

(Having FUN at) Digital Process Engineering 1976 - 1980

**Stories from my 23 years at DEC as a (Closet Engineer) “Bean-Counter”
1976-1998**

**Jeff Bergart presents a DECconnection Zoom
October 8, 2024 jeffbergart@gmail.com**



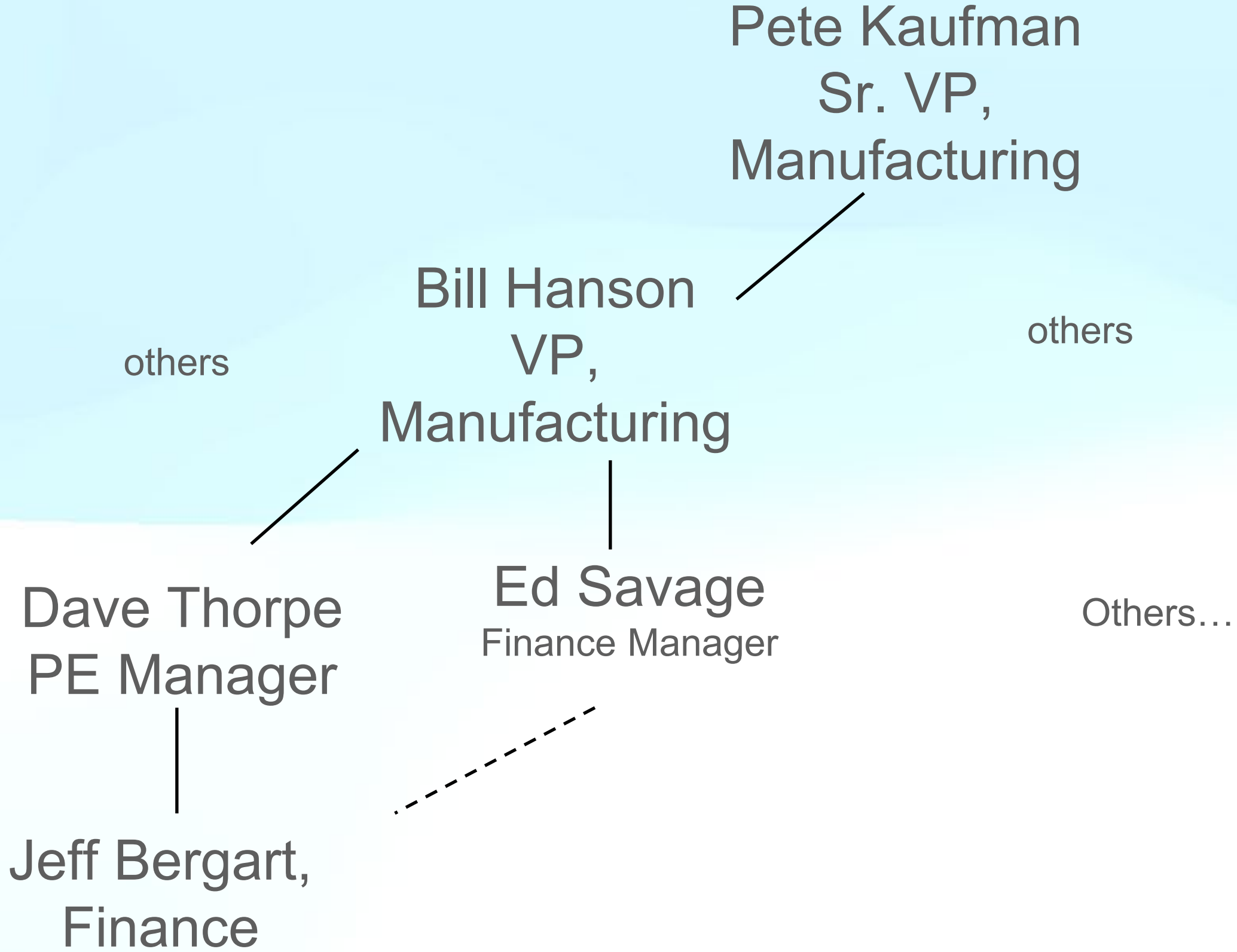
Jeff's Background

(the road to a "Double Nerd")



