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AN ECONOMIC EVALUATION OF ALTERNATIVE FUELING METHODS FOR THE CITY OF DENVER

BY:

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ABSTRACT

This thesis is based on a project done for the City of Denver and the Denver Police Department. The City of Denver was looking for ways to reduce the cost of refueling its police fleet of approximately 850 vehicles. An economic and statistical analysis compared commercial vendor fueling versus the current city fueling system of buying fuel and storing it in city owned underground fuel storage tanks.

Algorithms were developed that model the current city owned system of refueling and the commercial vendor fueling system for the Denver Police Department. These evaluations were conducted for both fueling alternatives using historical data from 1989 to 1992 and a five year forecast of the period January 1993 to December 1997.

The commercial vendor fueling system offers the best economic advantage when compared to the city owned fueling system. Some of the advantages are the officers remain in their districts, response time to emergencies is faster, and it's cheaper. The five year forecast from January 1993 to December 1997 shows a capital savings of $1,123,477.40 reflected in January 1993 dollars. For a fueling alternative analysis applicable to other city agencies this method used for the Denver Police Department can also be applied to those city agencies.

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Lastly, I wish to thank the men and women of the Denver Police Department. These extraordinary men and women put their lives on the line for us everyday to ensure our safety. Thank You.

Chapter 1
Introduction

1.1 Background Information

The City of Denver was charged by Mayor Wellington Webb's Underground Storage Tank Task Force on 09 March 1992, chaired by Theresa Donahue, Deputy Chief of Staff, to evaluate the use of a commercial vendor fueling system for city owned vehicles. This issue was to be explored and studied in order to make an objective cost-benefit analysis of the city owned refueling versus commercial vendor fueling.

Denver, like many other cities across the United States, is experiencing budgetary problems and increasing responsibilities to the environment. Recent Environmental Protection Agency (EPA) regulations directly impact Denver's underground fuel storage tank (UST) system. With these increasing requirements, it is more expensive to own and maintain underground storage tanks. The changing regulatory environment accentuates a number of issues, including the following:

- increasingly expensive city owned fuel operations
- liability for leaking UST's (Denver is self-insured)
- increased budgetary requirements for EPA compliance
- higher maintenance and operating costs for UST's
- higher costs of fuel to offset new UST expenses

These issues have increased the burden of controlling the city owned fuel supply. With limited options, this study examines several fueling alternatives.

With the help of Dr. Robert E. D. Woolsey, I was introduced to Dr. Stephen F. Browne, Deputy Manager, Department of Safety, Mrs. Margaret V. Browne (no relation to Dr. Browne), Deputy Budget Director, Finance Office and Chief Douglas A. White, Division Chief, Staff Services Division, Denver Police Department. These city officials of Denver wanted an unbiased and independent analysis of city owned fueling versus commercial vendor owned fueling. Additionally, the city has made a tremendous investment in a Hewlett Packard 3000 computer system and the software package Multiforce manufactured by Multiforce Systems Corp. This system is used by the city to manage its fleet of approximately 2,700 vehicles. This evaluation would have to examine this system since it is the mechanism for maintenance and accountability of parts and fuel for the cities fleet.

The commercial vendor fueling method proposed by the Department of Safety was considered for several reasons. Since Denver is self-insured, it is in the city's best interest to reduce its liability in the event an underground fuel storage tank should leak. The national average shows the conservative expected cost of a leaking tank is approximately $ 183,750.00[A] per tank incident (1). Additionally under

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[A] Costs are reflected in January 1993 dollars. See equation 4.9 for the formulation.

the current system, some police officers drive further than necessary to get fuel which sometimes causes them to leave their districts. This has resulted in an increased response time to "911" emergencies and other calls for police assistance.

This alternative fueling proposal involved establishing a fleet fueling contract with a large commercial vendor. In this case study Total Petroleum's Vickers stations are used because of their high station density (16 stations) in Denver and their existing fleet management credit card system. However, should Denver decide to adopt a commercial vendor system, the City of Denver would be required to call for bids.

1.2 Objectives of the Study

To do an economic evaluation of the current city owned fueling system versus the commercial vendor fueling system the following objectives were used:

1. Evaluate commercial vendor fueling as an alternative to the city owned underground storage tank fueling system over the next five years;
2. Determine the costs and benefits associated with using a commercial vendor for fuel versus the current city system;
3. Determine whether the alternative fuel dispensing system is viable for one or more city agencies; and
4. Determine a plan to enhance the use of the Multiforce Fleet Management System.

1.3 Goal of the Study

The goal of this project is to create a mathematical and economic algorithm that will evaluate a commercial vendor fueling system as an alternative to the city owned underground fuel storage tank system. With this algorithm it can be determined which alternative is more economically attractive for Denver. The Denver Police Department's fleet of gasoline powered vehicles will be evaluated in this study. The city will be able to take this method and apply it to other agencies to determine economic feasibility for their unique vehicle situation.

This evaluation of the City of Denver addresses, in no specific order, the following:

1. Impact on fleet maintenance system
2. Cost comparison of commercial vs. public system
3. Cost avoidance
4. EPA tank standard conformance
5. Multiforce computer interface and data transfer with the commercial vendors computer
6. Capital expenditures
7. Fuel prices
8. Security and accountability of fuel and records
9. Probability of city owned tanks leaking
10. Mileage savings
11. Value of controlling own fuel supply (city UST's)

12. Time savings
13. Budget constraints
14. Increased liability in owning UST's

1.4 Purpose of Thesis

The purpose, therefore, is to devise an economic and statistical algorithm that compares resources and cost to show the most economical fueling method for the City of Denver.

Chapter 2
Development of the Algorithm

In developing an algorithm to solve the problem of this thesis, I combined Banks and Carson's steps of a simulation study (14) and Winston's simulation process (15). Listed are the steps I followed in this project:

1. Problem Formulation
2. Field Work
3. Model Building and Data Collection
4. Implementation

These steps allowed for a methodical and systematic method to determine the problem and put it in a quantifiable form.

2.1 Problem Formulation

Currently the city of Denver purchases unleaded fuel daily in lots of eight thousand gallons. The lot amount is a constraint of the fuel tanker capacity. This fuel is retrieved from a commercial vendor and is delivered by Department of Public Works personnel daily to city owned underground fuel storage tanks. Overall, the city purchases approximately 3 million gallons of fuel per year (5).

Bids for the different types of fuel used by Denver are taken by the Department of Public Works Finance and Administration Section first thing each business day. The winning bids are then called over to the

Department of Public Works Fleet Maintenance Section that morning for fuel pickup and distribution to city owned tanks. The winning bid is the lowest cost per gallon of fuel provided by a commercial vendor. Currently the city does not use any form of the economic order quantity model for fuel purchases (17). Fuel is ordered on an as needed basis for any of the approximately two hundred fuel tanks (UST's). Charges to the Police Department and other agencies are calculated on an average cost of fuel plus an additional $0.09 per gallon for delivery charges. In the case of the police, they are then billed for fuel in three separate statements which are sent to the Department of Safety Finance Office. The bills represent the use of fuel by the Mayor's office, Office of the District Attorney, and the Police Department including the Sheriff's vehicles. On a monthly average the police consume 97% of the fuel.

At our first meeting, which included myself, Dr. Woolsey, Dr. Browne, Mrs. Browne, and Chief White, the fueling project proposal was discussed. The Department of Safety was interested in pursuing the prospect of using a commercial vendor for fuel purchases. Basically, they were considering using Total Petroleum's Fleet Credit Card System to purchase fuel for the entire police fleet (19). They presented a two page document that had been generated for an unbiased fueling study (20). Their document failed to address several factors such as holding costs for city owned fuel, administrative costs, different UST costs, and a method to evaluate the time an officer saves by the added flexibility of a commercial vendor fueling system. The City of Denver needed a decision

technique that incorporated the above factors to provide a quantifiable conclusion.

2.2 Field Work

I became intimately familiar with the operations of the Denver Police Department and those agencies related to fuel and police automobiles. I spent time at the Police Maintenance Facility, Budget and Finance Office, Staff Services Division, Safety Office of Policy Analysis, Total Petroleum's Denver office, Department of Public Works fuel points, and Vickers gas stations. This allowed me to appreciate what was happening with both fueling alternatives and to ensure that I had collected the true data needed for this evaluation. To ensure I had the correct perspective of the law enforcement mission, I participated in the Denver Police Departments Ride-Along program in Patrol District Two.

The Denver Police Department is charged to serve and protect the people, protect property, enforce the laws and ordinances of the city and state, apprehend violators, arrest and bring criminals to trial and maintain at all times the peace and dignity of the community. Comprising the Police Department are the Patrol Division, Investigation Division, Traffic Division, Staff Services Division, and Community Service Division. The Patrol Division is the greatest consumer of resources.

The City of Denver is divided into five police patrol districts, each commanded by a Captain. These districts are subdivided into sectors that are supervised by a Sergeant and each sector is further subdivided

into precincts patrolled by officers. In 1992 the Police Department instituted the flexible car plan in the Patrol Division. The flexible car plan is designed to utilize officers and vehicles more efficiently, meaning lower cost, and reduced officer levels. Precinct size and precinct numbers are adjusted based on the time of day and historical record of calls for service. This is a step forward taken by the Police Department to help reduce costs, but still provide adequate law enforcement service to Denver.

Overall, the Denver Police Department has an average inventory of 850 vehicles. Vehicle density varies, based on the time of the year and the number of vehicles purchased, sold, destroyed or confiscated by the Police. They all use unleaded gasoline, except for the bomb disposal truck which uses diesel fuel and travels less than 500 miles per year. The vehicles are issued as shown below:

Using Department	Number of Vehicles[B]
Mayor's Office	5
Chief of Police	31
Patrol Division	304
Investigation Division	194
Traffic Division	122
Staff Services Division	65
Community Service Division	43

[B] Vehicles in the inventory of the Department of Safety on 24 June 1992. The average is 850 vehicles for the years of '91 and '92.

District Attorney	39
Sheriff's Department	55
	858

2.3 Model Building and Data Collection

In order to develop a model that was useful to the Police Department and the City of Denver, I had to understand what the police do as law enforcement officers and also the cities system of acquiring and distributing fuel. By studying the above, I was able to identify any problems in their system and extract the primary conditions of the problem. I realized the model must meet certain requirements to ensure confidence in the system.

