CASES IN COST MANAGEMENT:

A Strategic Emphasis

JOHN K. SHANK

SOUTH-WESTERN

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The Amos Tuck School of Business
Dartmouth College

SOUTH-WESTERN College Publishing

An International Thomson Publishing Company

Sponsoring Editor: Elizabeth A. Bowers
Production Editor: Peggy A. Williams
Cover Designer: Paul Neff Design
Marketing Manager: Sharon C. Oblinger

ISBN: 0-538-86045-6

4 5 6 7 8 9 BN 3 2 1 0 9 8 7 6 5

Printed in the United States of America

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International Thomson Publishing
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Preface

This set of cases is offered for those instructors who want to augment their managerial accounting courses with a few, several, or many richer, longer "fun" problems. To me, each case is really just a tough, fun, managerial accounting "problem" with specific attention to the business context. Each case includes specific numerical questions to challenge and help develop the students' calculational skill with managerial accounting techniques. Each case also includes broader discussion questions to sharpen the controversial aspects of the calculations and emphasize the managerial issues behind the numbers.

Every one of the cases has been used many times in my courses. Many of the cases have also been used at numerous other schools. The versions presented here have been revised and sharpened based on classroom feedback over the years. Each case in this collection stands the test of time as an excellent classroom vehicle. I hope you will find them as fun to teach as I have.

The book also includes three supplementary readings which I have found to be very useful over the years for use with three particular topics as shown in the Table of Contents.

To make it easier to coordinate the cases with textbook materials, I have cross-referenced the cases with seven leading management accounting texts. This cross-reference appears on the inside of the front cover. While there is certainly some subjectivity in choosing which cases go best with each chapter of the various books, this cross-reference is a starting point for the instructor to decide which cases to use with each topic area.

I have also included recommendations on cases which may satisfy instructor needs for different course structures. These recommendations appear in Exhibit A. This book is intended primarily for use with graduate level courses in managerial accounting. Most of the cases can also be used very successfully in undergraduate courses.

This book can also be used as the basis for an advanced MBA level course in Strategic Cost Management. I teach such a course at the Amos Tuck School. For such a course, I would recommend combining cases with the book, Strategic Cost Management (Shank & Govindarajan, 1993). The cross-reference on the inside front cover identifies the cases which coordinate well with various chapters of that book.

Accompanying this book is an instructor's manual which contains comprehensive teaching commentaries for each of the cases. The manual also includes the course outlines for two MBA courses at the Amos Tuck School (Introduction to Managerial Accounting and Strategic Cost Management) which are based on cases drawn from this collection.

I want to thank my secretary, Susan Schwarz, for her countless hours of work with these cases. Each of the cases has gone through many revisions and edits and has been carefully formatted for electronic access. Also, this book is being assembled electronically for direct transfer to film for the printer, so she has also done all the page formatting and art work. For all practical purposes, she should be the lead author at this point.

John K. Shank
June 26, 1995

EXHIBIT A
Suggested Selections from the Collection

1.	4 cases	(a small sampling to add a different dimension to a text and problems course) 4, 5, 7, 22
2.	8 cases	(a bigger sampling, but still just a sampling) 4, 5, 7, 9, 15, 22, 23, 27
3.	10 cases	(1 per week for a trimester term) 2, 4, 5, 7, 9, 14, 15, 22, 23, 27
4.	15 cases	(1 per week for a semester) 2, 4, 5, 7, 9, 14, 15, 19, 22, 23, 26, 27, 28, 30, 32
5.	20 cases	(a 2 meetings per week trimester course) 2, 4, 5, 7, 8, 9, 10, 14, 15, 19, 22, 23, 24, 26, 27, 28, 30, 32, 34, 35
6.	30 cases	(a 2 meetings per week semester course) 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 15, 17, 18, 19, 20, 21, 22, 23, 24, 26, 27, 28, 30, 31, 32, 33, 34, 35

Cases in Cost Management: A Strategic Emphasis

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Ajax Petroleum*

This case is set in a small oil refinery owned by a large integrated oil company. The time is 1980 when the "best thinking" in the industry was that oil prices would be well over $50 a barrel by 1990.

