%)	Present value of ATCF		
	Cash Purchase	Finance	Lease		Cash Purchase	Finance	Lease
0	(170,000)	(38,000)	0	1.000	(170,000)	(38,000)	0
1	65,400	23,880	8,220	0.926	60,560	22,113	7,612
2	51,422	18,686	9,092	0.857	44,069	16,014	7,792
3	46,067	14,915	9,092	0.794	36,577	11,843	7,219
4	40,136	10,568	6,910	0.735	29,500	7,767	5,079
5	82,492	54,508	6,393	0.681	56,177	37,120	4,354
Total	115,507	84,557	39,707		56,883	56,857	32,056

TABLE 4.14: Comparison of IRR of three alternates modes of acquiring 35 ton crane on an incremental basis after taxes, with inflation included

Comparison of	Difference in down payments	Year 1	2	3	4	5	IRR on increment
Finance-Lease	$38,000	$\frac{15,660}{(1+r)} + \frac{9594}{(1+r)^2} + \frac{5823}{(1+r)^3} + \frac{3658}{(1+r)^4} + \frac{49,115}{(1+r)^5}$					22%
Cash Finance	$132,000	$\frac{38,570}{(1+r)} + \frac{32,736}{(1+r)^2} + \frac{31,152}{(1+r)^3} + \frac{29,568}{(1+r)^4} + \frac{27,984}{(1+r)^5}$					9%

4.3 ANALYSIS OF NON-FINANCIAL FACTORS

So far in this report, financial data has played an important role and has been discussed considerably with respect to the equipment acquisition problem. Economic information is quantifiable, and there exist proven methods and tools to evaluate the most economical acquisition alternative open to the contractor. However, there were no references found indicating how the contractor could evaluate the intangible factors affecting the acquisition problem. Several of these intangible factors are summarized in Table 4.15.

From a financial point of view, the contractor is also involved in an analysis of the following factors:

1. Preference with respect to timing of cash flows
2. Actual cash flow profile.

These factors will be evaluated along with the other non-financial items.

4.4 MULTI-ATTRIBUTED DECISION MAKING

A valuable tool for both subjective and objective evaluation of the equipment acquisition problem is the performance attributes interface matrix (45). The four alternative acquisition modes may be evaluated with respect to their capabilities to satisfy certain criteria. This process facilitates multi-disciplinary inputs. Judgements are expressed by numerical ratings which are processed through two levels of criteria in this report, into a single value for each alternative acquisition mode. This value is a

TABLE 4.15: List of non-economic evaluation criteria relative to mode of equipment acquisition

Advertisement	- Company name (logo)and colours - Prestige of company - Image to public and competitors
Adaptability	- Planning - budgets, upgrading, interchanging - Compatible with company goals (private, public) - Storage - work cycles, market fluctuations, weather - Mobility - remote sites, scheduling, coordination - Flexibility - versatility of acquisition mode
Availability	- Opportunity to get work because of owning specialized equipment - Lag time during procurement - Demand of market for this equipment, backlog of work - Freedom of use of equipment
Risk	- Possibility of losing contracts due to lack of working capital - Obsolescence - risk of improved model being developed - Timing - of loan, lease payments-slow season, market - Other investments - compare risks & rates of return - Disposal - risk of low salvage value, poor used market - Competitiveness - of acquisition mode, strategy (situation of other construction contractors)
Organization	- Capability of staff for proper operation, repair and maintenance of equipment - Transportation and assembly capability - Replacement parts, inventory, storage - Employee morale - new equipment, owned, etc. - Pre-acquisition analysis - future work, market - Post-acquisition analysis - generate work, replacement, etc.

non-dimensional number having no significance other than its relativity to the values of other solutions.

The selection of criteria is very important, and Table 4.15 contains only an example. The actual criteria to be used in any analysis must reflect the actual feelings and requirements of the contractor. Certain guidelines may be established for the selection of this decision criteria:

1. Applicability - Criteria must bear directly on the objective of evaluating alternative acquisition modes.

2. Comprehensibility - Criteria must be clearly defined and have a consistent and obvious meaning to the contractor.

3. Exhaustiveness - Criteria listed must be as complete as practicable to ensure that all factors have been considered by the contractor. Criteria which have been omitted or forgotten will reduce the overall effectiveness of the analysis.

Figure 4.9 contains a breakdown, into certain levels, of the decision criteria listed in Table 4.15. The figure contains three levels. In order for the contractor to select the optimum mode of acquisition, it is important that he descend to the lowest possible level, and begin has analysis there.