First, I needed to develop a model that was easy to use and one that the City of Denver could continue to use after this study was completed. I decided to use the software package Excel 3.0 for Windows, because the city of Denver is a licensed user of this package. This software package, with my algorithm, allows the user to select and modify basic assumptions (sensitivity analysis) until a useful approximation results.

Second, the output must be believable in order for the police to have confidence in the system. To ensure confidence in the model, I participated in many areas of the law enforcement mission and sought out the advice of those who would actually be affected by the model and its conclusion.

Data collection and model building took place from May to September 1992. Time was spent researching financial and administrative records of the City of Denver. Data collected during the study includes time spent refueling, distances traveled, resources expended, and requirements of police automobiles.

2.4 Verification and Validation

Once the data was collected and the model constructed, I approached the Police Department with the method flow-chart for their review. To verify the model, I conducted a check with historical information to ensure it generated factual information. This was done at the Department of Safety Finance Office by comparing calculated numbers with the records of payments to the Department of Public Works for fuel, repairs, new construction, and Multiforce Computer use. The model was validated when the outcome mirrored the reality. This ensured that I had grasped the essence of the system and that the essential variables and problem were addressed.

2.5 Implementation

The Department of Safety is currently in the process of implementing the recommendations of this thesis.

Chapter 3

The Algorithm

The model for the city of Denver Department of Safety will be refered to as Fueling Strategies. The model has two parts, one for public fueling and the other for commercial vendor fueling. Each part takes the chosen variables and generates the estimated cash flow values and converts them into Net Present Value (NPV). Net present value is the cumulative present worth of positive and negative investment cash flow using a specified discount rate to handle the time value of money (16). The time value of money is significant since two strategies are being considered. The Fueling Strategies model calculates the project's net present value, given the many variables considered, with considerations for rate of inflation and rate of return (ROR) of investments. Discounted cash flow analysis puts all investments on a common evaluation basis for handling the time value of money with compound interest rate of return. This enables the user to fairly and properly account for the magnitude and timing of these dollar value considerations regardless of the type of investment (16). The term *"discount"* is synonymous with *"present worth"* in economic evaluations and *"cash flow"* is used to refer to the net inflow or outflow of money that occurs during a specified period of time. The desired rate of return on investments comes from the General Investment Pool, managed by the Director of Financial Management, Treasury Division, City of Denver (4).

3.1 Model Focus

The primary mission of the Denver Police Department is law enforcement. Given the current budget and personnel constraints, efforts are being made to reduce dollars spent while maximizing the law enforcement officers effectiveness. The choice of fueling alternatives will most likely come down to the least expensive alternative, but careful consideration must be made to ensure that the officers' performance isn't hindered. The officers must enforce laws, protect citizens and property, see and be seen in the community, and respond to "911" and other emergencies rapidly. Statistical analysis must allow for interpretation of results; therefore, the model's conclusion must be based on common sense, street experience, and statistical analysis of verifiable data.

3.2 Evaluation Criteria

Evaluation criteria used in this model are based on the desires and concerns of the Department of Safety, Department of Public Works, Finance Office, and the Mayor's Underground Storage Tank Task Force. The evaluation is a cost comparison of the current city owned fuel compared to commercial vendor fueling for the Denver Police Department.

3.3 Issues of City Owned vs. Commercial Vendor Fueling

In creating an economic analysis certain issues are addressed. The listed issues are those of the Department of Safety, Department of Public Works, and the Finance and Budget Office. The lists are presented in no specific order.

Shared Issues:

1. Impact on current fleet maintenance system.
2. Accuracy of information from vendors.
3. Cost of using current fueling system for next five years.
4. Cost of using commercial vendor fueling system for the next five years.
5. Security and accountability of fuel.
6. Probability of UST's owned by Denver begin leaking.
7. Cost avoidance with commercial vendor.
8. Automated data interface of Multiforce and Vendor.
9. Value of controlling city owned fuel supply.

Department of Safety Issues:

1. Fair price for fuel.
2. Access to customized reports from Multiforce.
3. No responsibility for UST's.
4. Control of Police fleet information.

5. Alternative system must not hinder officer or decrease patrol time.

Budget and Finance Issues:

1. Retain information vital to fleet inventory and maintenance.
2. Determine cheaper alternatives.

Department of Public Works Issues:

1. Retain Multiforce computer system.
2. Retain effective preventive maintenance program.[c]

3.4 Assumptions and Constraints

In constructing this model certain assumptions had to be made. These assumptions were developed through discussions with the agencies concerned.

1. Average fuel consumption is 950,000 gallons of unleaded gasoline per year (6).
2. Denver is tax exempt for fuel purchases.
3. Police policy is that vehicles must refuel at ½ tank (3).
4. The Commercial Vendor system must be able to electronically down-load the following information to

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[c] This is not an issue for the Department of Public Works since the Police Department manages and operates its own fleet maintenance facility and program.

Multiforce on a daily basis to ensure continuity of the vehicle database.

(a) Vehicle administrative number

(b) Drivers personal identification number (PIN)

(c) Current odometer reading.

(d) Amount and cost of fuel.

5. The historical example is an annual average of data collected from the City of Denver.
6. The five year forecast all resources are held at a constant rate of use.

3.5 Current System for Refueling

The current system for refueling is managed by the Department of Public Works. The officers refuel at seven locations 99% of the time. Listed are the addresses of these Public Works refueling sites:

Address

1. 5440 Roslyn Street
2. 1390 Decatur Street
3. 7301 East Jewell Avenue
4. 3555 Colorado Boulevard
5. 1625 South University Boulevard
6. 1201 South Lincoln Street
7. 2013 South Osage Street

To refuel, the officer drives up to the pump and records the current odometer reading and vehicle administrative number. A credit card is inserted into the Multiforce terminal and the officer is prompted for the following information: vehicle administrative number, personal identification number, current odometer reading, and pump number. The Multiforce software program then authorizes the transaction and the officer may pump the needed fuel.

Currently, several problems are experienced by the officers. If the vehicle is refueled frequently for small amounts of fuel, the software program reduces the amount of fuel that vehicle can get. Additionally, an officer who inputs an incorrect odometer reading is locked out of the refueling process. The officer must then call the Department of Public Works for re-authorization to get fuel. The times I witnessed this, it took approximately thirty minutes and three people to resolve the problem. The Department of Public Works refuses to allow the Police access to the Multiforce computer program to correct these mistakes.

3.6 Total Petroleum's System for Refueling at Vickers Gas Stations

Total Petroleum uses a system they refer to as the Fleet Fueling program. Listed are the addresses of the Vickers stations (all 24 hour operations) within the city limits of Denver:

Address

1. 1001 South Broadway Boulevard

2. 1401 South Federal Boulevard
3. 1696 South Broadway Boulevard
4. 2210 South Colorado and Evans
5. 2485 South University Boulevard
6. 300 South Downing Street
7. 330 South Kalamath Street
8. 3490 North Colorado Boulevard
9. 3810 Federal Boulevard
10. 3860 Peoria Boulevard
11. 495 South Colorado Boulevard
12. 5301 East Yale and I-25
13. 5455 East Colfax and Hudson
14. 7045 East Hampden
15. 7607 East Iliff
16. 990 South Monaco

Total Petroleum's system is almost identical to the system the Department of Public Works uses in Denver. The officer drives up to the pump, pumps the fuel, goes to the cashier who inserts the credit card into the cash register while the officer inputs a personal identification number, odometer reading, and then signs a credit receipt for fuel provided by the attendant. This procedure provides the checks and balances necessary to verify the commercial vendors accuracy of fuel consumed and cost.

The Total software program compiles the entries of the day and places it into a file that the City of Denver accesses. At a predetermined time the Multiforce computer, utilizing a software program provided by Total Petroleum, accesses the Total Petroleum's computer by modem and downloads the daily data in approximately three minutes. This convenience allows the Multiforce computer to be updated daily thus ensuring all records are maintained in the exact same manner as the current system.

The Fleet Fueling card system contract is something that must be negotiated by the City of Denver and set in a contract. Potential problems with the commercial vendor such as unauthorized purchase of non-fuel products can be avoided through the thoroughness of the negotiated contract and instructions to the officers.

3.7 Steps of the Algorithm

Listed are the steps to guide the user of the Fueling Strategies program through the method.

Step 1: Determine Variables for the Model

Figures 3.1 and 3.2 show representative Fueling Strategies spreadsheets. The user inputs the values indicated into the shaded area on the spreadsheet. Input variables follow:

Economic Analysis of City Owned Fueling: January 1993 to December 1997		
	1	2
Month	January '93	February '93
Fuel Expenses		
Gallons Consumed	79,167	79,167
Cost per Gallon	$0.8000	$0.8000
Net Fuel Expense	$63,333.33	$63,333.33
Miscellaneous Expenses		
Multiforce Computer	$3,333.33	$3,333.33
Upgrade of Multiforce/Fuel System	$8,333.33	$8,333.33
UST-Maintenance	$377.26	$377.26
UST-Probability Cost of Leaking	$3,445.31	$3,445.31
UST-Upgrades	$9,000.00	$9,000.00
Holding Cost of Fuel	$92.36	$92.36
Net Miscellaneous Expenses		
Cash Flow	$87,914.93	$87,914.93
Discounted Cash Flow	$87,914.93	$87,660.00

Net Present Value
$175,574.93

Input Variables	Units	Input Values
Fuel Usage	gallons/year	950,000
Cost per Gallon	$/gallon	$0.8000
Multiforce Computer Cost	$/year	$40,000.00
ROR General Investment Pool	APR	0.0700
Inflation Rate	APR	0.0350
Upgrade of Multiforce/Fuel System	$/year	$100,000.00
UST-Maintenance	$/tank	$167.67
UST-Upgrades	$/year	$12,000.00
UST-Probability of Leaking	percentage	0.0250
UST Expected Cost of Leaking Tank	$/tank	$61,250.00
Number of City Owned UST's	integer	27