Bill MacGregor was still puzzled as he thought about the financial report lying on his desk (see Exhibit 1). The report summarized the key financial statistics for a capital expenditure project which one of MacGregor's subordinates was recommending. MacGregor was the general manager for Ajax Petroleum's Middletown, Ohio, refinery. Although he was a chemical engineer by training, his policy was to rely on the people reporting to him for recommendations about the technical side of the business. He strongly objected to second-guessing his managers on things for which they were responsible.

John Patterson, general superintendent for the catalytic cracking unit ("cat cracker") was pushing strongly for MacGregor's approval of a proposal to install a solvent-decarbonizing unit (SDU) in the refinery at a cost of roughly $30,000,000. The function of an SDU is to clean and purify residual oil so that it can serve as raw material ("feedstock") for the cat cracker. The cat cracker would then convert this feedstock into gasoline. Exhibit 2 is a schematic to help you visualize what goes on in the refinery. "Residual," or "No. 6," oil is one of the outputs when crude oil is refined. However, it represents, literally, what is left after the desirable end products are extracted from the barrel of crude. As the dregs, "resid" is dirty, smelly, and so viscous that it will not even flow at room temperature. It was considered in Ajax to be more a nuisance than anything else. However, there is an established nationwide market for resid, at a low enough price, with uses ranging from heating apartment buildings to generating electricity to asphalt manufacture for highways.

John Patterson was convinced that converting resid into more gasoline was a great idea, particularly since gasoline prices at the refinery were stable at $39.00/bbl. while resid prices were very volatile, having been as low as $18/bbl. in recent weeks. There was sufficient excess capacity at the cat cracker to process the extra feedstock, and no alternative external source of additional feedstock was available.

MacGregor had been intrigued by Patterson's idea because he was no great fan of No. 6 oil either. Because of wide seasonal swings in demand and supply and a relatively thin market, residual prices were notoriously volatile and unpredictable. MacGregor knew that the current price was about $25/bbl., but it had been as low as $18/bbl. and as high as $35/bbl. in recent months. Patterson had also told MacGregor that many of Ajax's competitors already had SDUs in their refineries and that there was always a waiting list for installation of an SDU, so they must be a good investment. MacGregor wasn't particularly impressed by these arguments, however, because he knew that the major oil companies often differed on strategic issues. Just because Ashland and Marathon were de-emphasizing heavy oil (No. 6) to yield more light oil (gasoline) from the barrel of crude did not

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* This case was prepared by Professor John K. Shank with the cooperation of a major oil company. All data in the case are generally realistic as of April, 1980, but proprietary information has been disguised.

mean Ajax should automatically follow along. In fact, this might make the heavy-oil business a lot better for the remaining suppliers. MacGregor had heard that Exxon, for one, still considered heavy oil to be a viable item in the product line. Also, MacGregor knew that Ajax's marketing department might not agree with de-emphasizing resid, since there were residual oil sales managers in each sales district and many long-standing customer relationships involved, including many electric utilities in the politically sensitive northeast. MacGregor did know, however, that the additional gasoline could easily be sold now in the wholesale market. Long-run prospects for gasoline demand were less certain.

MacGregor had told Patterson that the key in selling the SDU idea would be return on investment. He told Patterson to work with the economic analysis department to pull together the numbers for the SDU proposal. If it was such a good idea, the numbers would show it and MacGregor would then recommend the project to the corporate capital expenditures committee. The corporate "hurdle rate" for new investment proposals was currently 20%, after taxes. Patterson had eagerly accepted this idea, noting that an acquaintance of his at Ashland Oil had called the SDU in his refinery one of the more profitable investments he had seen in 20 years in the business. When MacGregor received the financial summary report, he was puzzled because the numbers for the SDU project just didn't look that good.