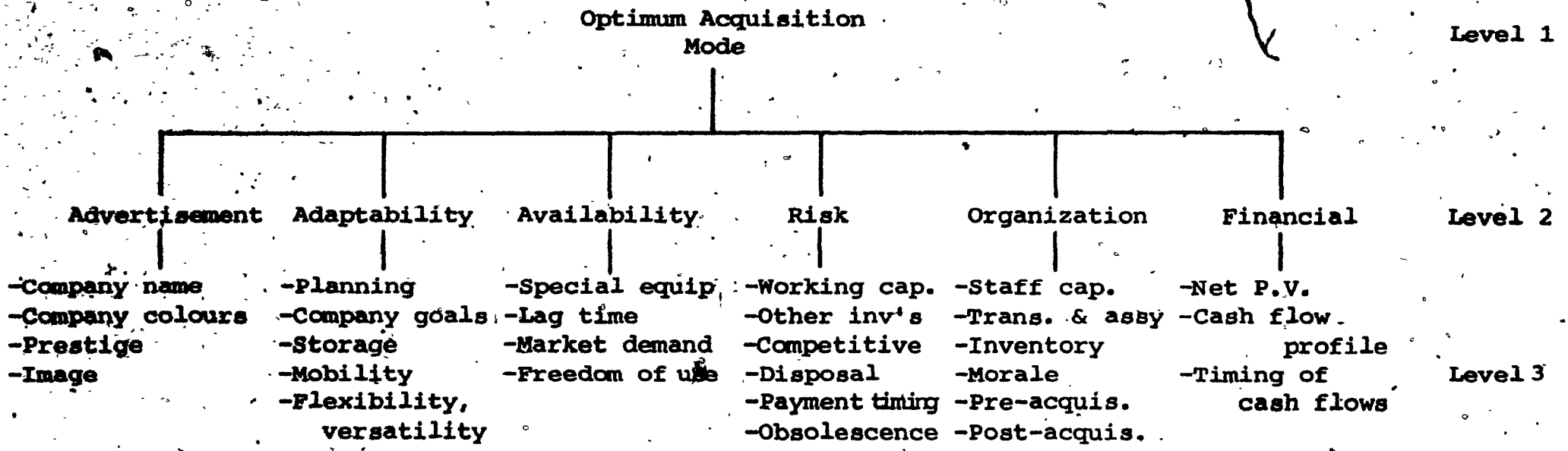


FIGURE 4.9: Performance criteria for evaluating alternative modes of equipment acquisition.

Table 4.16 to 4.21 inclusively evaluate the equipment acquisition performance criteria at level 2. The matrices are used to determine how each acquisition mode satisfies the criteria outlined in Table 4.15. The following is a brief description of the various symbols used in each matrix:

C_n ..... Weighting constant for criteria at level "n". The total of all weighting constants within one matrix is 1.00.

R ..... Rating of each acquisition mode with respect to criterion at the lowest level.

I_n ..... Total value of each category at level "n". This total becomes the rating (R) at the next highest level.

V ..... Value of C_n X R, or I_n

Each criterion at the selected level is given a weighting constant from 1 to 100. The total of all weighting constants within any one category must total 100%. Each criterion is weighted relative to one another within this limit, in order of importance. The most important criterion from the contractor's viewpoint carries the highest weighting.

Each alternative mode of acquisition is then evaluated against each criteria. The contractor selects a number from

0.0 to 1.0 to rate the ability of each mode to satisfy the specific criteria against which all modes are being judged. Both subjective and objective evaluations on the part of the contractor are possible. Objective evaluations require the conversion of quantifiable data into relative values ranging from 0.0 to 1.0. Subjective evaluations require a considerable amount of "soul-searching" on the part of the contractor. Some readers may disagree with the ratings and numbers used on the following three pages, however they are meant to serve only as an example.

Table 4.22 contains the selection of the optimum mode of equipment acquisition for the case study examined in this report. The results of the analysis indicate that the financing mode should be chosen. The cash purchase alternative is a close second, with the lease mode a distant third. A sensitivity analysis could be performed to verify results, if the contractor feels that it is warranted.