Manufacturing Process Engineering

Financial Success & FUN 1976-1980



2nd week on the job: “Reviewing” Puerto Rico Manufacturing



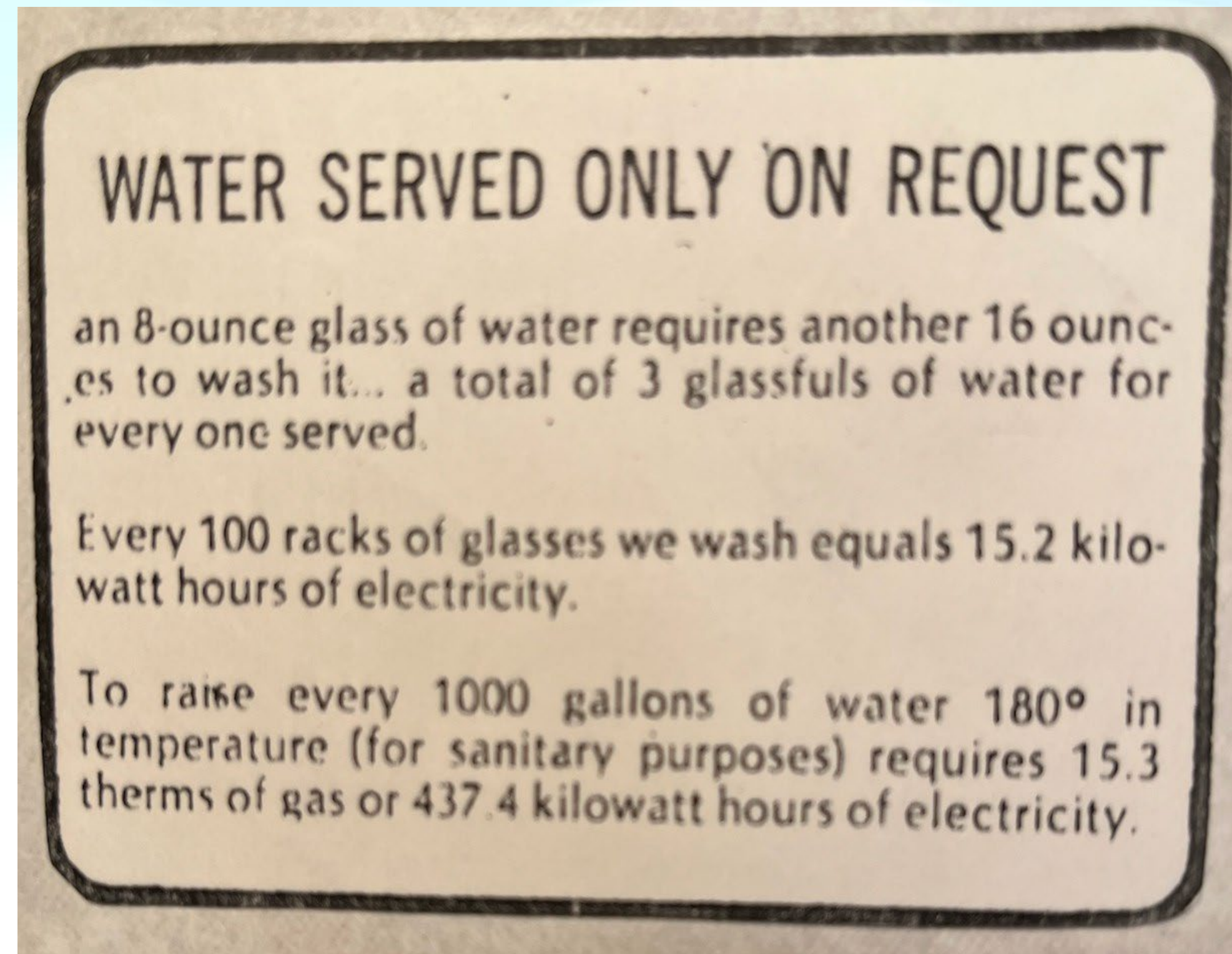
Mfg Process Engineering

Financial Success & FUN 1976-1980

Obvious Savings



