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The case involves a forklift cost comparison study for a company that operates public warehouses. The comparison involves propane, electric, and diesel forklifts. It can be used in an introductory or advanced cost/managerial accounting course. The objectives of the case are to have students apply net present value analysis in a multi-period cost study, determine the relevancy of various costs, and address issues dealing with validity of cost data. The case involves both numerical calculation and critical thinking. Spreadsheet software should be recommended for the net present value analysis.

"It's time we find out what it's costing us for the different types of forklifts we're using. Our three new warehouses will be up and running soon and we've got to buy forklifts for them. We need to decide on which is most cost effective."

Murray Gottlieb, Vice-President of Operations

INTRODUCTION

Vistavia Warehousing, Inc., operates 28 public warehouses in 16 cities throughout the midwestern and southeastern United States. The warehouses range from 11,200 to 36,000 square feet and service a wide variety of clients such as auto parts distributors, carpet mill suppliers, producers of paper goods, and wholesalers of agricultural products. Those warehouses storing food products must be kept at cooler temperatures than the others. Cleanliness is also a greater concern for the food warehouses. Clients are charged fees based on the services provided, such as unloading, loading, storage, repackaging, and inventory record-keeping. The fees are quite competitive with those charged by other warehouses in all but two of the 16 cities – Chattanooga and Little Rock. Vistavia's warehouses in these two cities are much larger than the competition, and have superior quality and location, so that significantly higher fees are obtained for Vistavia.

BACKGROUND

Vistavia Warehousing began in 1982 as a single warehouse in Atlanta, Georgia, storing tires for various manufacturers that supplied auto plants and tire service centers. During the next two decades, the company built seven more warehouses and purchased 20 others including their existing

equipment such as forklifts and pallets. Additionally, three new warehouses in New Orleans, Miami, and Houston are currently under construction and will be completed shortly.

Pre-tax earnings grew from $100,000 in the company's first full year of operations to $21,500,000 in 2002. From an original five employees, Vistavia has expanded to employ 755 workers by 2002. About 75 percent are blue-collar workers, virtually all of whom have a high school education. Still a privately-held corporation, Vistavia's owners plan to slow down the company growth during the next few years due to the current and expected economic conditions.

Forklifts

A major cost to Vistavia Warehousing is that of owning and operating forklifts. Three different types — propane, electric, and diesel — are being used throughout the company. Each warehouse, however, uses just one type in its operations. Some of each kind had been purchased by Vistavia, but most were obtained as part of the warehouse purchases. On average, the forklifts were being replaced after about eight years' use. Replacement and new acquisition decisions were made centrally by Murray Gottlieb, Vice-President of Operations, based on requests and justifications from warehouse managers. Currently, the overall average age of the company's forklifts is 3.25 years. As would be expected, the newer forklifts were in better shape and more efficient than the older ones.

Vistavia's forklifts are used both indoors and outdoors. Items are frequently transported between the warehouses and trucks, sometimes across hilly or unpaved outdoor areas. Accidents are more likely to happen in these places. Indoor accidents, notably crashes, also occur once in a while. When operating diesel forklifts indoors, windows or doors must usually be open due to the air pollution caused. Although propane forklifts tend to be rather noisy and its fuel has a strong odor and is potentially explosive, no special restrictions apply when the propane forklifts are operated indoors. The air pollution caused by diesels and the smells caused by the propanes make these two types of forklifts unsuitable for operation in food warehouses. Both diesel and propane forklifts are often stored outdoors overnight, but in very cold weather it is sometimes difficult to start the diesels. The electric forklifts need to remain indoors, as they are charged for about eight hours after each eight hours of usage. They then need to "cool off" for an eight-hour period before being used again. The charging generally takes place during off-peak hours, so the electricity cost incurred is not as great as it otherwise could be.

In early 2003, Gottlieb requested a meeting with the Controller, Russell Baker, to discuss how to compare costs for the different types of forklifts. Over the years, Baker had supplied him with bits and pieces of information about some forklift costs such as net purchase price or fuel cost, but he now wanted an overall cost comparison. He began his meeting with Baker by stating:

> *For too long I've been relying on the desires and beliefs of individual warehouse managers. I can't understand why some managers believe the propane forklifts are least costly, while others insist that electric is the way to go -- or diesel. I'd like to know total costs for all three so I can come up with some consistent policy. At least for now, I'd like to make the right decision on supplying our three new warehouses.*

With this introduction, he asked Baker to do a study that would compare the costs of owning and operating the three different types of forklifts. Gottlieb knew that he would soon need to

purchase 11 new forklifts for the three new warehouses (four each in Miami and Houston and three in New Orleans). None of these were food warehouses, so all three types of forklifts were feasible.