Input Variables for City Owned Fueling

Figure 3-1

Economic Analysis of Commercial Vendor Fueling: January 1993 to December 1997		
Month	1 January '93	2 February '93
Fuel Expenses		
Gallons Consumed	79,167	79,167
Cost per Gallon	$0.8000	$0.8000
Net Fuel Expense	$63,333.33	$63,333.33
Miscellaneous Expenses		
Multiforce Computer	$3,333.33	$3,333.33
Download from Total Petroleum	$50.00	$50.00
Totals Software for Download	$4,000.00	
Cash Flow		
Cash Flow	$70,716.67	$66,716.67
Discounted Cash Flow	$70,716.67	$66,523.20

Net Present Value
$137,239.87

Input Variables	Units	Input Values
Fuel Usage	gallons/year	950,000
Cost per Gallon	$/gallon	$0.8000
Multiforce Computer Cost	$/year	$40,000.00
ROR General Investment Pool	APR	0.0700
Inflation Rate	APR	0.0350
Download from Total Petroleum	$/year	$600.00
Totals Software for Download	$	$4,000.00

Input Variables for Commercial Vendor Fueling

Figure 3-2

City Owned Fueling

Input Variable		Units
1.	Fuel Usage	gallons per year
2.	Cost per Gallon	$/gallon
3.	Multiforce Computer Cost	$/year
4.	Personnel Cost	$ per man/year
5.	ROR General Investment Pool	Annual % Rate (APR)
6.	Inflation Rate[D]	APR
7.	UST-Maintenance	$/year
8.	UST-Probability of Leaking	percentage
9.	UST-Expected Cost of Leaker	$/incident
10.	Number of UST's	integer
11.	UST-Upgrade Program	$/tank
12.	Upgrade of Multiforce Computer	$/year

Total Petroleum Fleet Fueling

Input Variable		Units
1.	Fuel Usage	gallons/year
2.	Cost per Gallon	$/gallon
3.	Multiforce Computer Cost	$/year

[D] Inflation is not calculated for the period of 1989 to 1992 as the dollars are already escalated in the city owned example.

4.	Operating Cost per Vehicle	$/mile
5.	Personnel Cost	$ per man/year
6.	ROR General Investment Pool	Annual % Rate (APR)
7.	Inflation Rate[E]	APR
8.	Upgrade of Multiforce Computer	$/year
9.	Download from Total Petroleum	$/year
10.	Total's Software for Download	$

Step 2: Input Variables Into Spreadsheet Model

The user inputs the variables into the spreadsheet as indicated above and as illustrated in Figures 3.1 and 3.2. The spreadsheet then make the necessary calculations to determine the Net Present Value for the alternatives. These calculations are dependent on the input variables. If a variable is not needed the person must assign a zero value to that particular variable.

Step 3: Extract the Net Present Values from the Spreadsheets

The user takes the net present values from both spreadsheets and compares them. The lower NPV indicates the less expensive alternative.

[E] Inflation is not calculated for the period of 1989 to 1992 as the dollars are already escalated in the commercial vendor example.

3.8 Cash Flow Analysis

The term *"cash flow"* is used to refer to the inflow or outflow of money during any period of time. For the purpose of this analysis the period of 1989 through 1992 reflect a cash flow for forty-eight months (four years). The period of 1993 to 1997 reflects a cash flow for sixty months (five years). Cash flow, in these cases, is the cost of fuel plus the cost of services, capital expenditures, and operating costs. Analysis for the City of Denver is on a before-tax basis since the City of Denver is not subject to any form of tax. The term *"discounted cash flow"* means that the time value of money is represented using present value calculations that represent present worth (16).

Discounted Cash Flow Analysis is a systematic and quantitative method of evaluating all relevant factors that affect the economic outcome of a project. I have used this method to evaluate the economics of two mutually exclusive projects. This has placed both projects on the same evaluation basis of handling money with compound interest rate of return.

3.9 Net Present Value

The cash flow and the time value of money are the decision criteria used in economic evaluations. Net present value is defined as the cumulative value of all project cash flows discounted at a minimum rate of return to the present (16).

For this analysis, evaluations are done in *" escalated dollars"*, or

the actual dollars of revenue or cost that will be realized at specific points in time. Escalated dollars are occasionally referred to as current dollars, inflated dollars, nominal dollars, and dollars of the day (16).

3.10 Sensitivity Analysis

Sensitivity analysis is used to study the uncertainty of variables of this analysis and the associated risks. This measure allows the identification of those critical variables that, if changed, could significantly affect the project's cost. Variables are changed to show the comparisons between the two alternatives, publicly owned versus commercially owned refueling scenarios. With these variables identified, the decision makers can make the correct economic choice. The term *"uncertainty"* refers to the possible variation in parameters that affect this evaluation. An example of uncertainty is the cost of unleaded gasoline. The term *"risk"* refers to using a known mechanism that incorporates the probabilities of occurrence for success and failure. An example of risk is the probability of an underground fuel storage tank developing a leak.

Chapter 4
Fueling Strategy Examples

To evaluate the Fueling Strategy model I developed for the City of Denver, I took the historical data from the current city owned fueling system to determine if the model mirrored reality. The data evaluated reflects the period of January 1989 to December 1992 (4 years). Actual costs found in historical records are used in this model with the exception of the data covering April 1992 to December 1992, where funded projects that are approved for the 1992 annual budget and anticipated expenses were used. Once I developed the city owned fueling cost historical example, this in turn became the basis for the commercial vendor fueling model. With minor exceptions, both of the models are basically the same.

To give the City of Denver a fueling alternative economic prediction I applied the same principal of the historical models to the period of January 1993 to December 1997 (5 years). This analysis demonstrates the cost and flexibility of both fueling strategies available to the City of Denver.

Historical examples of 1989 to 1992 for city owned fueling and commercial vendor fueling are shown in January 1989 dollars. The historical example for city owned fueling does not include inflation since the dollars evaluated are already inflated. The five year forecasts (1993-

1997) for city owned fueling and commercial vendor fueling are shown in January 1993 dollars.

4.1 Mathematics of Spreadsheet

While developing this algorithm, I had the option of writing a unique code utilizing a programming language that might be difficult for the city staff to update. Instead, for reasons of utility I wrote an algorithm using a basic spreadsheet. This spreadsheet could then be updated, as circumstances change, by a non-programmer with a strong mathematical or statistical analysis background. Since Denver is a licensed user of the Excel 3.0 spreadsheet (21), I chose it for this method. See Appendix E for instructions on using the Fueling Strategies spreadsheet.

Probability Analysis is calculated using the Monte Carlo simulation technique. *Probability theory* allows us to measure the uncertainty of the occurrence of events that we are considering. The impact of these events and their calculations involve the probability that an underground fuel storage tank will leak before December 1998. In December 1998 new regulations for USTs take affect and all UST's must comply to these strict standards.

To run either of the Fueling Strategy models, some variables are used to generate the calculations needed to determine the *Cash Flow* and *Net Present Values*. Listed are the input variables and mathematical equations of the Fueling Strategy model spreadsheets. Variables are

taken from historical records or estimations based on actual use. Both cases are evaluated equally using the discounted cash flow analysis.

Input Variables

Fuel Usage: Input the anticipated fuel usage per year by the Police Department (2).

example: ***950,000*** gallons per year (4.1)

Cost per Gallon: Input the anticipated cost per gallon of unleaded gasoline with all additional charges in decimal form.

example: ***0.8000*** dollars per gallon (4.2)

ROR General Investment Pool: Input the desired rate of return on the General Investment Pool owned and managed by the City of Denver (4).

example: ***0.0700*** Annual Percentage Rate (APR) (4.3)

Inflation Rate: Input the anticipated inflation rate for the City of Denver.

example: ***0.0350*** Annual Percentage Rate (APR) (4.4)

Multiforce Computer Cost: Input the annual police department share (33%)[F] for access to the Multiforce computer (5).

[F] There exists an agreement between the Department of Safety and Department of Public Works that the Department of Safety will pay one-third of fuel related expenses. This is because the Department of Safety consumes one-third of the fuel purchased by the City of Denver.

example: ***40,000.00*** dollars per year (4.5)

Upgrade of Multiforce Computer and Fueling System: Input the annual police department share (33%) for upgrades to the Multiforce computer and Fueling System.

example: ***100,000.00*** dollars per year (4.6)

UST Maintenance: Input cost per year to maintain a single UST (7). Police share is 33%.

example: ***167.67*** dollars per year*tank. (4.7)

UST Probability of Leaking: Input probability (between 0 and 1) that a tank will become a leaker in any given year (8).

example: ***0.025*** probability of leaking in any given year (4.8)

UST Expected Cost of Leaker: Input the police departments share (33%) of the expected cost of cleaning up a single leaking underground fuel storage tank (5).

	Category	Probability of Leak	Clean-up Costs
1.	Leak, confined to owners property	0.85	$ 35,000.00
2.	Leak, migrates from owners property, no lawsuit	0.10	$ 190,000.00

3.	Leak, migrates from owners property, lawsuit ensues	0.05	$2,700,000.00

Total Expected Clean-up Costs:

0.85 * 35,000.00 =	29,750.00
0.10 * 190,000.00 =	19,000.00
0.05 * 2,700,000.00 =	135,000.00
	$ 183,750.00

example: ***61,250.00*** dollars per leaking tank (4.9)

Number of USTs: Input the number of unleaded gasoline USTs owned by the City of Denver (13).

example: ***27*** underground storage tanks (4.10)

UST Upgrades: Input the police departments share (33%) of annual costs for upgrades of the unleaded gasoline underground storage tanks (5).

example: ***40,000*** dollars per year (4.11)

Cost to Download from Total Petroleum: Input the annual cost to download sales data from Total Petroleum (18).

example: ***600.00*** dollars per year (4.12)

Totals Software for Download: Input the one time charge for the software program to automate and link the Multiforce computer database with Total Petroleums database of fuel transactions (18).

example: ***4,000.00*** dollars (4.13)

Calculations

Gallons Consumed

$$Eq.4.14 = \frac{(eq.4.1)(\#\,years)}{(\#\,months)}$$

$$Eq.4.14 = \frac{(950,000\,\frac{gallons}{year})(5\,years)}{(60\,months)} = 79,167\,\frac{gallons}{month} \tag{4.14}$$