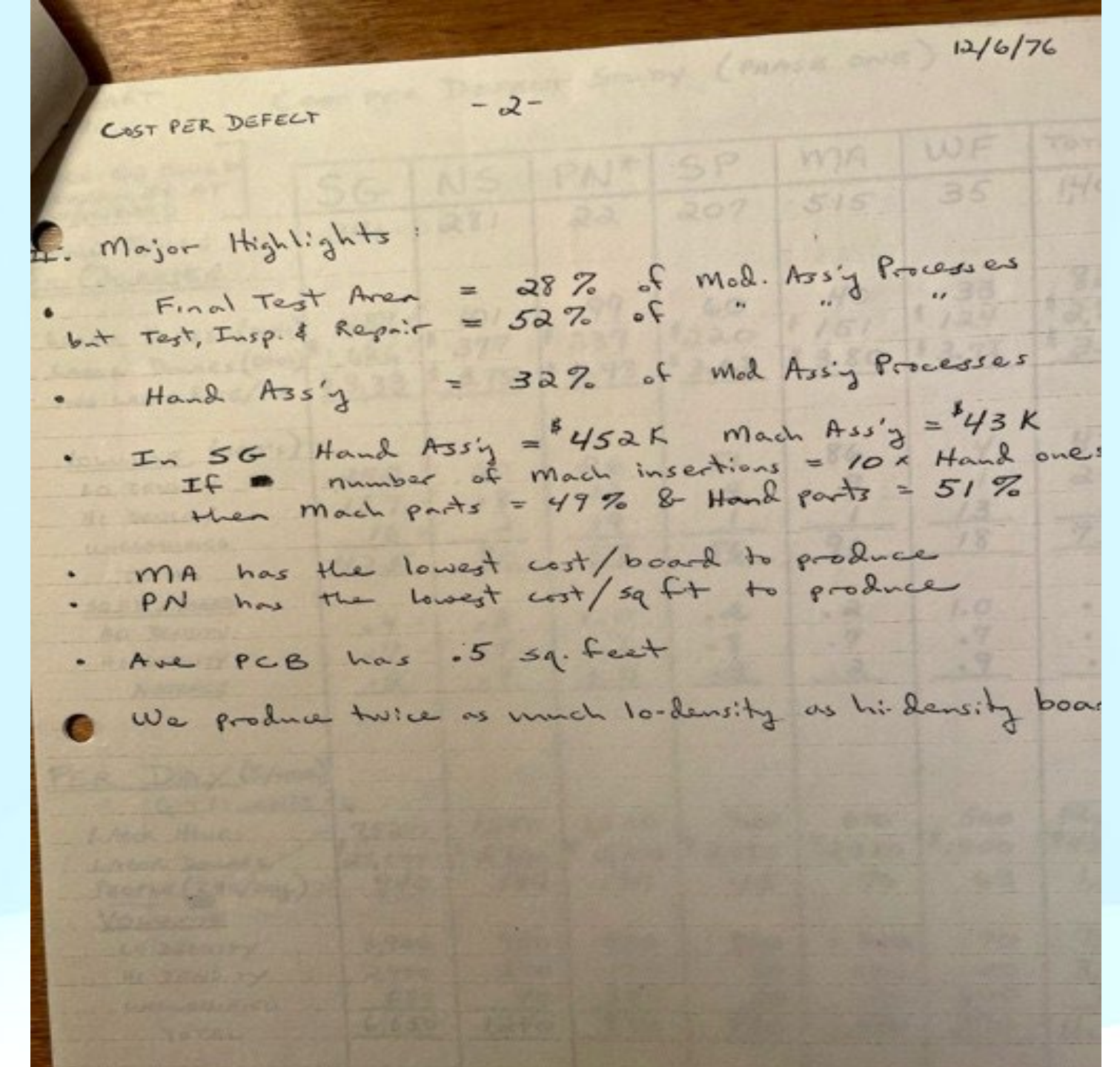
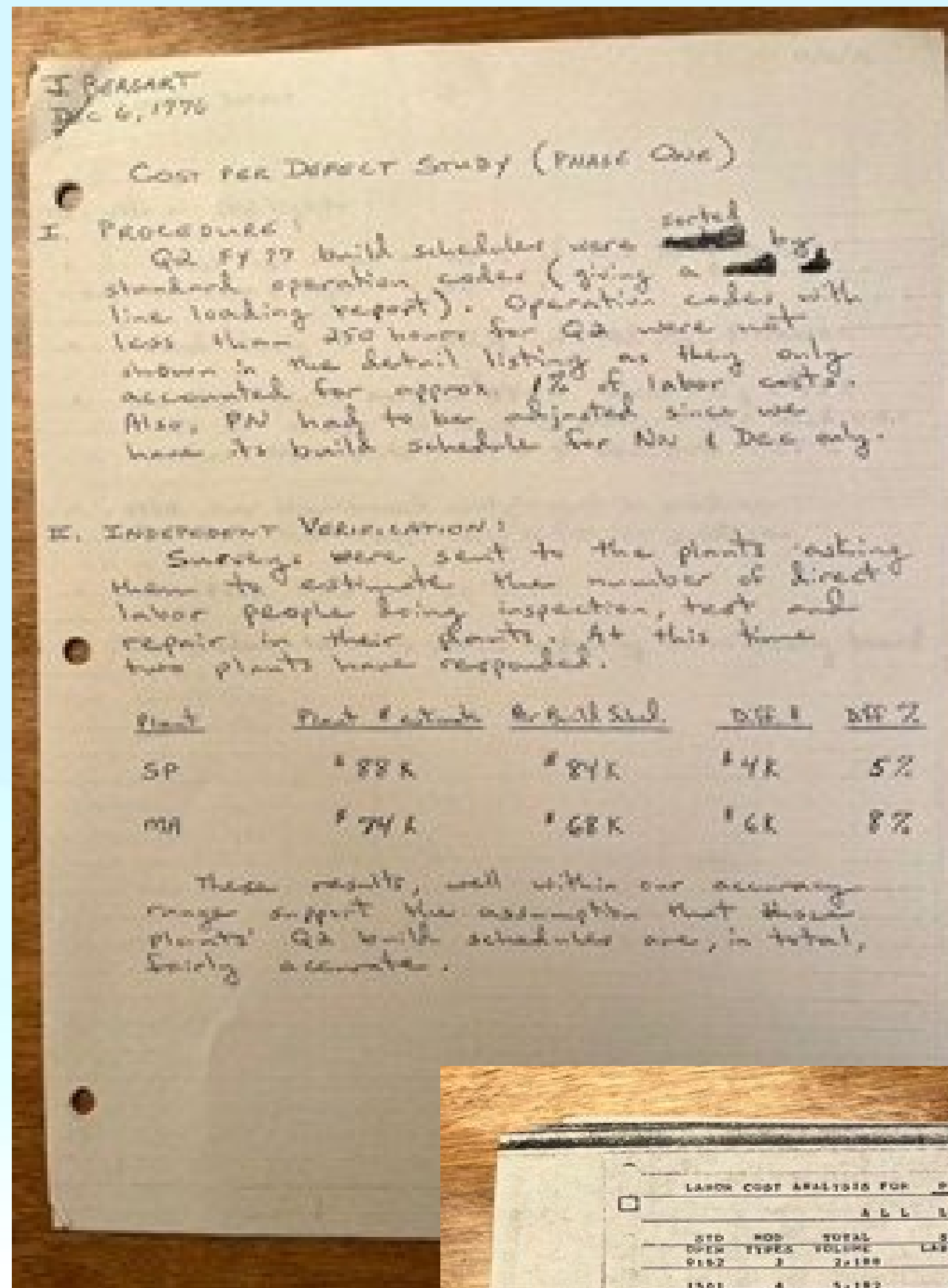
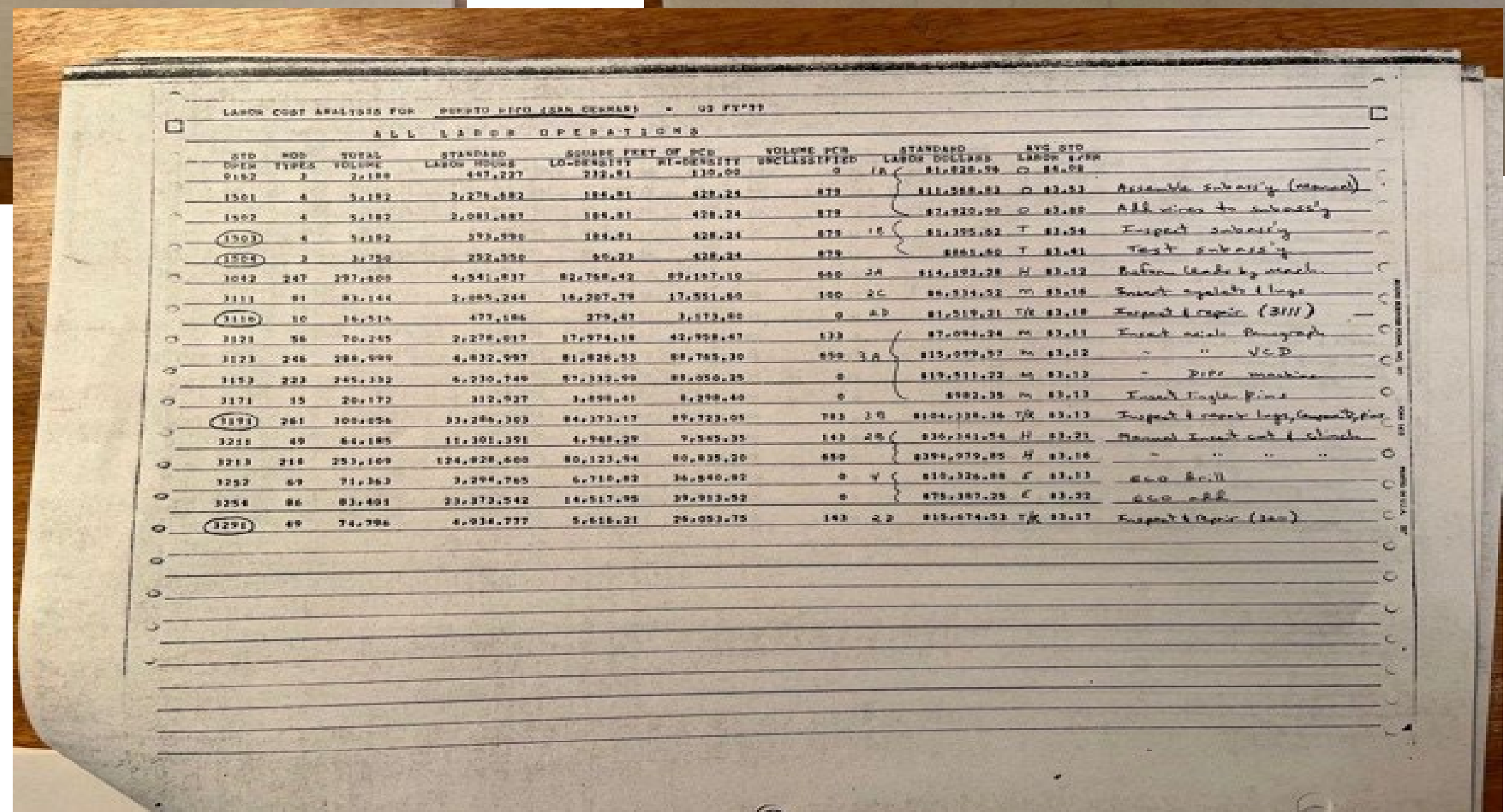
“Out-of-the-Box” Savings