When MacGregor showed the report to Patterson, the latter accused the "bean counters" of trying to scuttle the project with "funny numbers." He took exception to two items in the report, the cost of $29.00/bbl. for fuel gas and the cost of $32.30/bbl for residual oil. He said that fuel gas was really free because there wasn't anything else to do with it except use it as fuel. He argued that since the refinery gets it automatically when a barrel of crude is processed and it has no sales value, it should be considered as free. In fact, he said, fuel gas should show a negative cost since it costs money for equipment to flare it off if it isn't used. He should be encouraged to use it up, he said, to save this cost and to save the hassle with EPA about the air pollution when fuel gas is flared. He was even more unhappy with the reported cost of $32.30/bbl. for resid. He said it was absolutely crazy to show resid at a higher cost than crude itself when, in fact, resid is what's left after you take all the desired products out of the crude. Why should resid show a higher value than raw crude when it was dramatically less desirable to customers? Raw crude itself, although dangerous to handle because of static electricity buildup, is a substitute product for resid in nearly all applications. Patterson had said that he had never been much interested in cost calculations because he figured that the accountants were accurate, but if this report was an example of how they think, Ajax was in trouble. MacGregor had agreed that Patterson's points seemed to make sense.

MacGregor had subsequently called in Ben Anderson to discuss Patterson's objections to the cost calculations in Anderson's report. Anderson had assured MacGregor that he had no desire to scuttle Patterson's idea. In fact, he said, the analysis in the report was slanted in favor of the proposal and he had even felt guilty about leaning over backward to make the project look good. The problem with the report, he said, was that fuel gas shows an actual cost of $29.00 per equivalent barrel under Ajax' cost accounting system and that this is the cost approved by DOE for determining gasoline "ceiling" prices. However, he said, actual historical cost was not relevant for the proposed new capital investment. Anderson noted that about one-half of the refinery's current fuel needs were being met by fuel gas and the other half by residual oil. The SDU project would not increase the amount of fuel gas generated at the crude still, but it would consume as fuel some of the fuel gas already being generated. The net result for the refinery as a whole would be to increase the consumption of resid used as fuel by an amount equal to the fuel needs of the SDU. Since resid carries a cost of $32.30/bbl. in the accounting records, fuel cost for the SDU project should be $32.30. Anderson called this the "opportunity-cost" concept, as opposed to actual historical cost.

Regarding the question of what No. 6 costs, Anderson said he sympathized with Patterson but that the $32.30 was a factual number. In fact, he said, the refinery *does* produce a set of products at the crude still, *including* residual oil, and these products *must each* carry a share of the costs incurred in producing them. A barrel of residual oil thus costs whatever a barrel of crude oil costs, plus some share of the operating costs at the crude still. These crude-still operating costs, he said, could be allocated based on value of products produced, volume of products produced, total energy value (BTUs) of products produced, or some other basis. But under any allocation scheme, outputs from the crude still will cost more than crude oil. Anderson concluded by saying that with fuel gas and resid at $32.30, the SDU actually would be even less profitable than as shown in Exhibit 1 and that the project just couldn't be justified on economic grounds. But, since most companies use historical costs rather than opportunity costs in their accounting systems, he (Anderson) could "bend" as far as the analysis in the report, as an accommodation to Patterson. The meeting had ended with MacGregor agreeing that Anderson's points seemed to make sense.

MacGregor's background included very little training in cost accounting. He had always considered this area to be a technical specialty for which general managers could hire the expertise they needed. He was, however, feeling very frustrated about which cost numbers to believe for the solvent decarbonizing project. He also felt a little foolish for agreeing with both Patterson and Anderson when they talked to him.

He asked his plant controller, Fred Morton, to have lunch with him one day to look at Ben Anderson's report and comment on John Patterson's objections to it. Morton said the basic issue was what cost to show for No. 6 oil in the calculations. He said that Anderson was correctly using the cost numbers generated by Ajax' cost accounting system. Resid was considered to be one of the joint set of products produced in the refinery and, accordingly, was assigned a cost of $32.30/bbl. (as compared to middle distillate at $32.90 and gasoline at $34.80). He agreed that the *particular* allocation scheme (weight, volume, heat value, etc.) was essentially arbitrary, but he emphasized that charging a share of refining cost to resid makes it more costly.

He said that one way to show significantly lower cost on resid would be to consider it a "by-product" rather than a "joint product." A by-product has the following characteristics:

1. It is not desired output from the production process, it just happens to be created in the process of making the desired products.
2. It is low in sales value relative to the main products.
3. It is produced in relatively small quantities.

