Pollution Prevention and Finance
NATIONAL POLLUTION PREVENTION CENTER FOR HIGHER EDUCATION

For the Instructor: Teaching Note on Crotalus Circuits

This case gives students a chance to analyze a pollution prevention project from several different perspectives. Henry Dean, a lending officer with Rochester National Bank (RNB), must decide whether to approve a request to increase Crotalus Circuits' loan amount by $250,000 to fund the purchase of a new process technology. In analyzing this case, students should seek to answer the following questions:

- How well is Crotalus Circuits doing? Is its recent loss cause for concern?
- Does the proposal to implement non-formaldehyde electroless plating make financial sense?
- What risks are inherent in Crotalus' current process technology? In the proposed change?
- If RNB agrees to the additional loan amount, when can they expect to see repayment?

Several study questions are attached at the end of the case for instructors wishing to use them. Answers to these questions are addressed in this teaching note.

Crotalus Circuits Financial Health

A historical Sources and Uses of Funds Statement is attached as **Exhibit TN-1**. In 1996, Crotalus completed the final phase of a capital expansion project and added significantly to its fixed asset base. Most of this transaction was funded by long-term debt, although working capital flows were also readjusted to provide as much financing as feasible. Sources and uses in earlier years followed a more typical pattern of inflows and outflows. **Exhibit TN-2** provides five years of historical ratios. The firm's liquidity has been improving slowly, although it remains below the industry average. Crotalus' inventory turnover exceeds industry averages, but its average collection period lags slightly behind its peers (66 days vs. 58 days). Debt ratios have improved but remain significantly above industry averages. Coverage ratios are below average but, excepting this past year, have still remained at healthy levels. Profitability is excellent. Except for last year, Crotalus' financial statements show a generally healthy company. Therefore, the key question is this: Is last year an anomaly, or a predictor of things to come?

Investment Analysis

This case can be approached in many ways. A first step might be to compute the proposed investment project's NPV. **Exhibit TN-3** presents information on the financial return of the non-formaldehyde electroless copper technology. Major assumptions include a $250,000 initial outlay, all of which is assumed to be depreciable over a five-year MACRS period[1]; a 33% marginal tax rate; and a 12% hurdle rate. No credit is given for the sale of existing assets or recovery of capital costs at the end of the project's 5-year expected life, making these figures conservative estimates. (The project's continuing value in Year 5 is estimated as a level perpetuity: Year 5 cash flows ÷ discount rate). Annual savings of $23,811 are computed based on the following assumptions:

1) Savings in materials costs =
(.25)($44,790) = $11,198 [Exhibit 6]

2) Savings in water usage =
[(11.6 - 3.74) / 11.6]($6,503) = $4,406 [Exhibit 5]

3) Savings in electricity usage =
[(568.3 - 269.9 / 568.3]($2,757) = $1,448 [Exhibit 5]

4) Savings in permitting costs =
(.25)($13,642) = $3,411 [Exhibit 6]

5) Savings in maintenance costs =
(.25)($13,395) = $3,349 [Exhibit 6]

[1]The 5-year MACRS depreciation percentages are: 20%, 32%, 19.2%, 11.2%, 11.2%, and 5.76%.

May be reproduced freely for non-commercial educational purposes

To the extent production grows, these savings also understate the true benefits of switching to a non-formaldehyde electroless copper process. Crotalus' after-tax cost of debt equals (.10)(1 - .33) = 6.7%. The 12% hurdle rate assumes a total debt / assets ratio of 56% and a 6.7% after-tax cost of debt, implying an equity cost of 18.75 percent [12 = (.56)(6.7) + (.44)(x); x = 18.75]. This figure probably overstates the project's true hurdle rate but, again, errs on the side of conservatism. The technology is relatively new, after all! Factoring in all of these assumptions results in a net present value of -$28,076 and an IRR of 8.53%. On a purely financial basis, with these assumptions, the project just barely misses paying for itself.