Back at the Mill

Lessons Learned:

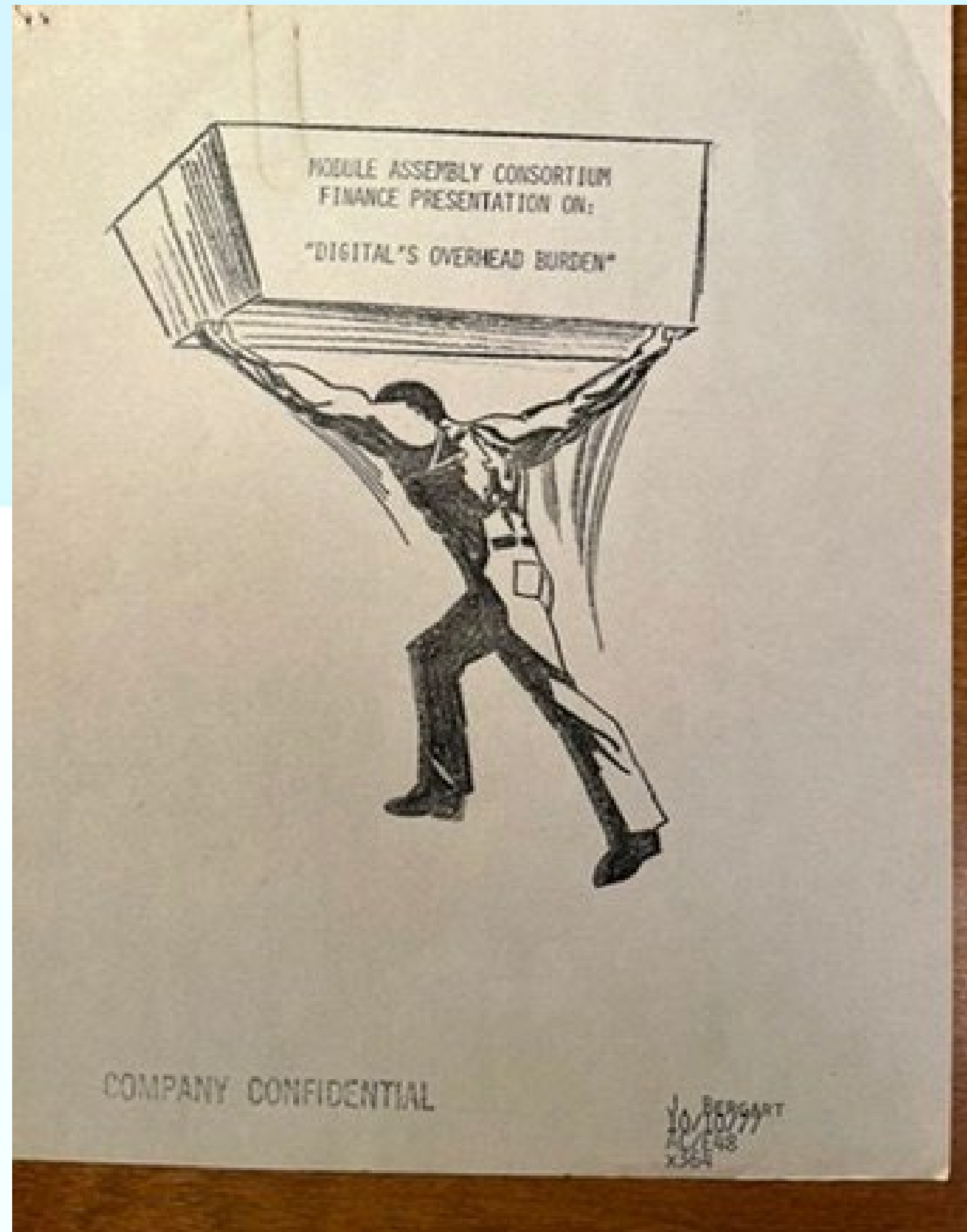
- We were spending 52% of our time Testing, Inspecting and Repairing what we were building!
- Hand-assembled parts outnumbered machine-assembled parts.