A clear example of the distinction between a by-product and a joint product is pigs feet versus bacon to a hog butcher. Morton went on to say that normal cost accounting procedure shows a zero cost for by-products. They are just sold for whatever the market will bring, and the sales revenue is netted back against the costs which must be assigned to the desired products. For the refinery, this would mean allocating the sum of crude cost plus crude-still operating costs minus resid sales revenue to gasoline and middle distillate (jet fuel, diesel fuel, and home heating oil), with resid showing a zero cost for accounting purposes. He noted that several of the major oil companies follow this approach, although several others use the same approach as Ajax.

Under the by-product approach, resid would be valued in the capital expenditure analysis at whatever you could sell it for if you didn't convert it to cracking stock or use it as refinery fuel. With gasoline selling for $39/bbl., he thought resid would average around $20 over its price cycles. However, he added that the long-run average price of resid would certainly be heavily influenced by regulatory pressures to stop utilities from burning resid and by trends in gasoline consumption.

The average price by 1985 could be as low as $17/bbl. or as high as $25/bbl., even if crude prices didn't change. Morton said this is what Anderson termed the opportunity-cost approach, as opposed to the historical-cost approach. He concluded by saying that this same idea applies to the fuel gas item—the reported cost incurred is $29/bbl. and the opportunity cost will average around $20/bbl. (the revenue forgone by not selling a barrel of resid).

MacGregor went back to Anderson the next day and asked him to refigure the SDU project showing both the joint product costing and by-product costing approaches for resid and both recorded cost and opportunity cost approaches for fuel gas. Anderson said that would be no problem and agreed to get the information to MacGregor by the next day. MacGregor wondered how much impact these accounting questions would have on the profitability of the SDU project. He couldn't imagine that bookkeeping issues would be that important to the overall analysis. He was anxious to see Anderson's revised report.

ASSIGNMENT QUESTIONS

1. Using the same format as in Exhibit 1, recalculate the economic return for the project, using both joint product costing ($32.30) and by-product costing for resid and using DOE costing ($29.00) and opportunity costing for fuel gas. All the basic data will be the same as in Exhibit 1 except for the cost of fuel gas and resid.

2. What do you believe is the best accounting method for fuel gas and residual oil? Why? Which set of accounting numbers produces the most meaningful economic return calculations?

3. Is the proposed solvent decarbonizing unit profitable enough to justify the investment? Can you calculate a break-even value for resid? So what?

4. As MacGregor, would you recommend the SDU project to headquarters? What economic analysis would you present to support your recommendation? What qualitative (versus quantitative) factors influence your decision?

EXHIBIT 1
Memorandum

March 17, 1980

TO: W. MacGregor
FROM: B. Anderson, Economic Analyst
RE: The Solvent Decarbonizing Unit Proposal

Here is the information you requested concerning the economics of the SDU project. I have the backup file if you want to dig deeper.

1.	Investment cost	$30,000,000	(delivered and installed)		
	Less Investment Tax Credit	3,000,000	(10% of cost)		
	Net Investment	$27,000,000			
2.	Annual Operating Costs (three-shift basis)			$3,300,000	(Labor, maintenance, insurance, property taxes, supplies)
				Per barrel of Cracking Stock Produced	
3.	Fuel			$2.90/bbl.	(See Note 1 below)
4.	Feedstock Cost			$32.30/bbl.	(See Note 2 below)
5.	Value of Cracking Stock Produced			$37.50/bbl.	(See Note 3 below)

6. Thruput is 9,000 bbls. per day (assuming an average of 90% utilization of theoretical capacity on a 365-day/year basis). One bbl. of resid will produce one bbl. of cracking stock.
7. Economic life is 20 years. (This is also the depreciable life for tax purposes. The current tax rate is 46%.) Use straight-line depreciation for simplicity and to be conservative.
8. Inflation in costs and prices is ignored. This would tend to offset for a project like this one.