Cost per Gallon

$$Eq.4.15 = (eq.4.2)$$

$$Eq.4.15 = (0.8000\,\frac{\$}{gallon}) = 0.8000\,\frac{\$}{gallon} \tag{4.15}$$

Net Fuel Expense

$$Eq.4.16 = (eq.4.14)(eq.4.15)$$

$$Eq.4.16 = (79,167\,\frac{gallons}{month})(0.8000\,\frac{\$}{gallon}) = 63,333.33\,\frac{\$}{month} \tag{4.16}$$

Multiforce Computer Costs

$$Eq.4.17 = \frac{(eq.4.5)(\#\,years)}{(\#\,months)}$$

$$Eq.4.17 = \frac{(40{,}000\,\frac{\$}{year})(5\,years)}{(60\,months)} = 3{,}333.33\,\frac{\$}{month} \qquad (4.17)$$

UST-Maintenance

$$Eq.4.18 = \frac{(eq.4.7)(eq.4.10)(\#\,years)}{(\#\,months)}$$

$$Eq.4.18 = \frac{(167.67\,\frac{\$}{tank*year})(27\,tanks)(5\,years)}{(60\,months)} = 377.26\,\frac{\$}{month} \qquad (4.18)$$

UST-Probability Cost of Leaking

$$Eq.4.19 = \frac{(eq.4.9)(eq.4.10)(eq.4.8)(\#\,years)}{(\#\,months)}$$

$$Eq.4.19 = \frac{(61{,}250.00\,\frac{\$}{tank})(27\,tanks)(0.025\%)(5\,years)}{(60\,months)} = 3{,}445.31\,\frac{\$}{month} \qquad (4.19)$$

UST-Upgrades

$$Eq.4.20 = \frac{(eq.4.11)(eq.4.10)(\#\,years)}{(\#\,months)}$$

$$Eq.4.20 = \frac{(4,000.00\,\frac{\$}{tank*year})(27\,\text{tanks})(5\,\text{years})}{(60\,\text{months})} = 9,000.00\,\frac{\$}{month} \qquad (4.20)$$

Holding Cost of Fuel

$$Eq.4.21 = \left[\frac{(eq.4.1)-(eq.4.1)(\frac{1}{2})}{2}\right]\left[\frac{(eq.4.3)}{12}\right]\left[\frac{(eq.4.2)(\#\,years)}{(\#\,months)}\right]$$

$$Eq.4.21 = \left[\frac{(950,000)-(950,000)(\frac{1}{2})}{(2)}\right]\left[\frac{0.0700}{12}\right]\left[\frac{(0.80)(5)}{(60)}\right]$$

$$Eq.4.21 = 92.36\,\frac{\$}{month} \qquad (4.21)$$

Download from Total Petroleum

$$Eq.4.22 = \frac{(eq.4.12)(\#\,years)}{(60\,months)}$$

$$Eq.4.22 = \frac{(600\,\frac{\$}{year})(5\,years)}{(60\,months)} = 50.00\,\frac{\$}{month}$$

(4.22)

Total's Software for Download

$$Eq.4.23 = (eq.4.13)$$

$$Eq.4.24 = (\$4,000.00)$$

(4.23)

Upgrade of Multiforce Computer and Fueling System

$$Eq.4.24 = \frac{(eq.4.6)(\#\,years)}{(\#\,months)}$$

$$Eq.4.24 = \frac{(100,000.00\,\frac{\$}{year})(5\,years)}{(60\,months)} = 8,333.33\,\frac{\$}{month}$$

(4.24)

City Owned Cash Flow

$$Eq.4.25 = (eq.4.16) + (eq.4.17) + (eq.4.18) + (eq.4.19) + (eq.4.20) + (eq.4.21) + (eq.4.24)$$

$$Eq.4.25 = (63,333.33\,\frac{\$}{month}) + (3,333.33\,\frac{\$}{month}) + (377.26\,\frac{\$}{month}) + (3,445.31\,\frac{\$}{month}) + (9,000.00\,\frac{\$}{month}) + (92.36\,\frac{\$}{month}) + (8,333.33\,\frac{\$}{month})$$

$$Eq.4.25 = 87,914.93\,\frac{\$}{month}$$

(4.25)

City Owned Net Present Value

$$Eq.4.26 = \left[\left(\frac{(1+i)}{(1+f)}\right)-1\right] \quad \text{escalated and inflated dollars}$$

$$\text{Eq.}4.26 = \left(\frac{1}{(1+\text{i})^{n}}\right) \quad \text{substitute for i}$$

$$\text{Eq.}4.26 = \left[\left(\frac{(1+(1+\text{i}))^{-1}}{(1+f)-1}\right)^{n}\right]$$

$$Eq.4.26 = \left[\left(\frac{(1+(1+\frac{i}{12}))^{-1}}{(1+\frac{f}{12})-1}\right)^{(n-1)}\right]$$

$$Eq.4.26 = (eq.4.25)\left[\left(\frac{(1+(1+\frac{(eq.4.3)}{12}))^{-1}}{(1+\frac{(eq.4.4)}{12})-1}\right)^{(n-1)}\right] \qquad (4.26)$$

Commercial Vendor Cash Flow

$$Eq.4.27 = (eq.4.16)+(eq.4.17)+(eq.4.22)+(eq.4.23)$$

$$Eq.4.27 = (64,085.42\,\tfrac{\$}{month})+(3,333.33\,\tfrac{\$}{month})+(50.00\,\tfrac{\$}{month})+$$

$$+(4,000.00\$)$$

$$Eq.4.27 = 71,468.75\,\tfrac{\$}{month}$$

(4.27)

Commercial Vendor Net Present Value

$$Eq.4.26 = \left[\left(\frac{(1+i)}{(1+f)}\right)-1\right] \quad \text{escalated and inflated dollars}$$

$$\text{Eq.}4.26 = \left(\frac{1}{(1+\text{i})^{n}}\right) \quad \text{substitute for i}$$

$$\text{Eq.}4.26 = \left[\left(\frac{(1+(1+\text{i}))^{-1}}{(1+f)-1}\right)^{n}\right]$$

$$Eq.4.26 = \left[\left(\frac{(1+(1+\frac{i}{12}))^{-1}}{(1+\frac{f}{12})-1}\right)^{(n-1)}\right]$$

$$Eq.4.26 = (eq.4.25)\left[\left(\frac{(1+(1+\frac{(eq.4.3)}{12}))^{-1}}{(1+\frac{(eq.4.4)}{12})-1}\right)^{(n-1)}\right]$$

(4.28)

4.2 Previous Years: 1989 to 1992

To demonstrate the Fueling Strategy Model and its abilities, I ran the spreadsheets with the current city owned fueling method and the commercial vendor strategy. The results of the four year historical analysis are listed.

	Net Present Value (Jan. '89 $)
City Owned Fueling	$ 3,041,277.31

Commercial Vendor Fueling	$ 2,510,350.49

The Commercial Vendor Fueling strategy demonstrates that for the 1989 to 1992 analysis period it is the better economic alternative. The savings of the commercial vendor is $ 530,926.82, this is represented in January 1989 dollars.

Economic Analysis of City Owned Fueling

The Net Present Value, in January 1989 dollars, for city owned fueling is $ 3,041,277.31. See Appendix A for the calculations.

Economic Analysis of Commercial Vendor Fueling

The Net Present Value, in January 1989 dollars, for commercial vendor fueling is $ 2,510,350.49. See Appendix B for the calculations.

4.3 Five Year Forecast: 1993 to 1997

Based on the models ability to mirror historical data I have used it to calculate a five year forecast. The results of the five year forecast are listed.

	Net Present Value (Jan.'93 $)
City Owned Fueling	$ 4,847,951.69
Commercial Vendor Fueling	$ 3,724,474.29

The results of the five year economic forecast for 1993 to 1997 is that Commercial Vendor Fueling is a better economic alternative. The savings of the commercial vendor is $ 1,123,477.40, this is reflected in January 1993 dollars.

Economic Analysis of City Owned Fueling

For the years 1993 to 1997 the city owned fueling net present value, in January 1993 dollars, is $ 4,847,951.69. See Appendix C for the calculations.

Economic Analysis of Commercial Vendor Fueling

For the years 1993 to 1997 the commercial vendor fueling net present value, in January 1993 dollars, is $ 3,724,474.29. See Appendix D for the calculations.

4.4 Sensitivity Analysis of Five Year Forecast

To account for the uncertainty of the variables and risks, I have used sensitivity analysis to demonstrate which variables will have the greatest impact on the Net Present Value. Sensitivity calculations were done by varying the value of individual variables in either a positive or negative direction. Only one variable was changed at a time with all others held at the base case value. Values were changed to show relative changes that could occur with sensitivity analysis. Changes are rounded off values of approximately one standard deviation. Calculations are for

the five year forecast for both alternatives and are listed in January 1993 dollars. To save printed space a computer disk is enclosed so the reader can duplicate these analyses. Requirements for the computer disk are the same as that for the City of Denver, which are a personal computer (either a Macintosh with Hyperdrive, or IBM compatible) with Excel 3.0 (21). The base case is marked with an asterisk.