STD MOD	TOTAL	STANDARD	SQUARE FEET OF PCB	VOLUME PER UNCLASSIFIED	STANDARD LABOR DECLASS	AVE STD LABOR PER	
1501	3,182	3,278,882	188.81	428.24	879	\$11,568.83	0 \$3.81 Assemble subassy (manual)
1502	3,182	2,087,887	188.81	428.24	879	\$7,929.00	0 \$3.89 Add wires to subassy
1503	3,182	373,330	188.81	428.24	879	\$1,175.52	T \$3.54 Inspect subassy
1504	3,182	222,330	80.23	428.24	879	\$661.80	T \$3.81 Test subassy
1042	247	297,800	4,341,837	82,758.42	880	\$14,103.28	H \$3.12 Reflow leads by mach
1111	81	83,144	1,885,244	18,287.79	100	\$8,934.32	M \$3.18 Solder separate flags
1110	10	16,514	477,186	279.81	0	\$1,519.21	T \$3.18 Inspect & repair (311)
1121	56	70,245	2,278,817	17,874.18	133	\$7,094.34	M \$3.11 Insert axial components
1123	248	288,999	4,832,987	81,826.53	850	\$15,079.57	M \$3.12 " " vs D
1153	223	245,130	4,230,749	87,332.99	88,050.25	\$19,511.22	M \$3.13 " " Pipe machine
1171	35	20,172	332,927	3,898.81	0	4982.35	M \$3.13 Insert Eagle pins
1191	261	300,056	33,286,303	84,373.17	783	\$104,338.36	T \$3.13 Inspect & repair legs, components
1211	49	64,185	11,301,391	4,948.29	143	\$36,241.54	H \$3.23 Manual insert cut & clinch
1213	214	253,109	124,828,460	80,123.44	880	\$394,979.85	H \$3.16 " " " "
1252	87	71,363	3,294,765	6,710.82	0	\$10,326.88	F \$3.13 a/c ball
1254	86	83,401	23,873,542	16,517.95	0	\$79,387.25	C \$3.22 a/c ball
1291	49	74,796	4,934,777	5,668.21	143	\$15,674.53	T \$3.17 Inspect & Repair (300)

How are we going to Get Engineers to measure their work?

FIRST: Show them where the costs are !!:



MODULE ASSEMBLY CONSORTIUM
"OVERHEAD" PRESENTATION
CONCLUSIONS

- I. WE MUST "WORK" THE BIGGEST ISSUES, AND OVERHEAD COSTS ARE OVER 4 TIMES GREATER THAN DIRECT LABOR COSTS.
- II. WE MUST "WORK" ISSUES OUTSIDE OF PRODUCTION. OVER 50% OF OVERHEAD COSTS ARE SPENT IN NON-PRODUCTION COST CENTERS.
- III. WE MUST NOW "WORK" INDIRECT LABOR ISSUES. INDIRECT LABOR RELATED COSTS ACCOUNT FOR ALMOST HALF OF OVERHEAD SPENDING.
- IV. PLANTS CONTROL THEIR OWN DESTINY. APPROXIMATELY 92% OF VALUE ADDED IS EXPENDED WITHIN THE PLANT.

J. BERGART
10/10/77

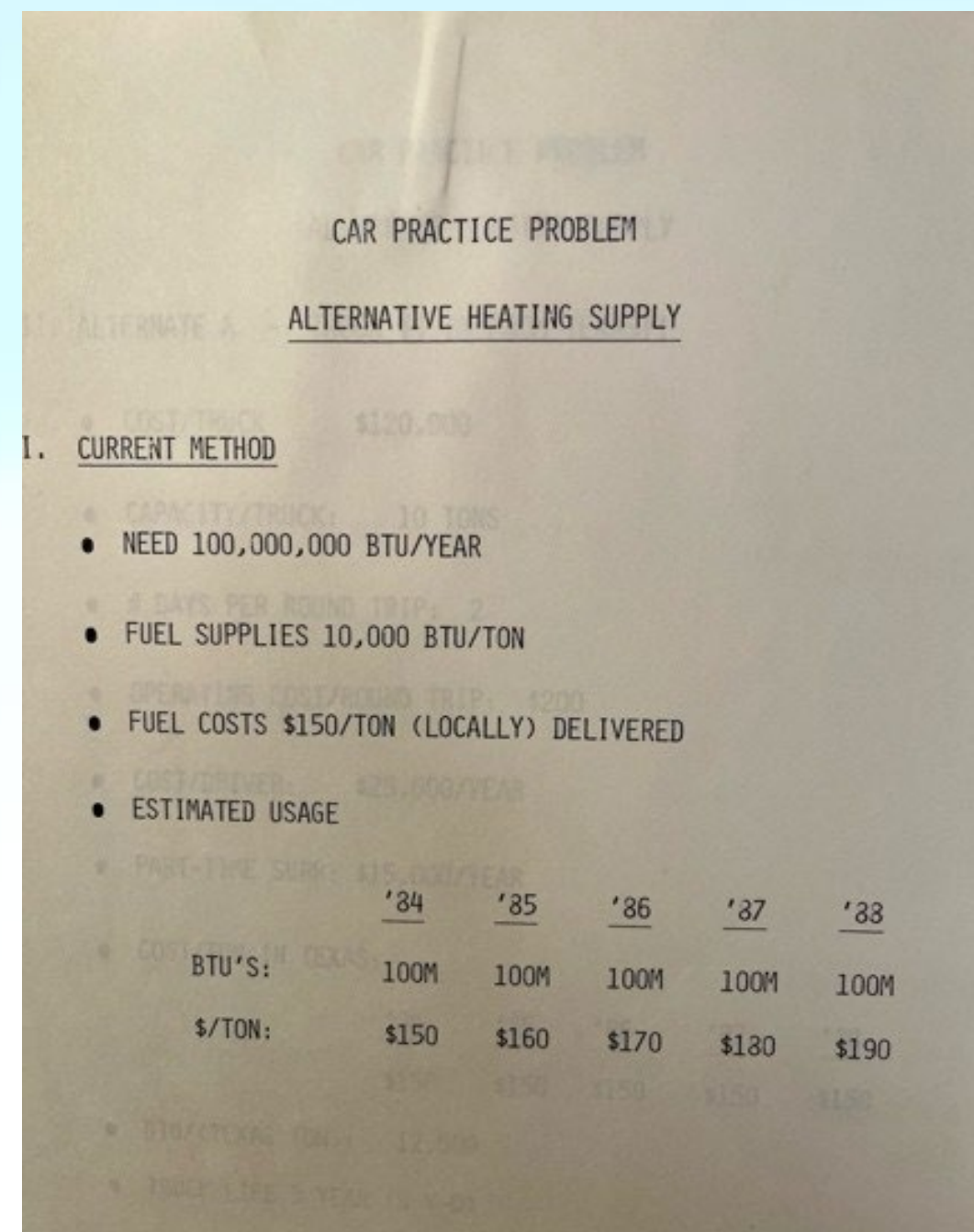
- **NEXT:** Teach them how to fill out Capital Appropriations Request (CAR) Forms.