Environmental Risks and Benefits

Students may argue for accepting the non-formaldehyde project because of the many non-quantitative benefits not captured in the discounted cash flow methodology. Human health risks are not accurately assessed in current models, for instance. Likewise, the decreased likelihood of a spill engendering Superfund liability also is not included. Factors enticing Dean to approve an additional $250,000 loan to Crotalus Circuits include:

1. Improved environmental reputation
2. Decreased (as yet unquantified) future costs
3. Decreased environmental risk
4. Avoidance of lender liability

EXHIBIT TN-1: CROTALUS CIRCUITS' HISTORICAL SOURCES AND USES OF FUNDS ($ THOUSANDS)

	Dec-96		Dec-95		Dec-94	
ASSETS	**Source**	**Use**	**Source**	**Use**	**Source**	**Use**
Cash & Equivalents	$575	$ 0	$ 0	$263	$ 0	$402
Net Receivables	521	0	0	878	0	224
Inventories	432	0	0	253	0	60
Prepaid Expenses	7	0	9	0	0	11
Other Current Assets	0	471	0	116	0	6
Total Current Assets						
Gross Plant, Property & Equipment	$ 0	$1,081	$ 0	$736	$ 0	$275
- Accumulated Depreciation	106	0	117	0	0	90
Net Plant, Property & Equipment						
Other Assets	$0	$ 234	$ 0	$106	$72	$ 0
Total Assets						
CLAIMS						
Current Portion of Long-term Debt	$ 2	$ 0	$ 1	$ 0	$ 0	$199
Notes Payable	285	0	14	0	0	0
Accounts Payable	0	335	432	0	135	0
Taxes Payable	0	7	114	0	0	64
Accrued Expenses	0	647	633	0	268	0
Other Current Liabilities	0	0	0	205	58	0
Total Current Liabilities						
Long Term Debt	$893	$ 0	$ 0	$ 4	$114	$ 0
Investment Tax Credit	0	0	0	0	0	0
Other Liabilities	0	48	185	0	0	40
Common Stock	0	0	97	0	2	0
Capital Surplus	35	0	40	0	109	0
Retained Earnings	0	33	925	0	614	0
Less: Treasury Stock	0	0	0	6	0	1
Common Equity						
TOTAL SOURCES/USES	**$2,856**	**$2,856**	**$2,567**	**$2,567**	**$1,372**	**$1,372**

Factors discouraging him from loaning the money might be:

1. Over-indebtedness (high debt ratio, poor liquidity)
2. Poor financial planning (Crotalus is growing too fast; even without the new process, it will need approximately $152,000 in additional financing next year— see Exhibit TN-5)
3. Uncertain demand

Students should be pressed to think carefully about how a change in Crotalus' manufacturing technology affects its various stakeholders (i.e., shareholders, community groups, employees, suppliers, financial institutions, etc.). It might be argued, for instance, that RNB should make the loan at a rate less than the 10% charged on the currently outstanding loan balance because implementation of a non-formaldehyde process reduces overall risk.

Repayment — When and How

Exhibits TN-4 and TN-5 present five-year pro forma forecast income statements and balance sheets using the percentage of sales method. Sales are expected to increase at a 15% annual rate; the remaining assumptions can be found at the base of the respective exhibits. The most important thing to note from these exhibits is that, regardless of the new investment, Crotalus will need additional funds to fuel its planned growth. In fact, Crotalus is expanding at a rate well beyond its

EXHIBIT TN-2: CROTALUS CIRCUITS' HISTORICAL RATIOS ($ THOUSANDS)