Fuel Usage (4.1)

gallons	City NPV	Commercial NPV
900,000	4,663,871.41	3,538,479.29
950,000*	4,847,951.69	3,724,474.29
1,000,000	5,032,031.97	3,910,469.28

Cost per Gallon (4.2)

$/gallon	City NPV	Commercial NPV
0.75/0.7595	4,629,356.35	3,506,197.23
0.80*/0.8095*	4,847,951.69	3,724,474.29
0.85/0.8595	5,066,547.03	3,942,751.30

ROR General Investment Pool (4.3)

% ROR	City NPV	Commercial NPV
0.05	5,084,244.84	3,906,984.79
0.07*	4,847,951.69	3,724,474.29
0.09	4,624,805.75	3,553,694.28

Inflation Rate (4.4)

%Inflation	City NPV	Commercial NPV
0.015	4,624,432.08	3,552,938.14
0.035 *	4,847,951.69	3,724,474.29
0.055	5,086,077.34	3,907,219.58

Multiforce Computer Cost (4.5)

$/year	City NPV	Commercial NPV
30,000	4,801,998.63	3,678,521.23
40,000*	4,847,951.69	3,724,474.29
50,000	4,893,904.75	3,770,427.34

Upgrade of Multiforce Computer (4.6)

$/year	City NPV	Commercial NPV
50,000	4,618,186.41	n/a
100,000*	4,847,951.69	n/a
150,000	5,077,716.97	n/a

UST Maintenance (4.7)

$/tank	City NPV	Commercial NPV
67.67	4,835,544.36	n/a
167.67*	4,847,951.69	n/a
267.67	4,860,359.01	n/a

UST Probability of Leaking (4.8)

% Probability	City NPV	Commercial NPV
0.005	4,695,961.96	n/a
0.025*	4,847,951.69	n/a
0.045	4,999,941.42	n/a

UST Expected Cost of Leaker (4.9)

$/tank	City NPV	Commercial NPV
31,250	4,754,896.75	n/a
61,250*	4,847,951.69	n/a
91,250	4,941,006.63	n/a

Number of USTs (4.10)

tanks	City NPV	Commercial NPV
22	4,717,010.29	n/a
27*	4,847,951.69	n/a
32	4,978,893.08	n/a

UST Upgrades (4.11)

$/tank	City NPV	Commercial NPV
6,000	4,599,805.19	n/a
12,000*	4,847,951.69	n/a
18,000	5,096,098.19	n/a

Cost to Download from Total Petroleum (4.12)

$/year	City NPV	Commercial NPV
200	n/a	3,722,636.16
600*	n/a	3,724,474.29
1,000	n/a	3,726,312.41

Totals Software for Download (4.13)

$	City NPV	Commercial NPV
0	n/a	3,720,474.29
4,000 *	n/a	3,724,474.29
8,000	n/a	3,729,474.29

The sensitivity analysis of both fueling systems demonstrate that only five variables change the NPV by more than 0.05%. This was done by comparing the ratios of change. These variables are the Cost of Fuel, ROR of the General Investment, Inflation, Cost to Upgrade Multiforce and Fuel System, and UST Upgrades. Listed are the percent changes to the variables.

Variable		City % Change	Commercial % Change
4.1	Fuel Usage	± 0.04	± 0.05
4.2	Cost per Gallon	± 0.04	± 0.06
4.3	ROR General Invest.	± 0.05	± 0.05

4.4	Inflation Rate	± 0.05	± 0.05
4.5	Multiforce Computer	± 0.01	± 0.01
4.6	Upgrade to Multiforce	± 0.05	n/a
4.7	UST-Maintenance	± 0.01	n/a
4.8	UST-Prob. of Leak	± 0.03	n/a
4.9	UST-Expected Value	± 0.01	n/a
4.10	Number of USTs	± 0.03	n/a
4.11	UST-Upgrades	± 0.005	n/a
4.12	Cost to Download	n/a	± 0.0005
4.13	Totals Software	n/a	± 0.001

Of significance to the City of Denver is the cost of unleaded gasoline. The price of fuel has fluctuated wildly in the last few years; however, both alternatives would be affected equally in % change of the dollar amount of the NPV if the price went up or down.

Chapter 5
Related Areas to Fueling Method Alternatives

While conducting the research for the Economic Evaluation of Alternative Fueling Methods for the City of Denver I was asked to examine related areas as part of my thesis (6). These included the impact of Fueling Alternatives, problems with the Underground Storage Tanks, and the Police Maintenance Facility.

5.1 Impact of Fueling Alternatives

Costs

Either fueling alternative is feasible since the fuel is delivered to the Department of Safety in a reasonable manner, but the lower cost makes the commercial vendor fueling method more attractive. The cost of fuel is approximately the same for either system currently being considered. The Department of Public Works sold the fuel for approximately $0.0095 per gallon cheaper than the commercial vendor in the years 1988 to 1992. The significant factors favoring the commercial vendor over the city owned fueling system are the costs associated with the upgrade and maintenance of underground fuel storage tanks.

Accuracy and Security

Accuracy of information is of concern, especially when one considers that the Department of Safety consumes 1 million gallons of

fuel per year. Security and accountability of records and fuel ultimately is the responsibility of those charged with managing the hardware and software. Both fueling systems have safeguards to prevent unauthorized use or tampering with records. In either alternative, the finance officer in the Department of Safety must ensure records balance and reflect actual fuel use. The only difference between the two systems is with a commercial vendor fueling there is a paper trail beginning with the purchase receipt signed by the officer.

Controlling Own Fuel Supply

Maintaining control of the city's fuel supply isn't a major issue. Should the Department of Safety decide to use commercial vendor fueling, safeguards should be written into the negotiated contract to ensure an uninterrupted supply of fuel. The Department of Public Works can only provide a few days of fuel in the event of an emergency. When their fuel supply is exhausted they must go back to a commercial vendor for more fuel. The probability of an emergency occurring of the magnitude that the city would be required to depend on stored fuel is statistically insignificant.

Officer Productivity

The officers' productivity is slightly increased using the alternative of the commercial vendor. In Denver Police Districts I, IV, and V the officers will spend more time on patrol since the commercial vendor is

more convenient than the city owned fueling locations. Denver Police districts II and III have no change since there is a fueling station at the district headquarters or close by the precincts. This allows the officer to stay closer to their precinct and spend less time getting fuel. A benefit to the city, but difficult to capture statistically, is the officers' random presence in a commercial vendors facility which historically is a criminal's target.

Mileage Savings

Given the current method of vehicle utilization of the Patrol Division and the job requirements of the officers, there is no measurable mileage savings. Vehicles in the patrol division are virtually operating twenty-four hours per day. Mileage savings would be seen in all other divisions merely from the aspect of fueling convenience.

5.2 Underground Fuel Storage Tanks

At this time there are few greater concerns of the Environmental Protection Agency than leaking Underground Storage Tanks. The reason for the increased attention of the USTs is that so many people and organizations are now affected by them. Insurance companies are at the point that they will not insure a piece of property with a UST on it. When an insurance company will insure a tank it is because the latest safeguards are used and have been verified (7). This prospect has affected many UST owners that do not meet the strict regulations of the

EPA. Causes are the high cost of compliance and the legal cost for non-compliance. Denver is self insured so the risks to the city must be weighed.

The national average is that approximately one to five percent of all USTs leak. The issue of leaking USTs is currently being addressed by the Federal and State EPA with local EPA authorities. Since the City of Denver is self insured, it is in the city's best interest to quickly resolve the UST problem. The **conservative estimate** for the cost to clean up a leaking UST is approximately $ 183,750.00 for each tank (1). If the leaking fuel gets into ground water or under a building the cost could approach 2.7 million dollars[G] .

In spite of new and improved government regulations the City of Denver is years away from full compliance. The tightness testing standard (automated leak detection) will be in effect in December of 1993. By December 1998 all USTs in the United States must be in compliance with the new tank standards (9). The tank standards approved at the Federal and State level are of several different designs. The materials are fiberglass or cathodically protected steel. Also being considered is the use of secondary containment as an additional barrier around the primary storage tank. This would prevent the rapid loss of fuel into the ground.

[G] See equation 4.9 for a detailed explanation of the dollar figure.

5.3 Dept. of Public Works and the Multiforce Computer

A major issue exists between the Department of Public Works and the Multiforce system with the two fueling alternatives. Several key people in the Department of Public Works have been uncooperative in every aspect of examining this project. As an unbiased observer, and in my opinion, I perceived the following items to be major internal problems to the Department of Public Works: lack of cooperation, lack of candor in addressing issues, and internal politics. To overcome these internal problems I was forced to work around the Department of Public Works by working with the Multiforce Corporation, city employees, and other municipalities currently using the Multiforce System[H] .

Developing Multiforce Reports for Administrative Purposes

The Chief of the Staff Services Division and the Fleet Maintenance Manager have desired reports that address specific information (6). To date the Department of Public Works has taken two years to address this issue (10,11).

The Multiforce Corporation's system is a thorough and effective software and hardware combination for the management of fleet operations. It can do much to assist the user in keeping a record of their work. The problem, I believe, is that the Department of Public Works

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[H] As of 12 August 1992 there are 30 Municipalities using the Multiforce System. I contacted four of the users for their comments.

does not know how to effectively use the Multiforce software. When Public Works was faced with developing trivial reports for the Department of Safety they referred the matter to the Multiforce programmers. The minimum cost to generate these reports desired by Police Fleet Maintenance Facility is **$14,000.00**. This is the cost for Multiforce Corporation to use the report writer system already included in the city's software package. For any additional changes or new reports there will be an equally high cost (12).

Multiforce User Training

The Multiforce Corporation system is currently in use at 30 municipalities and companies in the United States. A common comment is that the system is difficult to use unless the operator is trained in the operation of Multiforce. The Police Maintenance Facility personnel are the prime users of the Multiforce system in the Department of Safety. They are proficient but are encumbered since they lack the proper training and operator manuals for the software and hardware.

I recommend that the Department of Safety invest in a training course for these personnel. Once the primary users are trained, I recommend that Bill Hughes, Police Maintenance Facility Manager, and Peg Howard, Police Maintenance Facility Systems Operator, are further trained as system administrators. After this training, the Department of Public Works must allow the Department of Safety unrestricted access to the computer system. The charge for training in Denver is approximately

$4,000.00 per week for a class. Allan Yeast of Multiforce Corporation may be contacted at (609) 683-4242 for specific details.

Remodel Existing City Fueling Sites

Remodeling existing sites to accommodate police vehicles varies in cost. Charges are based on modifications of existing facilities and unique requirements of the Police. Key factors involved are sunk costs with existing renovations, totaling approximately $400,000.00 in the last four years, and additional costs to modify and replace existing tanks to come into minimal EPA compliance by December 1998 (9).

5.4 Police Maintenance Facility

I was impressed with the men and women at the Police Maintenance Facility. Their dedication and attention to detail set them apart from the other maintenance workers in the city. Bill Hughes does a fine job of managing the heavy workload at the Police Maintenance Facility.

Police Fleet Maintenance

The impact on fleet maintenance for either fueling system is negligible. Both systems require the Multiforce computer software for accountability of maintenance and fuel costs. The only difference is the

city owned fueling allows for instantaneous updating of data provided by the officer at the fuel transaction time; the commercial vendors' program allows for daily updates. Based on the current operating system and methods used to generate reports maintenance will not be affected.