TABLE 4.16: Performance criteria for advertisement

Alternatives / Criteria	Criteria Weight	Cash Purchase		Finance with Loan		Lease	
		Rating	Value	Rating	Value	Rating	Value
	C_n	R	V	R	V	R	V
Company name	20	1.00	20.0	.90	18.0	.80	16.0
Company colours	20	1.00	20.0	.85	17.0	.75	15.0
Prestige	30	1.00	30.0	.80	24.0	.80	24.0
Image	30	1.00	30.0	.75	22.5	.70	21.0
Total (I_n)	100%		100.0		81.5		76.0

TABLE 4.17: Performance criteria for adaptability

Alternatives / Criteria	Criteria Weight	Cash Purchase		Finance with Loan		Lease	
		Rating	Value	Rating	Value	Rating	Value
	C_n	R	V	R	V	R	V
Planning	25	0.75	18.8	0.85	21.3	0.90	22.5
Company goals	20	0.80	16.0	0.85	17.0	0.80	16.0
Storage	20	0.70	14.0	0.70	14.0	0.75	15.0
Mobility	15	0.75	11.3	0.75	11.3	0.80	12.0
Flexibility	20	0.75	15.0	0.80	16.0	0.85	17.0
Total (I_n)	100%		75.1		79.6		82.5

TABLE 4.18: Performance criteria for availability

Alternatives / Criteria	Criteria Weight	Cash Purchase		Finance with Loan		Lease	
		Rating	Value	Rating	Value	Rating	Value
	C_n	R	V	R	V	R	V
Special equip't	25	0.90	22.5	0.85	21.3	0.75	18.8
Lag time	15	0.85	12.8	0.85	12.7	0.80	12.0
Market demand	25	0.85	21.3	0.85	21.3	0.90	22.5
Freedom of use	35	1.00	35.0	0.85	29.7	0.80	28.0
Total (I_n)	100%		91.6		85.0		81.3

TABLE 4.19: Performance criteria for risk

Alternatives / Criteria	Criteria Weight	Cash Purchase		Finance with Loan		Lease	
		Rating	Value	Rating	Value	Rating	Value
	C_n	R	V	R	V	R	V
Working Capital	20	0.80	16.0	0.85	17.0	0.90	18.0
Other investments	25	0.70	17.5	0.75	18.8	0.85	21.3
Competitiveness	20	0.75	15.0	0.85	17.0	0.80	16.0
Disposal	15	0.80	12.0	0.80	12.0	0.90	13.5
Payment timing	10	0.60	6.0	0.90	9.0	0.90	9.0
Obsolescence	10	0.75	7.5	0.75	7.5	0.80	8.0
Total (I_n)	100%		74.0		81.3		85.8

TABLE 4.20: Performance criteria for organization

Alternatives / Criteria	Criteria Weight	Cash Purchase		Finance with Loan		Lease	
		Rating	Value	Rating	Value	Rating	Value
	C_n	R	V	R	V	R	V
Staff capability	25	0.80	20.0	0.80	20.0	0.95	23.8
Transportation	15	0.80	12.0	0.80	12.0	0.90	13.5
Parts inventory	10	0.75	7.5	0.75	7.5	0.80	8.0
Employee morale	15	0.95	14.3	0.90	13.5	0.80	12.0
Pre-acquisition	20	0.75	15.0	0.80	16.0	0.90	18.0
Post-acquisition	15	0.75	11.3	0.75	11.3	0.90	13.5
Total (I_n)	100%		80.1		80.3		88.8

TABLE 4.21: Performance criteria for finance

Alternatives / Criteria	Criteria Weight	Cash Purchase		Finance with Loan		Lease	
		Rating	Value	Rating	Value	Rating	Value
	C_n	R	V	R	V	R	V
Net present value	50	0.84	42.0	1.00	50.0	0.19	9.5
Cash flow timing	25	0.50	12.5	0.70	17.5	0.95	23.8
Cash flow profile	25	0.70	17.5	0.80	20.0	0.50	12.5
Total (I_n)	100%		72.0		87.5		45.8

Note: Net present values were obtained from Table 4.9, and are expressed as a percent of the highest NPV of $15,874 (finance alternative)

TABLE 4.22: Selection of optimum mode of equipment acquisition

Alternatives / Criteria	Criteria Weight	Cash Purchase		Finance with Loan		Lease	
		Rating	Value	Rating	Value	Rating	Value
	C_n	R	V	R	V	R	V
Advertisement	12	1.00	12.0	0.82	9.8	0.76	9.1
Adaptability	7	0.75	5.3	0.80	5.6	0.83	5.8
Availability	8	0.92	7.4	0.85	6.8	0.81	6.5
Risk	15	0.74	11.1	0.81	12.2	0.86	12.9
Organization	8	0.80	6.4	0.80	6.4	0.89	7.1
Financial	50	0.72	36.0	0.88	44.0	0.46	23.0
Total (I_n)	100%		78.2		84.8		64.4

CHAPTER 5

5.1 CONCLUSIONS

The importance of an effective equipment acquisition strategy is often ignored by construction contractors in North America. In terms of the original objectives of this report contained in Section 1.2, the following conclusions have been drawn:

Objective 1

There are four basic modes of acquiring construction equipment in North America:

a) Cash purchase
b) Finance through borrowing
c) Rental
d) Lease

Each mode has its own respective advantages and disadvantages, both from a financial and non-financial point of view. All feasible acquisition modes should be analyzed and evaluated carefully by the contractor, before proceeding on to the next step in the acquisition problem.