	Dec-96	Dec-95	Dec-94	Dec-93	Dec-92	
Liquidity Ratios						**Definition**
Current Ratio	1.79	1.73	1.83	1.66	1.58	Current assets/Current liabilities
Quick Ratio	1.51	1.37	1.43	1.25	1.14	(CA - Inv)/CL
Activity Ratios						
Inventory Turnover	8.88 x	7.99 x	8.13 x	7.22 x	7.14 x	COGS/Ending Inventory
Avg Collect Period	66 days	65 days	51 days	52 days	48 days	Accts Rec'vble/(Sales/365)
Avg Payment Period	45 days	45 days	34 days	33 days	32 days	Accts Payable/(COGS/365)
Total Asset Turnover	1.06 x	1.42 x	1.48 x	1.42 x	1.43 x	Sales/Total Assets
Debt Management						
Total Debt Ratio	56.2%	55.6%	56.5%	61.4%	66.7%	Total Debt/Total Assets
Times Interest Earned	-.24 x	23.1 x	18.67 x	13.24 x	7.37 x	EBIT/Interest
Profitability Ratios						
Gross Profit Margin	-0.3%	12.1%	10.5%	8.5%	5.6%	EBIT/Sales
Net Profit Margin	-1.6%	8.3%	6.7%	5.6%	3.3%	Adj Net Income/Sales
Return on Equity (ROE)	-3.8%	26.6%	22.7%	20.7%	14.3%	Adj Net Income/Total Equity
Return on Assets (ROA)	-1.7%	11.8%	9.9%	8.0%	4.8%	Adj Net Income/Total Assets
Sustainable Growth						
Net Profit Margin (P)	-1.6%	8.3%	6.7%	5.6%	3.3%	Adj Net Income/Sales
Retention Rate (R)	100.0%	100.0%	100.0%	100.0%	100.0%	(Adj NI - Dividends)/Adj NI
Total Asset Turnover (A)	1.06 x	1.42 x	1.48 x	1.42 x	1.43 x	Sales/Total Assets
Equity Multiplier (T-hat)	2.29 x	3.03 x	3.02 x	3.47 x		Assets/Beg Equity
Sust'able Growth (g*)	-3.8%	35.8%	29.8%	27.8%		P*R*A*T-hat
Growth Rates						
Sales	-24.3%	27.3%	21.0%	14.6%		
Inventory	-38.1%	28.7%	7.3%	12.0%		
Accounts Receivable	-22.5%	60.9%	18.4%	24.9%		
Accounts Payable	-30.2%	63.7%	24.9%	18.3%		
Property, net	30.6%	24.1%	16.6%	3.3%		

sustainable growth (around 5%) and will run into immediate problems within the next two years. In addition to its overly optimistic sales growth, expanding its asset base by 20% per year puts a severe strain on the firm's financing capabilities. Reducing either of these figures would be helpful. Another source of assistance might arise from improvements in the non-formaldehyde electroless copper process. The new process slashes total operating time from 316 days to 142 days (about 55 percent) — if inventories could be reduced by a concomitant amount, the firm would significantly increase its financing flexibility. Additional slack might come from decreasing cash balances (currently 11% of sales) and improving collections of accounts receivable.

If sales develop as planned, Crotalus will need additional funds immediately (exclusive of the $250,000 to fund the electroplating project). In fact, if the firm continues along this path, something must eventually give. RNB should consider its options in the event Crotalus does not repay the loan as planned. Pro forma ratios (**Exhibit TN-6**) aren't very encouraging.

Fundamentally, this is Crotalus' problem *now*. A couple of quick fixes (i.e., improving collections or decreasing inventories) can to improve things , but Crotalus will continue to need external financing unless it slows its growth. With respect to the environmental wild card, Henry Dean is caught between a rock and a hard place: If RNB extends the loan, it avoids lender liability for the foreclosed assets, but may be giving up possible recoupment of principal; if it stops lending and / or calls the loan, Crotalus may crash and burn on its own, throwing RNB open to potential environmental liabilities.