Police Maintenance Facility

What I found at the maintenance facility was a three week backlog of police cars even though every mechanic was working each of the nine times I visited the facility. The report by CPTs Paulo, Lauritzen, Grandinetti, and Hulsebosch provided to the Department of Safety in September 1991, set a baseline for my research at the police maintenance facility (10). I observed vast improvement from what was identified as problems in their report. Some of the problems I found at the maintenance facility and the districts were the degenerate condition of the patrol cars. My experience in riding and talking with the police officers indicates the cars are not intentionally abused, rather they are worked hard. Though not witnessed, I am certain a very small percentage of the cities cars that are damaged may be abused through irresponsibility or neglect. Local taxi and delivery fleets experience many of the same problems as the police fleet. The constant operation in city traffic and the requirement to work with a backlog at the maintenance facility consequently causes the preventive maintenance program and repairs to suffer.

I have six recommendations to relieve maintenance problems for the police fleet.

1. Authorize overtime pay for the mechanics. This authorization should occur whenever there is a five day backlog of vehicles. The authorization should come from SGT Singleton or LT Webb. To minimize overtime, incentives should be used for the mechanics.

2. Place some maintenance requirements on the officers. Create a method or voucher system for the officers to get emissions testing and oil changes with commercial vendors. These alone would be at a break-even cost to the city.

3. Institute a commensurate penalty for vehicle abuse and negligence of the operator depending on the severity of the damage. Punishment should be quick, fair, and public.

4. Assign vehicles to the minimum number of operators. The same people from each shift operate the same vehicle daily. This will assist in determining who abuses vehicles and, hopefully, peer pressure will make any offending officer clean up their act.

5. Ensure that the purchase order for new police cars specify the police duty package.

6. Commanders and Staff Supervisors need to be involved with the maintenance program. Their presence and involvement with vehicles will accentuate the importance of maintenance to their subordinates.

Chapter 6

Conclusions and Suggestions for Improvement

6.1 Conclusions

I wanted to provide the City of Denver with a tool that would be easy to use but that would be useful and effective. The Fueling Strategy spreadsheet allows the user to change variables as needed to determine the total Net Present Value. The Net Present Value emphasizes the importance of the time value of money, and as used in the models places both fueling alternatives on an equal footing for an economic and statistical evaluation.

The commercial vendor fueling system offers the best economic advantage when compared to the city owned fueling system. Some of the advantages are the officers remain in their districts, response time to emergencies is faster, and it's cheaper. The five year forecast from January1993 to December 1997 shows a capital savings of $1,123,477.40 reflected in January 1993 dollars. For a fueling alternative analysis applicable to other city agencies this method used for the Denver Police Department can also be applied to those city agencies.

Additionally, the requirements placed by the Environmental Protection Agency on the use of Underground Fuel Storage Tanks is a cost that is increasing at a rate greater than that of inflation. This places the City of Denver in the position to prorate the entire cost of owning and upgrading the UST's over a fleet of less than three thousand vehicles.

6.2 Suggestions for Improvement

This model has application for other areas in the city. The method can be applied to any area where an evaluation is desired of two or more events. An example would be the evaluation of the Harley Davidson police motorcycle versus the Kawasaki police motorcycle. Each alternative can be compared on a common basis for a realistic comparison. The spreadsheet as it is written would have to be changed to account for the different scenario and variables.

The difficulty with using a model like this or one produced by the City of Denver, is keeping it updated. This will require the spreadsheets user to know the workings of the system and have a strong background in Statistics and Mathematics to make any algorithm changes.

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Appendix A

Results of the Economic Analysis of City Owned Fueling from January 1989 to December 1992 show the Net Present Value to be $3,041,277.31.

Economic Analysis of City Owned Fueling: January 1989 to December 1992

	1	2	3	4	5	6
Month	January '89	February '89	March '89	April '89	May '89	June '89
Fuel Expenses						
Gallons Consumed	70,246	70,246	70,246	70,246	70,246	70,246
Cost per Gallon	$0.7072	$0.7072	$0.7072	$0.7072	$0.7072	$0.7072
Net Fuel Expense	$49,678.05	$49,678.05	$49,678.05	$49,678.05	$49,678.05	$49,678.05
Miscellaneous Expenses						
Multiforce Computer	$864.29	$864.29	$864.29	$864.29	$864.29	$864.29
Upgrade of Multiforce/Fuel System	$10,479.51	$10,479.51	$10,479.51	$10,479.51	$10,479.51	$10,479.51
UST-Maintenance	$450.00	$450.00	$450.00	$450.00	$450.00	$450.00
UST-Probability Cost of Leaking	$1,687.50	$1,687.50	$1,687.50	$1,687.50	$1,687.50	$1,687.50
UST-Upgrades	$2,083.33	$2,083.33	$2,083.33	$2,083.33	$2,083.33	$2,083.33
Holding Cost of Fuel	$89.21	$89.21	$89.21	$89.21	$89.21	$89.21
Net Miscellaneous Expenses						
Cash Flow	$65,331.90	$65,331.90	$65,331.90	$65,331.90	$65,331.90	$65,331.90
Discounted Cash Flow	$65,331.90	$64,865.95	$64,403.31	$63,943.98	$63,487.93	$63,035.13

Net Present Value
$3,041,277.31

Input Variables	**Units**	**Input 1989**	**Input 1990**	**Input 1991**	**Input 1992**
Fuel Usage	gallons/year	842,953	871,689	932,528	950,000
Cost per Gallon	$/gallon	$0.7072	$0.8134	$0.7688	$0.7244
Multiforce Computer Cost	$/year	$10,371.47	$19,650.97	$21,428.76	$37,110.60
ROR General Investment Pool	APR	0.0862	0.0806	0.0651	0.0501
Upgrade of Multiforce/Fuel System	$/year	$125,754.11	$216,241.40	$11,512.00	$30,000.00
UST-Maintenance	$/tank	$200.00	$210.00	$220.00	$230.00
UST-Upgrades	$/year	$25,000.00	$30,000.00	$35,000.00	$40,000.00
UST-Probability of Leaking	percentage	0.0250	0.0250	0.0250	0.0250
UST Expected Cost of Leaking Tank	$/tank	$90,000.00	$100,000.00	$110,000.00	$120,000.00
Number of City Owned UST's	integer	27	27	27	27

City Owned Fueling 1989 to 1992

7	8	9	10	11	12	13	14	15
July '89	August '89	September '89	October '89	November '89	December '89	January '90	February '90	March '90
70,246	70,246	70,246	70,246	70,246	70,246	72,641	72,641	72,641
$0.7072	$0.7072	$0.7072	$0.7072	$0.7072	$0.7072	$0.8134	$0.8134	$0.8134
$49,678.05	$49,678.05	$49,678.05	$49,678.05	$49,678.05	$49,678.05	$59,085.97	$59,085.97	$59,085.97
$864.29	$864.29	$864.29	$864.29	$864.29	$864.29	$1,637.58	$1,637.58	$1,637.58
$10,479.51	$10,479.51	$10,479.51	$10,479.51	$10,479.51	$10,479.51	$18,020.12	$18,020.12	$18,020.12
$450.00	$450.00	$450.00	$450.00	$450.00	$450.00	$472.50	$472.50	$472.50
$1,687.50	$1,687.50	$1,687.50	$1,687.50	$1,687.50	$1,687.50	$1,875.00	$1,875.00	$1,875.00
$2,083.33	$2,083.33	$2,083.33	$2,083.33	$2,083.33	$2,083.33	$2,500.00	$2,500.00	$2,500.00
$89.21	$89.21	$89.21	$89.21	$89.21	$89.21	$99.22	$99.22	$99.22
$65,331.90	$65,331.90	$65,331.90	$65,331.90	$65,331.90	$65,331.90	$83,690.39	$83,690.39	$83,690.39
$62,585.55	$62,139.19	$61,696.00	$61,255.98	$60,819.10	$60,385.33	$77,230.43	$76,715.16	$76,203.33

City Owned Fueling 1989 to 1992

16	17	18	19	20	21	22	23	24
April '90	May '90	June '90	July '90	August '90	September '90	October '90	November '90	December '90
72,641	72,641	72,641	72,641	72,641	72,641	72,641	72,641	72,641
$0.8134	$0.8134	$0.8134	$0.8134	$0.8134	$0.8134	$0.8134	$0.8134	$0.8134
$59,085.97	$59,085.97	$59,085.97	$59,085.97	$59,085.97	$59,085.97	$59,085.97	$59,085.97	$59,085.97
$1,637.58	$1,637.58	$1,637.58	$1,637.58	$1,637.58	$1,637.58	$1,637.58	$1,637.58	$1,637.58
$18,020.12	$18,020.12	$18,020.12	$18,020.12	$18,020.12	$18,020.12	$18,020.12	$18,020.12	$18,020.12
$472.50	$472.50	$472.50	$472.50	$472.50	$472.50	$472.50	$472.50	$472.50
$1,875.00	$1,875.00	$1,875.00	$1,875.00	$1,875.00	$1,875.00	$1,875.00	$1,875.00	$1,875.00
$2,500.00	$2,500.00	$2,500.00	$2,500.00	$2,500.00	$2,500.00	$2,500.00	$2,500.00	$2,500.00
$99.22	$99.22	$99.22	$99.22	$99.22	$99.22	$99.22	$99.22	$99.22
$83,690.39	$83,690.39	$83,690.39	$83,690.39	$83,690.39	$83,690.39	$83,690.39	$83,690.39	$83,690.39
$75,694.91	$75,189.89	$74,688.23	$74,189.92	$73,694.94	$73,203.26	$72,714.85	$72,229.71	$71,747.80