Objective 2

The financial and non-financial factors to be considered by the contractor in the acquisition analysis were discussed. Ambiguities in several references relating to the various terminologies or calculations were clarified. In terms of

the financial analysis, the acquisition strategy must be based on accurate estimates of equipment revenues and expenses. A careful analysis is also required in selecting the non-financial factors involved in the analysis. The decision to purchase with cash, finance through a loan, rent or lease depends on the proper consideration of all pertinent factors related to the acquisition problem.

Objectives 3 and 4

Three means of financial analysis were examined in Chapter 4:

a) Cash flow method
b) Internal rate of return (IRR)
c) Present value method (NPV)

It was shown that the cash flow method involved the collection of accurate financial data essential for a further economic evaluation of the alternative acquisition modes. Important factors to be considered while studying the cash flows of different modes are the timing of the flows and their respective profiles.

A key consideration in the economic evaluation of alternative modes is the time value of money. Both the internal rate of return and the net present value methods studied in Chapter 4 use this very important principle. Results from the IRR method were found to be consistent with those found using NPV.

In terms of analyzing economic and non-economic factors simultaneously, the process of multi-attributed decision making was demonstrated in Chapter 4. The analysis of the case study examined in this report indicates that a method for evaluating all pertinent factors affecting the mode of equipment acquisition does exist, and can be utilized by construction contractors. The example in Chapter 4 was used to illustrate a procedure for acquisition analysis, and the numbers used and generated in the case study were primarily meant to serve this purpose.

5.2 RECOMMENDATIONS

Based on the information presented in this report, on the comprehensive literature analysis performed and on the acquisition procedures studied, it is recommended that the contractor analyze both the economic and non-economic factors in a framework similar to the process of multi-attributed decision making, as demonstrated in Tables 4.16 to 4.22. This type of framework should be studied further, in order that more practical formats may be developed, to be utilized by the contractor during the equipment acquisition period.

In analyzing the financial aspect of the acquisition decision, it is recommended that the contractor use net present value, as explained in Section 4.2.3. Special consideration should also be given to the timing of the cash flows, and also their respective profiles.

Several recommendations where further research work and study should be directed can be made:

1. A universal guideline for determining rental rates should be developed, instead of the many rental rate schemes currently in existence throughout North America.

2. Tax laws should be studied, and possible revisions should be recommended to the Federal Government. In particular, an allowance for inflation costs should be studied.

3. Contractors have a need for economic policy guidelines concerning long term debt financing, in order that they may critically evaluate the actual cost of these loans and be better prepared for construction market fluctuations.

4. Further study should be directed towards the application of the computer in the equipment acquisition analysis. The computer has great potential for cost reduction throughout the firm, and ways of adapting it to the equipment acquisition problem should be studied.

5. Follow-up procedures should be developed to periodically verify the contractors equipment acquisition policy.

6. Equipment revenues and expenses should be studied further, in order to develop a more accurate data base. This may be done in conjunction with the universal rental rate guideline. The affect of

inflation on revenues and expenses should also be studied, in particular the affect of differential inflation rates as noted in Section 4.2.4.

REFERENCES

1. Ahmed, S.B., Optimal Equipment Replacement and Investment Policies of a Transportation Firm, Texas A and M University, 1967.

2. Alchian, A., Economic Replacement Policy, Rand Corporation, 1958.

3. Anderson, P.F., Financial Aspects of Industrial Leasing Decisions, MSU Business Studies, 1977.

4. Anthony, R.N., Reese, J.S., Management Accounting: Text and Cases, Richard D. Irwin Inc., 1975.

5. Associated General Contractors of America, Contractors' Equipment Manual, Seventh Edition, 1975.

6. Associated General Contractors of Minnesota, Construction Equipment Cost Manual for Value Recovery Rates, Second Edition, 1977.