Gottlieb suggested that Baker use cost data from all forklifts owned by Vistavia. Although there was some variation on forklift sizes and weight ratings, the vast majority of Vistavia's forklifts had weight ratings between 4,000 and 5,000 pounds.

Data Gathering

Baker began by gathering cost data on all 38 electric, 28 propane, and 17 diesel forklifts owned by Vistavia Warehousing (see Exhibit 1). Some costs were collected over a three year-period (2000 to 2002), while others were collected for only one or two of those years. Some of the costs experienced a fair amount of variation during this time period, and it was felt that, for some items, the most recent year (2002) might not serve as the best indicator for future costs.

Exhibit 1
Number of Forklifts

	Electric	Propane	Diesel
Atlanta (5 warehouses)	7	3	6
Birmingham		2	
Chattanooga			4
Charlotte (2 warehouses)	3	2	
Cincinnati (2 warehouses)	5		
Indianapolis	4		
Jacksonville		3	
Kansas City			3
Little Rock			4
Louisville (2 warehouses)	6		
Memphis (3 warehouses)	3	6	
Nashville	2		
Omaha		3	
Richmond		4	
St. Louis (3 warehouses)	8		
Tampa (2 warehouses)	5	5	5
Totals	*38*	*28*	*17*

To compare costs on an equal basis, Baker made the presumption that each forklift is used 40 hours per week for 52 weeks per year. Costs per forklift were collected for the following categories of costs:

Initial cost — purchase price of a new forklift; includes sales tax, but excludes any special attachments.
Freight — cost for incoming forklifts purchased; amount is based on distance shipped and weight (all three forklift types have similar weights).

Residual value — estimate of what could be received today for a forklift that is eight years old.
Labor for forklift operators — wages (and fringe benefits) paid to forklift operators.
Forklift batteries — purchase price of a forklift battery for an electric forklift.
Maintenance-forklift batteries — cost of time spent on maintenance of electric forklift battery.
Battery charger — purchase price of a battery charger (one per electric forklift is needed).
Construction of recharging area — cost of constructing recharging area for an electric forklift (e.g., wiring costs)
Opportunity cost of recharging area — loss of earnings from alternative use of space.
Energy — cost of recharging a battery, diesel fuel cost, or propane used to operate the forklift. (The propane is purchased in canisters, so that no construction costs need be incurred, unlike for diesel or electric forklifts.)
Fuel tank — cost of constructing a fuel tank to store diesel fuel.
Cranes, hoists, etc. — purchase cost of equipment used to change batteries for the electric forklifts.
Extra ventilation — cost of installing equipment for extra ventilation necessitated by the forklift.
Replacement of tires — cost of replacing tires on the forklift.
Replacement of batteries — cost of replacing the battery for a propane or diesel forklift.
Maintenance-parts — cost of parts (filters, oil, etc.) related to preventive maintenance.
Maintenance-labor — cost of labor related to preventive maintenance.
Repair-parts — cost of parts (hoses, starters, etc.) related to the repair of the forklift.
Repair-labor — cost of labor related to the repair of the forklift (e.g., hydraulic leaks).
Insurance — cost allocation from company's overall umbrella policy, based on proportions of revenues earned by warehouses.

After visiting several warehouses and corresponding by phone, fax, and email to managers of the remaining ones, Baker obtained average life cycle costs per forklift as shown in Exhibit 2. The average cost calculations pertaining to those costs which are fixed are shown in Exhibit 3. He did not believe that income tax expenses would significantly impact the cost comparisons, so he did not adjust these costs for any income tax effects.

As Baker began to look more closely at the costs, he was especially puzzled by the large difference in operating labor costs among forklifts. He felt that neither time of operation nor skill level of operators should differ very much. After contacting a few warehouse managers again, he found out that wage rates varied by warehouse location because of local cost of living conditions. Additionally, there was some variation in energy costs from city to city. Neither the turnover rates for forklift operators nor the amount of training seemed to differ much by warehouse location.