City Owned Fueling 1989 to 1992

25	26	27	28	29	30	31	32	33
January '91	February '91	March '91	April '91	May '91	June '91	July '91	August '91	September '91
77,711	77,711	77,711	77,711	77,711	77,711	77,711	77,711	77,711
$0.7688	$0.7688	$0.7688	$0.7688	$0.7688	$0.7688	$0.7688	$0.7688	$0.7688
$59,743.95	$59,743.95	$59,743.95	$59,743.95	$59,743.95	$59,743.95	$59,743.95	$59,743.95	$59,743.95
$1,785.73	$1,785.73	$1,785.73	$1,785.73	$1,785.73	$1,785.73	$1,785.73	$1,785.73	$1,785.73
$959.33	$959.33	$959.33	$959.33	$959.33	$959.33	$959.33	$959.33	$959.33
$495.00	$495.00	$495.00	$495.00	$495.00	$495.00	$495.00	$495.00	$495.00
$2,062.50	$2,062.50	$2,062.50	$2,062.50	$2,062.50	$2,062.50	$2,062.50	$2,062.50	$2,062.50
$2,916.67	$2,916.67	$2,916.67	$2,916.67	$2,916.67	$2,916.67	$2,916.67	$2,916.67	$2,916.67
$81.03	$81.03	$81.03	$81.03	$81.03	$81.03	$81.03	$81.03	$81.03
$68,044.21	$68,044.21	$68,044.21	$68,044.21	$68,044.21	$68,044.21	$68,044.21	$68,044.21	$68,044.21
$59,758.38	$59,435.94	$59,115.24	$58,796.27	$58,479.02	$58,163.49	$57,849.65	$57,537.51	$57,227.05

City Owned Fueling 1989 to 1992

34	35	36	37	38	39	40	41	42
October '91	November '91	December '91	January '92	February '92	March '92	April '92	May '92	June '92
77,711	77,711	77,711	79,167	79,167	79,167	79,167	79,167	79,167
$0.7688	$0.7688	$0.7688	$0.7244	$0.7244	$0.7244	$0.7244	$0.7244	$0.7244
$59,743.95	$59,743.95	$59,743.95	$57,348.33	$57,348.33	$57,348.33	$57,348.33	$57,348.33	$57,348.33
$1,785.73	$1,785.73	$1,785.73	$3,092.55	$3,092.55	$3,092.55	$3,092.55	$3,092.55	$3,092.55
$959.33	$959.33	$959.33	$2,500.00	$2,500.00	$2,500.00	$2,500.00	$2,500.00	$2,500.00
$495.00	$495.00	$495.00	$517.50	$517.50	$517.50	$517.50	$517.50	$517.50
$2,062.50	$2,062.50	$2,062.50	$2,250.00	$2,250.00	$2,250.00	$2,250.00	$2,250.00	$2,250.00
$2,916.67	$2,916.67	$2,916.67	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33
$81.03	$81.03	$81.03	$59.86	$59.86	$59.86	$59.86	$59.86	$59.86
$68,044.21	$68,044.21	$68,044.21	$69,101.57	$69,101.57	$69,101.57	$69,101.57	$69,101.57	$69,101.57
$56,918.27	$56,611.16	$56,305.70	$59,477.04	$59,229.76	$58,983.50	$58,738.27	$58,494.06	$58,250.86

City Owned Fueling 1989 to 1992

43	44	45	46	47	48
July '92	August '92	September '92	October '92	November '92	December '92
79,167	79,167	79,167	79,167	79,167	79,167
$0.7244	$0.7244	$0.7244	$0.7244	$0.7244	$0.7244
$57,348.33	$57,348.33	$57,348.33	$57,348.33	$57,348.33	$57,348.33
$3,092.55	$3,092.55	$3,092.55	$3,092.55	$3,092.55	$3,092.55
$2,500.00	$2,500.00	$2,500.00	$2,500.00	$2,500.00	$2,500.00
$517.50	$517.50	$517.50	$517.50	$517.50	$517.50
$2,250.00	$2,250.00	$2,250.00	$2,250.00	$2,250.00	$2,250.00
$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33
$59.86	$59.86	$59.86	$59.86	$59.86	$59.86
$69,101.57	$69,101.57	$69,101.57	$69,101.57	$69,101.57	$69,101.57
$58,008.67	$57,767.49	$57,527.32	$57,288.14	$57,049.96	$56,812.76

City Owned Fueling 1989 to 1992

Appendix B

Results of the Economic Analysis of Commercial Vendor Fueling from January 1989 to December 1992 show the Net Present Value to be $2,510,350.49.

Economic Analysis of Commercial Vendor Fueling: January 1989 to December 1992

	1	2	3	4	5	6
Month	January '89	February '89	March '89	April '89	May '89	June '89
Fuel Expenses						
Gallons Consumed	70,246	70,246	70,246	70,246	70,246	70,246
Cost per Gallon	$0.7081	$0.7081	$0.7081	$0.7081	$0.7081	$0.7081
Net Fuel Expense	$49,741.28	$49,741.28	$49,741.28	$49,741.28	$49,741.28	$49,741.28
Miscellaneous Expenses						
Multiforce Computer	$864.29	$864.29	$864.29	$864.29	$864.29	$864.29
Download from Total Petroleum	$41.67	$41.67	$41.67	$41.67	$41.67	$41.67
Total's Software for Download	$4,000.00					
Net Miscellaneous Expenses						
Cash Flow	$54,647.23	$50,647.23	$50,647.23	$50,647.23	$50,647.23	$50,647.23
Discounted Cash Flow	$54,647.23	$50,286.01	$49,927.36	$49,571.28	$49,217.73	$48,866.70

Net Present Value
$2,510,350.49

Input Variables	Units	Input 1989	Input 1990	Input 1991	Input 1992
Fuel Usage	gallons/year	842,953	871,689	932,528	950,000
Cost per Gallon	$/gallon	$0.7081	$0.8388	$0.7490	$0.7600
Multiforce Computer Cost	$/year	$10,371.47	$19,650.97	$21,428.76	$37,110.60
ROR General Investment Pool	APR	0.0862	0.0806	0.0651	0.0501
Cost to Download from Total Pet.	$/year	$500.00	$525.00	$550.00	$575.00
Total's Software for Download	$	$4,000.00	$0.00	$0.00	$0.00

7	8	9	10	11	12	13	14	15
July '89	August '89	September '89	October '89	November '89	December '89	January '90	February '90	March '90
70,246	70,246	70,246	70,246	70,246	70,246	72,641	72,641	72,641
$0.7081	$0.7081	$0.7081	$0.7081	$0.7081	$0.7081	$0.8388	$0.8388	$0.8388
$49,741.28	$49,741.28	$49,741.28	$49,741.28	$49,741.28	$49,741.28	$60,931.05	$60,931.05	$60,931.05
$864.29	$864.29	$864.29	$864.29	$864.29	$864.29	$1,637.58	$1,637.58	$1,637.58
$41.67	$41.67	$41.67	$41.67	$41.67	$41.67	$43.75	$43.75	$43.75
$50,647.23	$50,647.23	$50,647.23	$50,647.23	$50,647.23	$50,647.23	$62,612.38	$62,612.38	$62,612.38
$48,518.18	$48,172.15	$47,828.58	$47,487.46	$47,148.77	$46,812.50	$57,779.41	$57,393.91	$57,010.99

Commercial Vendor Fueling 1989 to 1992

16	17	18	19	20	21	22	23	24
April '90	May '90	June '90	July '90	August '90	September '90	October '90	November '90	December '90
72,641	72,641	72,641	72,641	72,641	72,641	72,641	72,641	72,641
$0.8388	$0.8388	$0.8388	$0.8388	$0.8388	$0.8388	$0.8388	$0.8388	$0.8388
$60,931.05	$60,931.05	$60,931.05	$60,931.05	$60,931.05	$60,931.05	$60,931.05	$60,931.05	$60,931.05
$1,637.58	$1,637.58	$1,637.58	$1,637.58	$1,637.58	$1,637.58	$1,637.58	$1,637.58	$1,637.58
$43.75	$43.75	$43.75	$43.75	$43.75	$43.75	$43.75	$43.75	$43.75
$62,612.38	$62,612.38	$62,612.38	$62,612.38	$62,612.38	$62,612.38	$62,612.38	$62,612.38	$62,612.38
$56,630.62	$56,252.79	$55,877.48	$55,504.67	$55,134.35	$54,766.50	$54,401.11	$54,038.15	$53,677.62

Commercial Vendor Fueling 1989 to 1992

25	26	27	28	29	30	31	32	33
January '91	February '91	March '91	April '91	May '91	June '91	July '91	August '91	September '91
77,711	77,711	77,711	77,711	77,711	77,711	77,711	77,711	77,711
$0.7490	$0.7490	$0.7490	$0.7490	$0.7490	$0.7490	$0.7490	$0.7490	$0.7490
$58,205.28	$58,205.28	$58,205.28	$58,205.28	$58,205.28	$58,205.28	$58,205.28	$58,205.28	$58,205.28
$1,785.73	$1,785.73	$1,785.73	$1,785.73	$1,785.73	$1,785.73	$1,785.73	$1,785.73	$1,785.73
$45.83	$45.83	$45.83	$45.83	$45.83	$45.83	$45.83	$45.83	$45.83
$60,036.84	$60,036.84	$60,036.84	$60,036.84	$60,036.84	$60,036.84	$60,036.84	$60,036.84	$60,036.84
$52,726.08	$52,441.59	$52,158.63	$51,877.19	$51,597.28	$51,318.87	$51,041.97	$50,766.56	$50,492.64

Commercial Vendor Fueling 1989 to 1992

34	35	36	37	38	39	40	41	42
October '91	November '91	December '91	January '92	February '92	March '92	April '92	May '92	June '92
77,711	77,711	77,711	79,167	79,167	79,167	79,167	79,167	79,167
$0.7490	$0.7490	$0.7490	$0.7600	$0.7600	$0.7600	$0.7600	$0.7600	$0.7600
$58,205.28	$58,205.28	$58,205.28	$60,166.67	$60,166.67	$60,166.67	$60,166.67	$60,166.67	$60,166.67
$1,785.73	$1,785.73	$1,785.73	$3,092.55	$3,092.55	$3,092.55	$3,092.55	$3,092.55	$3,092.55
$45.83	$45.83	$45.83	$47.92	$47.92	$47.92	$47.92	$47.92	$47.92
$60,036.84	$60,036.84	$60,036.84	$63,307.13	$63,307.13	$63,307.13	$63,307.13	$63,307.13	$63,307.13
$50,220.19	$49,949.22	$49,679.71	$54,489.66	$54,263.11	$54,037.50	$53,812.83	$53,589.10	$53,366.29

Commercial Vendor Fueling 1989 to 1992

43	44	45	46	47	48
July '92	August '92	September '92	October '92	November '92	December '92
79,167	79,167	79,167	79,167	79,167	79,167
$0.7600	$0.7600	$0.7600	$0.7600	$0.7600	$0.7600
$60,166.67	$60,166.67	$60,166.67	$60,166.67	$60,166.67	$60,166.67
$3,092.55	$3,092.55	$3,092.55	$3,092.55	$3,092.55	$3,092.55
$47.92	$47.92	$47.92	$47.92	$47.92	$47.92
$63,307.13	$63,307.13	$63,307.13	$63,307.13	$63,307.13	$63,307.13
$53,144.42	$52,923.46	$52,703.42	$52,484.30	$52,266.09	$52,048.79

Commercial Vendor Fueling 1989 to 1992

Appendix C

Results of the Economic Analysis of City Owned Fueling from January 1993 to December 1997 show the Net Present Value to be $ 4,847,951.69.