←===== 3 OPTIONS =====→

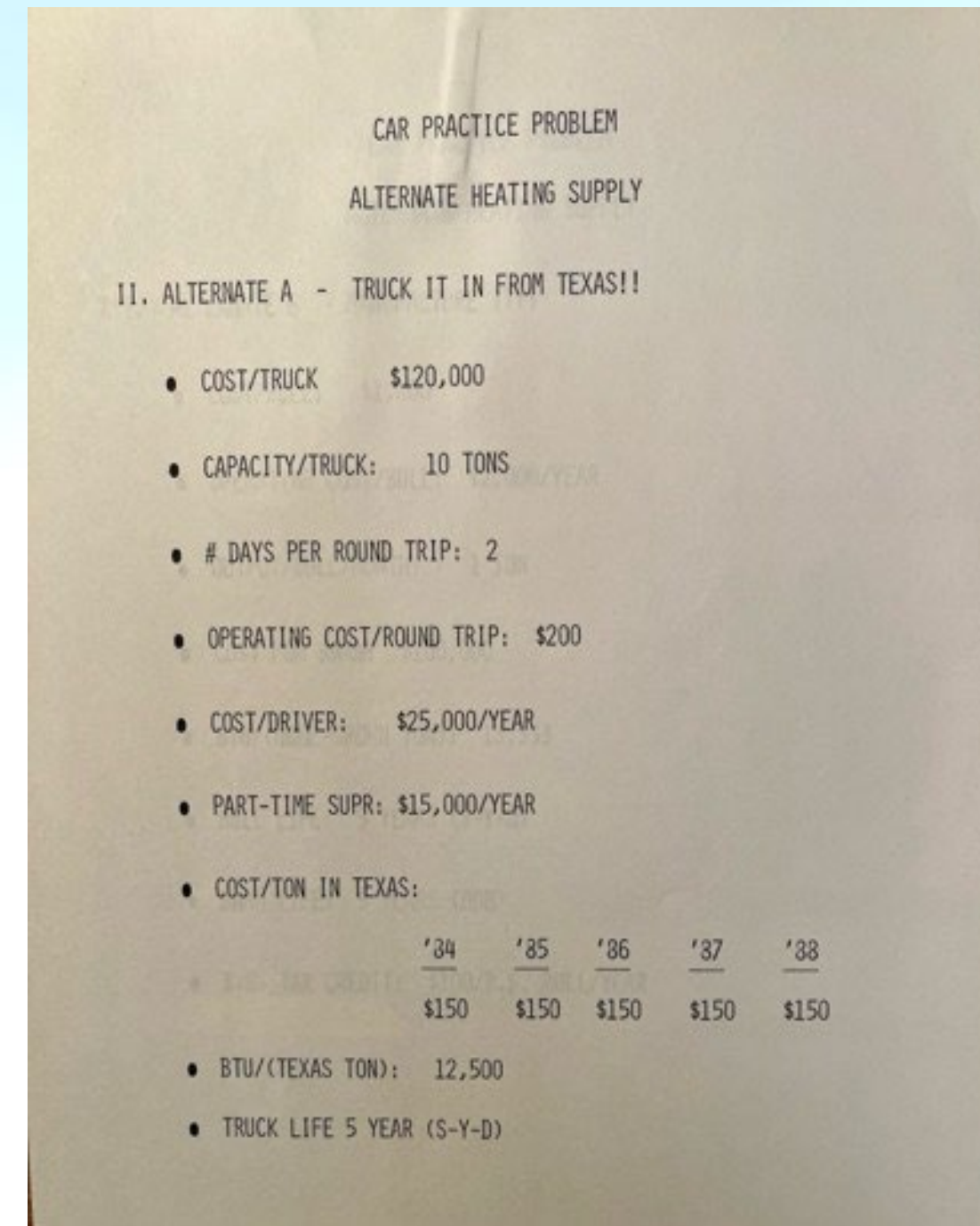