EXHIBIT TN-3: CROTALUS CIRCUITS' INVESTMENT ANALYSIS

New Asset	
Initial Price:	$250,000
Depreciable Life:	5-yr MACRS
Terminal Book Value:	$14,400
Terminal Scrap Value:	$0
Terminal Tax Effect:	-$4,752

Initial Outlay	
Purchase of New Asset:	-$250,000
Installation/Shipping:	$0
Sale of Old Asset:	$0
Tax Effects of Old Sale:	$0
Working Capital Effects:	$0
Other Effects:	$0
	-$250,000

Depreciation	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*
New Asset:	$50,000	$80,000	$48,000	$28,800	$28,800	$14,400
Old Asset:	$0	$0	$0	$0	$0	
Incremental Depreciation:	$50,000	$80,000	$48,000	$28,800	$28,800	

Terminal Value (Perpetuity)	
Operating Cash Flow in Yr 5:	
÷ Discount Rate:	$212,143
	$212,143

Incremental Cash Flows	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*
Revenues:	$0	$0	$0	$0	$0
(Non-Depreciable Expenses):	(-$23,811)	(-$23,811)	(-$23,811)	(-$23,811)	(-$23,811)
Revenues - NDE:	$23,811	$23,811	$23,811	$23,811	$23,811
(Depreciation):	($50,000)	($80,000)	($48,000)	($28,800)	($28,800)
EBT:	($26,189)	($56,189)	($24,189)	($4,989)	($4,989)
(Taxes):	(-$8,642)	(-$18,542)	(-$7,982)	(-$1,646)	(-$1,646)
EAT:	($17,547)	($37,647)	($16,207)	($3,343)	($3,343)
+ Depreciation	$50,000	$80,000	$48,000	$28,800	$28,800
Operating Cash Flow:	$32,453	$42,353	$31,793	$25,457	$25,457
Cash Flows: -$250,000	$32,453	$42,353	$31,793	$25,457	$212,143

Ordinary Tax Rate:	33%
Capital Gains Tax Rate:	33%
Discount Rate:	12%

NPV:	($28,076)
IRR:	8.53%
PI:	0.8877

Lender Liability Issues

How significant is the threat of lender liability? This case is intended as a vehicle for increasing students' awareness of this issue. Although the threat is there, it's not yet a widespread phenomenon. Consequently, a fairly qualitative discussion is appropriate here. Briefly discussing each of the legal cases in **Exhibit 8** may prove useful in stimulating student discussion. Note that Crotalus' facilities are in a former paint factory — what unknown solvents and contaminants might still lurk there? An interesting question to pursue might be a calculation of Crotalus' liquidation value, should RNB foreclose. How severe is the problem of environmental stigma? Will RNB be able to find a buyer for Crotalus' assets?

The Decision

As with most cases, there are no right answers, only good arguments. This is a close call — the project just barely makes financial sense, though there are clear environmental and health benefits, to be sure. However, the technology is as yet unproven and carries substantial risks in this highly competitive market. Moreover, probably Crotalus needs to address its overall future growth strategy before committing to a decision. To the extent Dean realizes this but Sawyer does not, there is likely to be some conflict, because Sawyer will probably balk at certain restrictions Dean will place upon the loan. On the other hand, the last thing Dean and RNB want is to take ownership of a Superfund site. Implementation of a non-formaldehyde electroless copper process w*ould* seem to be one step in reducing this risk.

EXHIBIT TN-4: CROTALUS CIRCUITS' PRO FORMA INCOME STATEMENTS ($ THOUSANDS)

	Dec-97	Dec-98	Dec-99	Dec-00	Dec-01	Dec-02
Sales	$11,431	$13,146	$15,117	$17,385	$19,993	$22,992
- Cost of Goods Sold	($7,870)	($9,053)	($10,414)	($11,979)	($13,778)	($15,847)
Gross Profit	$3,561	$4,092	$4,703	$5,406	$6,215	$7,145
- Selling Expense	($2,165)	($2,491)	($2,866)	($3,296)	($3,792)	($4,362)
EBITDA	$1,396	$1,601	$1,838	$2,110	$2,423	$2,783
- Depreciation, Depletion & Amortization	($1,007)	($1,246)	($1,495)	($1,794)	($2,153)	($2,583)
Operating Profit (EBIT)	$389	$356	$343	$316	$270	$200
- Interest Expense	($201)	($210)	($274)	($356)	($461)	($594)
+/- Non-operating Expense	$114	$131	$151	$174	$200	$230
Earnings Before Tax	$302	$277	$220	$134	$9	($165)
- Total Income Tax	($100)	($91)	($73)	($44)	($3)	$54
Income w/o Extra Items & Discont'd Ops	$202	$186	$148	$90	$6	($110)
+/- Extraordinary Items	$0	$0	$0	$0	$0	$0
+/- Discontinued Operations	$0	$0	$0	$0	$0	$0
Adjusted Net Income	$202	$186	$148	$90	$6	($110)