Project Profitability
Payback = 9.10 years
Net Present Value (at 20% after taxes) = negative $12.6 million
Economic Rate of Return = 9%
Profitability Index = .72
Return on Capital Employed = 19.8%

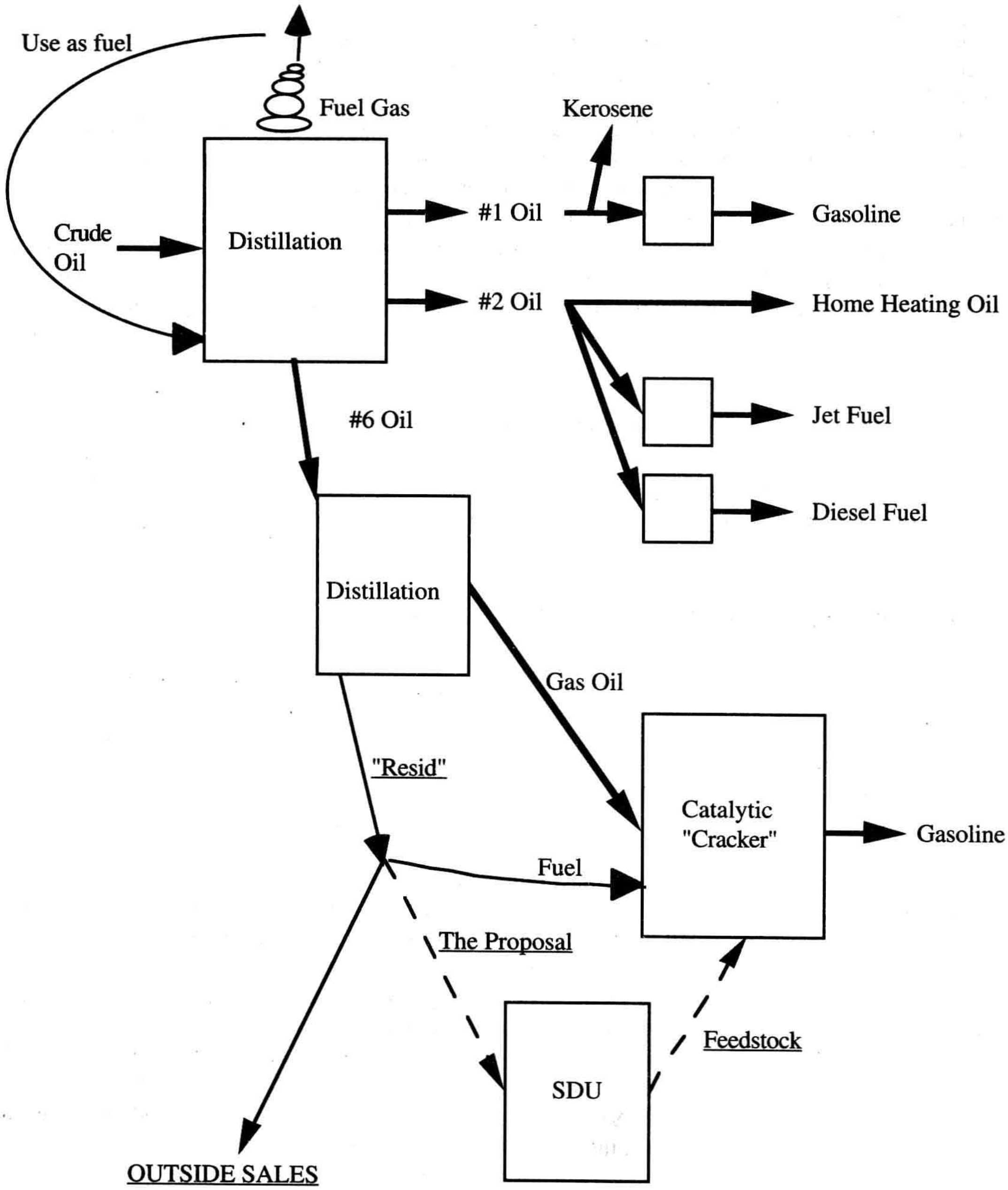
Note 1 The SDU runs on fuel gas,[a] to which Ajax currently assigns a cost of $29.00 per equivalent bbl. It takes .10 bbl. of fuel gas to produce a barrel of thruput at the SDU. Thus, fuel gas costs $2.90 per barrel of thruput.