As Baker sat down at his personal computer to begin the cost analysis, he decided it would be reasonable to use a 15 percent rate to discount future cash flows. He also wondered about inflation and decided to project an inflation rate of 4 percent per year for all items.

CASE QUESTIONS

1. Discuss how fleet size may have affected the cost data.
2. In addition to the assumptions made in the case, what others might be necessary to meaningfully compare the cost data?
3. For each of the three types of forklifts, conduct a net present value analysis to determine the costs of owning and operating the 11 new forklifts planned to be purchased. Comment on

Exhibit 2
Average Costs During Life of Forklift

	Electric	Propane	Diesel
Initial cost	$21,451	$19,779	$18,965
Freight	650	500	570
Residual value	4,179	1,597	1,688
Labor for forklift operator (annual)	27,860	25,920	24,035
Electric forklift battery (every 4 years)	2,915		
Maintenance-forklift battery (annual)	121		
Battery charger	1,708		
Construction of recharging area	324		
Opportunity cost of recharging area (annual)	488		
Energy (annual)	847	2,444	1,786
Diesel fuel tank			1,550
Cranes, hoists, etc.	210		
Extra ventilation	72	195	306
Replacement of tires (every 2 years)	768	655	994
Replacement of batteries (every 2 years)		68	133
Maintenance-parts (annual)	181	397	443
Maintenance-labor (annual)	309	417	454
Repair-parts (annual)	1,156	1,912	1,023
Repair-labor (annual)	613	1,066	779
Insurance (annual allocation)*	60	65	72

Note: Costs are for each occurrence (e.g., every 2 years it costs $768 to replace tires on an electric forklift). Also, these are costs per forklift (e.g., the $1,550 diesel fuel tank cost is an allocation of a total construction cost to one forklift).

* These allocations are from the company's overall umbrella policy, based on proportions of revenues earned by warehouses.

the implications of using the life cycle of the forklift as the time horizon rather than a more long-term perspective.

4. Aside from quantifiable cost considerations, what other considerations should be made when comparing the three types of forklifts?
5. Explain how the relevance of some costs would be affected if the decision were to replace existing forklifts with the same type or add to a current fleet with the same type of forklift at current warehouses instead of purchasing forklifts for new warehouses.

TEACHING NOTES

Teaching notes are available from the editor. Send a request from the "For Contributors" page of the journal website, http://gpae.bryant.edu.

Exhibit 3
Average Fixed Costs Per Forklift

Electric	Atlanta	Charlotte	Cincinnati	Indianapolis	Louisville	Memphis	Nashville	St. Louis	Average Cost
Construction of recharging area	$1,500	$1,100	$1,500	$1,300	$1,600	$1,000	$1,100	$1,900	$1,375
Construction per forklift	$214	$367	$300	$325	$267	$333	$550	$238	$324
Opp. cost of recharging area (annual)	$2,350	$1,600	$2,200	$1,900	$2,400	$1,600	$1,700	$2,700	$2,056
Opp. cost per forklift	$336	$533	$440	$475	$400	$533	$850	$338	$488
Cranes, hoists, etc.	$900	$750	$800	$750	$1,000	$800	$800	$950	$844
Cranes, hoists, etc. per forklift	$129	$250	$160	$188	$167	$267	$400	$119	$210
Extra ventilation	$300	$300	$300	$300	$300	$250	$250	$300	$288
Extra ventilation per forklift	$43	$100	$60	$75	$50	$83	$125	$38	$72

Propane	Atlanta	Birmingham	Charlotte	Jacksonville	Memphis	Omaha	Richmond	Tampa	Average Cost
Extra ventilation	$600	$600	$550	$550	$600	$650	$650	$600	$600
Extra ventilation per forklift	$200	$300	$275	$183	$100	$217	$163	$120	$195

Diesel	Atlanta	Chattanooga	Kansas City	Little Rock	Average Cost
Diesel fuel tank	$6,550	$6,100	$6,100	$6,200	$6,238
Diesel fuel tank per forklift	$1,092	$1,525	$2,033	$1,550	$1,550
Extra ventilation	$1,300	$1,100	$1,300	$1,200	$1,225
Extra ventilation per forklift	$217	$275	$433	$300	$306