7. Ahuja, H.N., Construction Performance Control by Networks John Wiley & Sons, 1976.

8. Barrie, D.S., Paulson, B.C., Professional Construction Management, McGraw-Hill Book Company, 1978.

9. Beach, D.I., Tax Guide for Construction Contractors, Methuen Publications, 1974.

10. Beenhakker, H.L., Replacement and Expansion Investments, Rotterdam University Press, 1975.

11. C.A. Magazine, The Leasing Alternative, December 1977.

12. Canadian Construction Association, Rental Rates on Construction Equipment, 1973 Edition.

13. C.I.T. Corporation, Construction Industry Forecast, 1978 and 1979 Editions.

14. Construction Contracting, McGraw-Hill, Construction Update, February, 1975.

15. Construction Contracting, Contractors Scramble to Buy Equipment, August 1978 pp. 14 - 15.

16. Cox, E.A., et AL, Heavy Construction Manual.

17. Day, D.A., Construction Equipment Guide, John Wiley & Sons, 1973.

18. Douglas, J., Construction Equipment Policy, McGraw-Hill Inc., 1975.

19. Ebly, R.W., Comparison of Methods for Evaluating Capital Equipment Replacement, 1973 Transactions, American Association of Cost Engineers.

20. Engineering and Contract Record, Buying, Leasing & Selling Equipment, July 1975, pp. 52 - 57.

21. Engineering and Contract Record, Taxing all Construction Vehicles a Program Still Unique to Quebec, Fall 1976.

22. Engineering and Contract Record, How Contractors Prefer to Obtain New Equipment, July 1977 pp. 61 - 65.

23. Engineering and Contract Record, What's the Best Equipment Deal for You?, July 1979, 1978, 1977.

24. Grant, E.L., Ireson, W.G., Principles of Engineering Economy, Fifth Edition, Ronald Press Company, 1970.

25. Gynther, M., Analysis for Replacement of Fixed Assets, University of Queensland Press, 1968.

26. Heavy Construction News, Outlook for Distributors, January 17, 1977, p. 13.

27. Helfert, E.A., Techniques of Financial Analysis, Third Edition, Richard D. Irwin Inc., 1972.

28. Hinze, J., Ashton, W.B., Current Equipment Policies of Utility Contractors, Journal of the Construction Division, ASCE, September 1979.

29. Income Tax Act Interpretation Bulletin IT-331, Department of National Revenue, Taxation, July 1976.

30. International Harvester, Earthmoving Principles: A Guide to Production and Cost Estimating, 1975.

31. Jackson, J.F., An Evaluation of Finance Leasing, University of Texas at Austin, 1967.

32. Jardine, A.K.S., Maintenance, Replacement and Reliability, Pitman Publishing, 1973.

33. Jorgenson, D.W., McCall, J.J., Radner, R., Optimal Replacement Policy, North-Holland Publishing Company, 1967.

34. Kellner, I.L., Business Report, Manufacturers Hanover Trust, Spring 1978.

35. MacDonald, W.A., Cronkwright, G., Canada's Tax System Hurts Competitiveness, McMillan Publications, 1978.

36. Nevins, W.J., A Matter of Interest, Canadian Construction Association Magazine, December 1979.

37. Nourallah, F.S., Accountant's and Lawyers Concise Guide to Tax Savings Opportunities, Prentice-Hall Inc., 1978.

38. Nunnally, S.W., Managing Construction Equipment, Prentice-Hall Inc., 1973.

39. Ontario Road Builders' Association (ORBA), Rental Rates for Construction Equipment, 11th Edition, 1976.

40. Peurifoy, R.L., Construction Planning, Equipment and Methods, McGraw-Hill Inc., 1979.

41. Piekarski, J.A., Fundamentals of Manufacturing Ec Economics, 1973 Transactions, American Association of Cost Engineers.

42. Piekarski, J.A., Capital Budgeting for Construction Vehicles, 1976 Transactions, American Association of Cost Engineers.

43. Power Crane and Shovel Association, Operating Cost Guide, 1976.

44. Revsine, L., Replacement Cost Accounting, Prentice-Hall Inc., 1973.

45. Rosen, H.J., Construction Specification Writing, Wiley-Interscience Publication, 1974.

46. Smith, J., Extended Overtime and Construction Productivity, Transactions of American Association of Cost Engineers, 1975.

47. Statistics Canada Survey, Financial Leasing Statistics for 1974 and 1975, August 1976.

48. Statistics Canada Data, Ottawa, 1979.

49. Taylor, W.E., The Management of Contingency and Escalation in Construction, Concordia University, April 1979.

50. Van Horne, J.C., Dipchand, C.R., Hanrahan, J.R., Financial Management and Policy, Fourth Edition, Prentice-Hall of Canada, Ltd., 1977.

51. Vancil, R.F., Weil, R.L., Replacement Cost Accounting Thomas Horton, 1976.

52. Wood, S., Heavy Construction: Equipment and Methods, Prentice-Hall Inc., 1977.