Assumptions

- Sales grow at a 15% annual rate
- COGS is 69% of sales - $11,198 materials savings, $4,406 water savings, $1,448 electricity savings
- Selling expense is 19% of sales - $3,411 permitting expense - $3,349 maintenance expense
- depreciation is 15% of previous gross PPE
- Interest expense is 10% of previous (Notes Payable + Current LTD + LTD)
- non-operating expense is 1% of sales
- marginal tax rate is 33%
- no preferred dividends, extraordinary items or discontinued operations

EXHIBIT TN-5: CROTALUS CIRCUITS' PRO FORMA BALANCE SHEETS ($THOUSANDS)

ASSETS	Dec-97	Dec-98	Dec-99	Dec-00	Dec-01	Dec-02
Cash & Equivalents	$1,257	$1,446	$1,663	$1,912	$2,199	$2,529
Net Receivables	1,816	2,089	2,402	2,763	3,177	3,653
Inventories	914	1,052	1,209	1,391	1,599	1,839
Prepaid Expenses	114	131	151	174	200	230
Other Current Assets	572	657	756	869	1,000	1,150
Total Current Assets	$4,674	$5,375	$6,182	$7,109	$8,175	$9,401
Gross Plant, Property & Equipment	$8,304	$9,965	$11,958	$14,350	$17,220	$20,664
- Accumulated Depreciation	(3,557)	(4,802)	(6,297)	(8,091)	(10,244)	(12,827)
Net Plant, Property & Equipment	$4,748	$5,163	$5,661	$6,259	$6,977	$7,838
Other Assets	572	657	756	869	1,000	1,150
Total Assets	$9,993	$11,195	$12,599	$14,237	$16,151	$18,389

CLAIMS	Dec-97	Dec-98	Dec-99	Dec-00	Dec-01	Dec-02
Current Portion of Long-term Debt	$ 175	$ 200	$ 200	$ 200	$ 200	$ 200
Notes Payable	152	966	1,988	3,238	4,772	6,660
Accounts Payable	800	920	1,058	1,217	1,400	1,609
Taxes Payable	114	131	151	174	200	230
Accrued Expenses	1,486	1,709	1,965	2,260	2,599	2,989
Other Current Liabilities	114	131	151	174	200	230
Total Current Liabilities	$2,842	$4,058	$5,514	$7,263	$9,370	$11,918
Long Term Debt	1,772	1,572	1,372	1,172	972	772
Investment Tax Credit	0	0	0	0	0	0
Other Liabilities	1,080	1,080	1,080	1,080	1,080	1,080
Common Stock	190	190	190	190	190	190
Capital Surplus	1,116	1,116	1,116	1,116	1,116	1,116
Retained Earnings	3,005	3,191	3,339	3,429	3,435	3,325
Less: Treasury Stock	(12)	(12)	(12)	(12)	(12)	(12)
Common Equity	$4,299	$4,485	$4,633	$4,723	$4,729	$4,619
Total Claims	$9,993	$11,195	$12,599	$14,237	$16,151	$18,389
Additional Financing Needed	$152	$966	$1,988	$3,238	$4,772	$6,660