Note 2 Feedstock for the SDU is No. 6 oil. The cost of No. 6 is computed by assigning crude oil cost and crude-still operating costs to the set of outputs at the crude still, based on relative production volumes for each product. With crude running $29.00 average for the refinery, this equates currently to about $32.30/bbl. for resid.

Note 3 Gasoline is currently selling for about $39/bbl. at the refinery. The cost is about $1.50/bbl. at the cat cracker to convert feedstock into gasoline. Thus, the net realizable value of thruput at the SDU which feed the cat cracker is $37.50/bbl. ($39 minus $1.50).

[a] "Fuel gas" is generated at the crude still in a gaseous state as one of the products when a barrel of crude is "cracked." It is not feasible to convert the fuel gas into a salable end product, but it can be used as fuel to power the various production units in the refinery. The DOE-approved guidelines (for measuring the allowable cost of gasoline for price control purposes) charge fuel gas for a proportionate share of the average cost of crude oil but not for any portion of the operating costs of the crude still. Currently, about 5% of the equivalent volumetric production at the crude still is fuel gas. With crude cost at $30.45 for the incremental barrel and $29.00 on average, Ajax followed the DOE-approved approach and costed fuel gas at $29.00 per equivalent barrel.

EXHIBIT 2
A SCHEMATIC OF THE REFINERY TO HELP YOU VISUALIZE WHAT THE "SDU" DOES
AJAX PETROLEUM



- For generating electricity
- For heating office buildings & apartment buildings
- Low grade industrial fuel
- Manufacture asphalt for highways

APPENDIX
Some Technical Comments (more than you want to know?) About Oil

Petroleum

Petroleum is a complex mixture of organic compounds, mainly hydrocarbons, with smaller quantities of other organic compounds containing nitrogen, oxygen, or sulfur. Petroleum is formed over a period of millions of years by the decomposition of marine plants and animals.

The usual first step in the refining, or processing, of petroleum is separation of the crude oil into fractions on the basis of boiling points. The fractions commonly taken are shown in the table below. The fractions that boil at higher temperatures are made up of molecules with larger numbers of carbon atoms per molecule. The fractions collected in the initial separation may require further processing to yield a usable product. For example, modifications must be made to the straight-run gasoline obtained from fractionation of petroleum to render it suitable for use as a fuel in automobile engines. Similarly, the fuel oil fraction may need additional processing to remove sulfur before it is suitable for use in an electrical power station or a home heating system. At present, the most commercially important single product from petroleum refining is gasoline.

Hydrocarbon Fractions From Petroleum

Fraction	Size Range of Molecules	Boiling-point Range (°C)	Uses
Gas	C_1-C_5	-160 to 30	Gaseous fuel, production of H_2
Straight-run Gasoline	C_5-C_{12}	30 to 200	Motor fuel
Kerosene, Fuel Oil	C_{12}-C_{18}	180 to 400	Diesel fuel, furnace fuel, cracking
Lubricants	C_{16} and up	350 and up	Lubricants
Paraffins	C_{20} and up	Low-melting solids	Candles, matches
Asphalt	C_{36}	Gummy residues	Surfacing roads, fuel

Gasoline

Gasoline is a mixture of volatile hydrocarbons. Depending on the source of the crude oil, it may contain varying amounts of cyclic alkanes and aromatic hydrocarbons in addition to alkanes. Straight-run gasoline consists mainly of straight-chain hydrocarbons, which in general are not very suitable for use as fuel in an automobile engine. In an automobile engine, a mixture of air and gasoline vapor is ignited by the spark plug at the moment when the gas mixture inside the cylinder has been compressed by the piston. The burning of the gasoline should create a strong, smooth expansion of gas in the cylinder, forcing the piston outward and imparting force along the drive shaft of the engine. If the gas burns too rapidly, the piston receives a single hard slam rather than a strong, smooth push. The result is a "knocking" or pinging sound and the efficiency with which the energy of gasoline combustion is converted to power is reduced.