Economic Analysis of City Owned Fueling: January 1993 to December 1997

	1	2	3	4	5	6
Month	January '93	February '93	March '93	April '93	May '93	June '93
Fuel Expenses						
Gallons Consumed	79,167	79,167	79,167	79,167	79,167	79,167
Cost per Gallon	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000
Net Fuel Expense	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33
Miscellaneous Expenses						
Multiforce Computer	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33
Upgrade of Multiforce/Fuel System	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33
UST-Maintenance	$377.26	$377.26	$377.26	$377.26	$377.26	$377.26
UST-Probability Cost of Leaking	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31
UST-Upgrades	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00
Holding Cost of Fuel	$92.36	$92.36	$92.36	$92.36	$92.36	$92.36
Net Miscellaneous Expenses						
Cash Flow	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93
Discounted Cash Flow	$87,914.93	$87,660.00	$87,405.81	$87,152.35	$86,899.63	$86,647.64

Net Present Value
$4,847,951.69

Input Variables	Units	Input Values
Fuel Usage	gallons/year	950,000
Cost per Gallon	$/gallon	$0.8000
Multiforce Computer Cost	$/year	$40,000.00
ROR General Investment Pool	APR	0.0700
Inflation Rate	APR	0.0350
Upgrade of Multiforce/Fuel System	$/year	$100,000.00
UST-Maintenance	$/tank	$167.67
UST-Upgrades	$/year	$12,000.00
UST-Probability of Leaking	percentage	0.0250
UST Expected Cost of Leaking Tank	$/tank	$61,250.00
Number of City Owned UST's	integer	27

7	8	9	10	11	12	13	14	15
July '93	August '93	September '93	October '93	November '93	December '93	January '94	February '94	March '94
79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167
$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000
$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33
$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33
$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33
$377.26	$377.26	$377.26	$377.26	$377.26	$377.26	$377.26	$377.26	$377.26
$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31
$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00
$92.36	$92.36	$92.36	$92.36	$92.36	$92.36	$92.36	$92.36	$92.36
$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93
$86,396.39	$86,145.86	$85,896.06	$85,646.98	$85,398.63	$85,150.99	$84,904.07	$84,657.87	$84,412.39

City Owned Fueling 1993 to 1997

16	17	18	19	20	21	22	23	24
April '94	May '94	June '94	July '94	August '94	September '94	October '94	November '94	December '94
79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167
$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000
$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33
$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33
$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33
$377.26	$377.26	$377.26	$377.26	$377.26	$377.26	$377.26	$377.26	$377.26
$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31
$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00
$92.36	$92.36	$92.36	$92.36	$92.36	$92.36	$92.36	$92.36	$92.36
$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93
$84,167.61	$83,923.55	$83,680.19	$83,437.54	$83,195.59	$82,954.34	$82,713.80	$82,473.95	$82,234.79

City Owned Fueling 1993 to 1997

25	26	27	28	29	30	31	32	33
January '95	February '95	March '95	April '95	May '95	June '95	July '95	August '95	September '95
79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167
$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000
$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33
$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33
$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33
$377.26	$377.26	$377.26	$377.26	$377.26	$377.26	$377.26	$377.26	$377.26
$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31
$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00
$92.36	$92.36	$92.36	$92.36	$92.36	$92.36	$92.36	$92.36	$92.36
$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93
$81,996.33	$81,758.56	$81,521.48	$81,285.09	$81,049.39	$80,814.36	$80,580.02	$80,346.36	$80,113.37

34	35	36	37	38	39	40	41	42
October '95	November '95	December '95	January '96	February '97	March '97	April '97	May '97	June '97
79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167
$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000
$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33
$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33
$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33
$377.26	$377.26	$377.26	$377.26	$377.26	$377.26	$377.26	$377.26	$377.26
$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31
$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00
$92.36	$92.36	$92.36	$92.36	$92.36	$92.36	$92.36	$92.36	$92.36
$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93
$79,881.07	$79,649.43	$79,418.47	$79,188.17	$78,958.55	$78,729.59	$78,501.29	$78,273.66	$78,046.68

City Owned Fueling 1993 to 1997

43	44	45	46	47	48	49	50	51
July '97	August '97	September '97	October '97	November '97	December '97	January '98	February '98	March '98
79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167
$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000
$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33
$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33
$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33
$377.26	$377.26	$377.26	$377.26	$377.26	$377.26	$377.26	$377.26	$377.26
$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31
$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00
$92.36	$92.36	$92.36	$92.36	$92.36	$92.36	$92.36	$92.36	$92.36
$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93
$77,820.37	$77,594.71	$77,369.70	$77,145.35	$76,921.65	$76,698.59	$76,476.19	$76,254.42	$76,033.30

City Owned Fueling 1993 to 1997

52	53	54	55	56	57	58	59	60
April '98	May '98	June '98	July '98	August '98	September '98	October '98	November '98	December '98
79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167
$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000	$0.8000
$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33	$63,333.33
$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33
$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33	$8,333.33
$377.26	$377.26	$377.26	$377.26	$377.26	$377.26	$377.26	$377.26	$377.26
$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31	$3,445.31
$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00	$9,000.00
$92.36	$92.36	$92.36	$92.36	$92.36	$92.36	$92.36	$92.36	$92.36
$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93	$87,914.93
$75,812.83	$75,592.99	$75,373.79	$75,155.22	$74,937.29	$74,719.99	$74,503.32	$74,287.28	$74,071.87

City Owned Fueling 1993 to 1997

Appendix D

Results of the Economic Analysis of Commercial Vendor Fueling from January 1993 to December 1997 show the Net Present Value to be $3,724,474.29.

Economic Analysis of Commercial Vendor Fueling: January 1993 to December 1997

	1	2	3	4	5	6
Month	January '93	February '93	March '93	April '93	May '93	June '93
Fuel Expenses						
Gallons Consumed	79,167	79,167	79,167	79,167	79,167	79,167
Cost per Gallon	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095
Net Fuel Expense	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42
Miscellaneous Expenses						
Multiforce Computer	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33
Download from Total Petroleum	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00
Totals Software for Download	$4,000.00					
Cash Flow						
Cash Flow	$71,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75
Discounted Cash Flow	$71,468.75	$67,273.11	$67,078.03	$66,883.52	$66,689.58	$66,496.19

Net Present Value
$3,724,474.29

Input Variables	Units	Input Values
Fuel Usage	gallons/year	950,000
Cost per Gallon	$/gallon	$0.8095
Multiforce Computer Cost	$/year	$40,000.00
ROR General Investment Pool	APR	0.0700
Inflation Rate	APR	0.0350
Download from Total Petroleum	$/year	$600.00
Totals Software for Download	$	$4,000.00

7	8	9	10	11	12	13	14	15
July '93	August '93	September '93	October'93	November '93	December '93	January '94	February '94	March '94
79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167
$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095
$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42
$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33
$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00
$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75
$66,303.37	$66,111.11	$65,919.40	$65,728.25	$65,537.66	$65,347.61	$65,158.12	$64,969.18	$64,780.79

Commercial Vendor Fueling 1993 to 1997

16	17	18	19	20	21	22	23	24
April '94	May '94	June '94	July '94	August '94	September '94	October '94	November '94	December '94
79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167
$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095
$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42
$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33
$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00
$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75
$64,592.94	$64,405.63	$64,218.87	$64,032.65	$63,846.98	$63,661.84	$63,477.23	$63,293.16	$63,109.63

Commercial Vendor Fueling 1993 to 1997

25	26	27	28	29	30	31	32	33
January '95	February '95	March '95	April '95	May '95	June '95	July '95	August '95	September '95
79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167
$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095
$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42
$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33
$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00
$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75
$62,926.63	$62,744.16	$62,562.21	$62,380.80	$62,199.91	$62,019.54	$61,839.70	$61,660.38	$61,481.58

34	35	36	37	38	39	40	41	42
October '95	November '95	December '95	January '96	February '97	March '97	April '97	May '97	June '97
79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167
$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095
$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42
$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33
$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00
$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75
$61,303.30	$61,125.54	$60,948.29	$60,771.55	$60,595.33	$60,419.62	$60,244.42	$60,069.73	$59,895.54

Commercial Vendor Fueling 1993 to 1997

43	44	45	46	47	48	49	50	51
July '97	August '97	September '97	October '97	November '97	December '97	January '98	February '98	March '98
79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167
$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095
$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42
$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33
$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00
$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75
$59,721.86	$59,548.68	$59,376.00	$59,203.83	$59,032.15	$58,860.97	$58,690.29	$58,520.10	$58,350.41

Commercial Vendor Fueling 1993 to 1997

52	53	54	55	56	57	58	59	60
April '98	May '98	June '98	July '98	August '98	September '98	October '98	November '98	December '98
79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167	79,167
$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095	$0.8095
$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42	$64,085.42
$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33	$3,333.33
$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00
$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75	$67,468.75
$58,181.21	$58,012.49	$57,844.27	$57,676.54	$57,509.29	$57,342.53	$57,176.25	$57,010.45	$56,845.14

Commercial Vendor Fueling 1993 to 1997