Assumptions

- cash & equivalents at 11% of sales
- 58 day avg collection period
- inventories at 8% of sales
- prepaid expenses at 1% of sales
- other current assets at 5% of sales
- gross PPE grows at 20% annual rate + initial $250K
- accum depreciation = previous + I/S change
- other assets = 5% of sales
- current LTD = $1600/10 + 250/10 (in 1998)
- notes payable = PLUG
- accounts payable at 7% of sales
- taxes payable at 1% of sales
- accrued expenses at 13% of sales
- other current liabilities at 1% of sales
- LTD = prev LTD - curr LTD
- remaining accounts are fixed except retained earnings
- retained earnings = prev RE + net income from I/S

EXHIBIT TN-6: CROTALUS CIRUITS' PRO FORMA RATIOS

	Dec-97	Dec-98	Dec-99	Dec-00	Dec-01	Dec-02
Liquidity Ratios						
Current Ratio	1.64	1.32	1.12	0.98	0.87	0.79
Quick Ratio	1.32	1.07	0.90	0.79	0.70	0.63
Activity Ratios						
Inventory Turnover	8.61 x	8.61 x	8.61 x	8.61 x	8.61 x	8.62 x
Avg Collect Period	58 days	58 days	58 days	58 days	58 days	58 days
Avg Payment Period	37 days	37 days	37 days	37 days	37 days	37 days
Total Asset Turnover	1.14 x	1.17 x	1.2 x	1.22 x	1.24 x	1.25 x
Debt Management						
Total Debt Ratio	57.0%	59.9%	63.2%	66.8%	70.7%	74.9%
Times Interest Earned	1.93 x	1.69 x	1.25 x	.89 x	.59 x	.34 x
Profitability Ratios						
Gross Profit Margin	3.4%	2.7%	2.3%	1.8%	1.4%	0.9%
Net Profit Margin	1.8%	1.4%	1.0%	0.5%	0.0%	-0.5%
Return on Equity (ROE)	4.7%	4.1%	3.2%	1.9%	0.1%	-2.4%
Return on Assets (ROA)	2.0%	1.7%	1.2%	0.6%	0.0%	-0.6%
Sustainable Growth						
Net Profit Margin (P)	1.8%	1.4%	1.0%	0.5%	0.0%	-0.5%
Retention Rate (R)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total Asset Turnover (A)	1.14 x	1.17 x	1.2 x	1.22 x	1.24 x	1.25 x
Equity Multiplier (T-hat)	2.44 x	2.25 x	1.71 x	1.97 x	2.24 x	. x
Sust'able Growth (g*)	4.9%	3.7%	2.0%	1.2%	0.1%	0.0%
Growth Rates						
Sales	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
Inventory	30.1%	15.0%	15.0%	15.0%	15.0%	15.0%
Accounts Receivable	1.0%	15.0%	15.0%	15.0%	15.0%	15.0%
Accounts Payable	3.2%	15.0%	15.0%	15.0%	15.0%	15.0%
Property, net	14.1%	8.7%	9.7%	10.6%	11.5%	12.3%

The National Pollution Prevention Center for Higher Education
University of Michigan, Dana Building
430 East University Ave.
Ann Arbor, MI 48109-1115
• Phone: 734-764-1412
• Fax: 734-647-5841
• E-mail: nppc@umich.edu

The mission of the NPPC is to promote sustainable development by educating students, faculty, and professionals about pollution prevention; create educational materials; provide tools and strategies for addressing relevant environmental problems; and establish a national network of pollution prevention educators. In addition to developing educational materialsand conducting research, the NPPC also offers an internship program, professional education and training, and conferences.

Your Input is Welcome!

We are very interested in your feedback on these materials. Please take a moment to offer your comments and communicate them to us. Also contact us if you wish to receive a documents list, order any of our materials, collaborate on or review NPPC resources, or be listed in our *Directory of Pollution Prevention in Higher Education*.

We're Online!

The NPPC provides information on its programs and educational materials through the Internet's Worldwide Web; our URL is:
http://www.umich.edu/~nppcpub/
Please contact us if you have comments about our online resources or suggestions for publicizing our educational materials through the Internet. Thank you!