Gasolines are rated according to octane number. Gasolines with high octane numbers burn more slowly and smoothly and thus are more effective fuels, especially in engines in which the gas-air mixture is highly compressed. It happens that the more highly branched alkanes have higher octane numbers than the straight-chain compounds. The octane number of gasoline is obtained by comparing its knocking characteristics with those of "isooctane" (2,2,4-trimethylpentane) and heptane. Isooctane is assigned an octane number of 100, whereas heptane is assigned 0. Gasoline with the same knocking characteristics as a mixture of 95 percent isooctane and 5 percent heptane would be rated as 95-octane.

Because straight-run gasoline contains mostly straight-chain hydrocarbons, it has a low octane number. It is therefore subjected to a process called cracking to convert the straight-chain compounds into more desirable branchedchain molecules. Cracking is also used to convert some of the less volatile kerosene and fuel-oil fractions into compounds with lower molecular weights that are suitable for use as automobile fuel. In the cracking process, the hydrocarbons are mixed with a catalyst and heated to 400-500°C. The catalysts used are naturally occurring clay minerals, or synthetic Al_2O_3-SiO_2 mixtures. In addition to forming molecules more suitable for gasoline, cracking results in the formation of hydrocarbons of lower molecular weight, such as ethylene and propene. These are used in a variety of processes to form plastics and other chemicals.

The octane number of a given blend of hydrocarbons can be improved by adding an antiknock agent, a substance that helps control the burning rate of the gasoline. The most widely used substances for this purpose are tetraethyl lead, $(CH_3CH_2)_4Pb$, and tetramethyl lead, $(CH_3)_4Pb$. The premium gasolines contain 2 or 3 mL of one of these lead compounds per gallon, with a resultant increase of 10 to 15 in octane rating. Although alkyl lead compounds are undoubtedly effective in improving gasoline performance, their use in gasolines has been drastically curtailed because of the environmental hazards associated with lead. This metal is highly toxic, and there is good evidence that the lead released from automobile exhausts is a general health hazard. Although other substances have been tried as antiknock agents in gasolines, none of these has proved to be an effective and inexpensive antiknock agent that is environmentally safe. The 1975 and later model cars are designed to operate with unleaded gasolines. The gasolines blended for these cars are made up of more highly branched components and more aromatic components, because these have relatively high octane ratings.

Allied Stationery Products*

This case is set in the business forms business in 1992 in a company which augments its "commodity" products with value-added distribution and logistics services. The subject is customer profitability analysis using ABC, ABM and SCM.

BACKGROUND

Allied Stationery Products was founded in 1866 in Denver, Colorado as a one-man operation producing note paper and cards for sale in general stores in Denver. By 1992 it had grown to a corporation with annual sales of $900 million.

One division of the company produced specialty paper products, such as writing paper, envelopes, note cards, and greeting cards. Another division manufactured and printed business forms. By 1988, this division was one of the top 6 firms in the U.S. business forms industry.

That year the company expanded into business forms inventory management services. This was an area where Allied believed it could offer value-added management services to differentiate the firm from other business forms manufacturers. The forms manufacturing business was mature by 1988 and all competitors were seeking ways to generate sales growth. Allied embarked on a campaign to enroll its corporate clients in a program which it called "Total Forms Control" (TFC). Allied considered TFC to be a key to future success.

By 1992, sales from TFC were about $60 million and Allied had established a separate company within the business forms division to handle these accounts. The services provided under TFC included warehousing and distribution of forms (including inventory financing) as well as inventory control and forms usage reporting. Allied used a sophisticated computer systems network which enabled them to monitor a client's forms inventory, forms usage, and ordering activities. They provided this information to their clients via comprehensive yet simple to read management reports.

As part of its distribution services, Allied also offered "pick pack" service where trained and experienced workers actually opened full cartons to pick the exact number of forms requested by the clients. Allied's philosophy was that a well run warehousing and distribution network is vital to any forms management program—"we know what you need... the *right* product at the *right* place at the *right* time."

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* This case is adapted by Professor John Shank of the Amos Tuck School, by permission, from earlier versions prepared by Professor Vijay Govindarajan and Jay Weiss (T'93) of the Amos Tuck School, and copyright (1992) by Osceola Institute. This case was made possible with the cooperation of a *Fortune 500* firm. The name of the company and financial data are disguised.