How to Heat the Plant



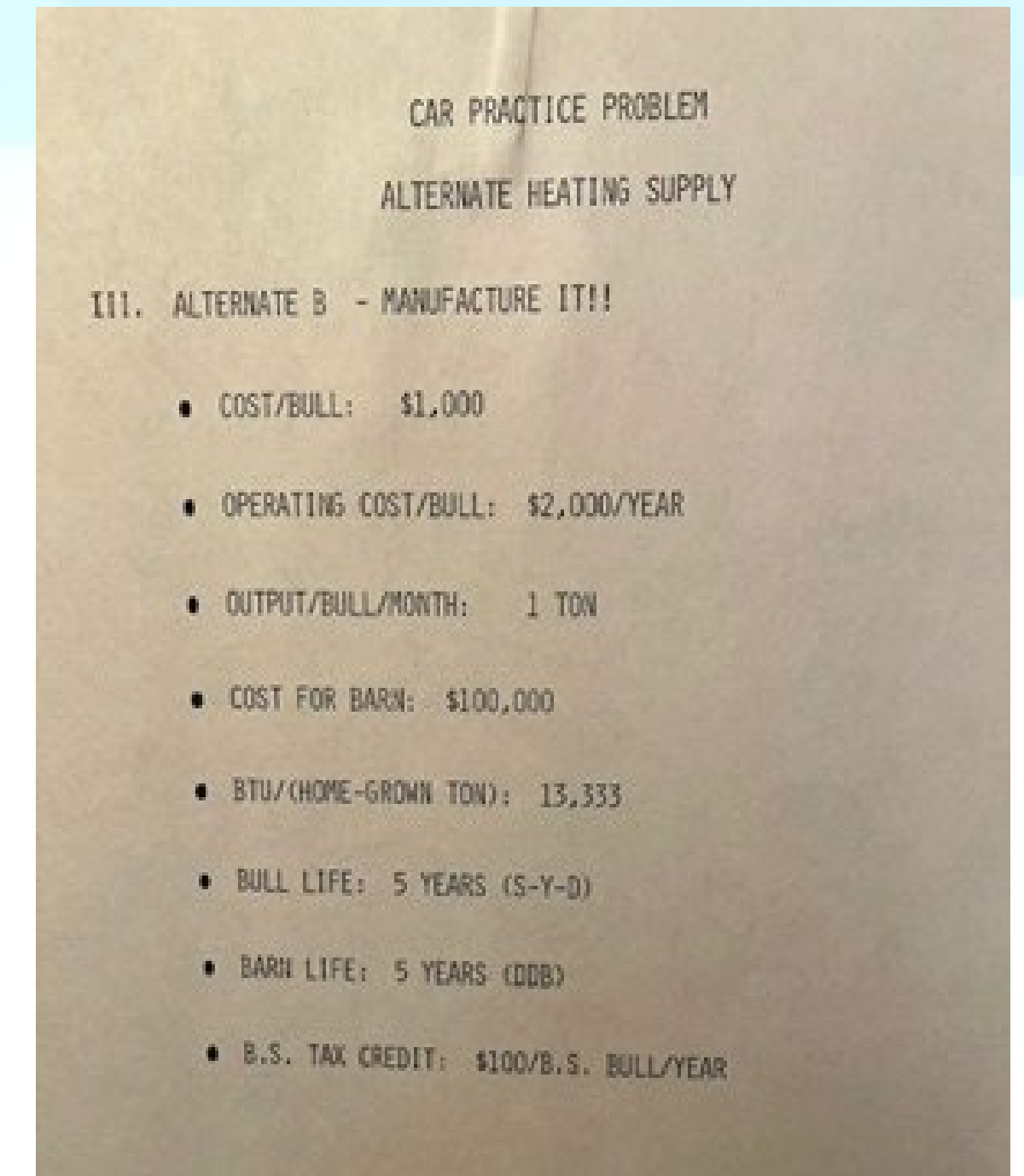
Buy Fuel



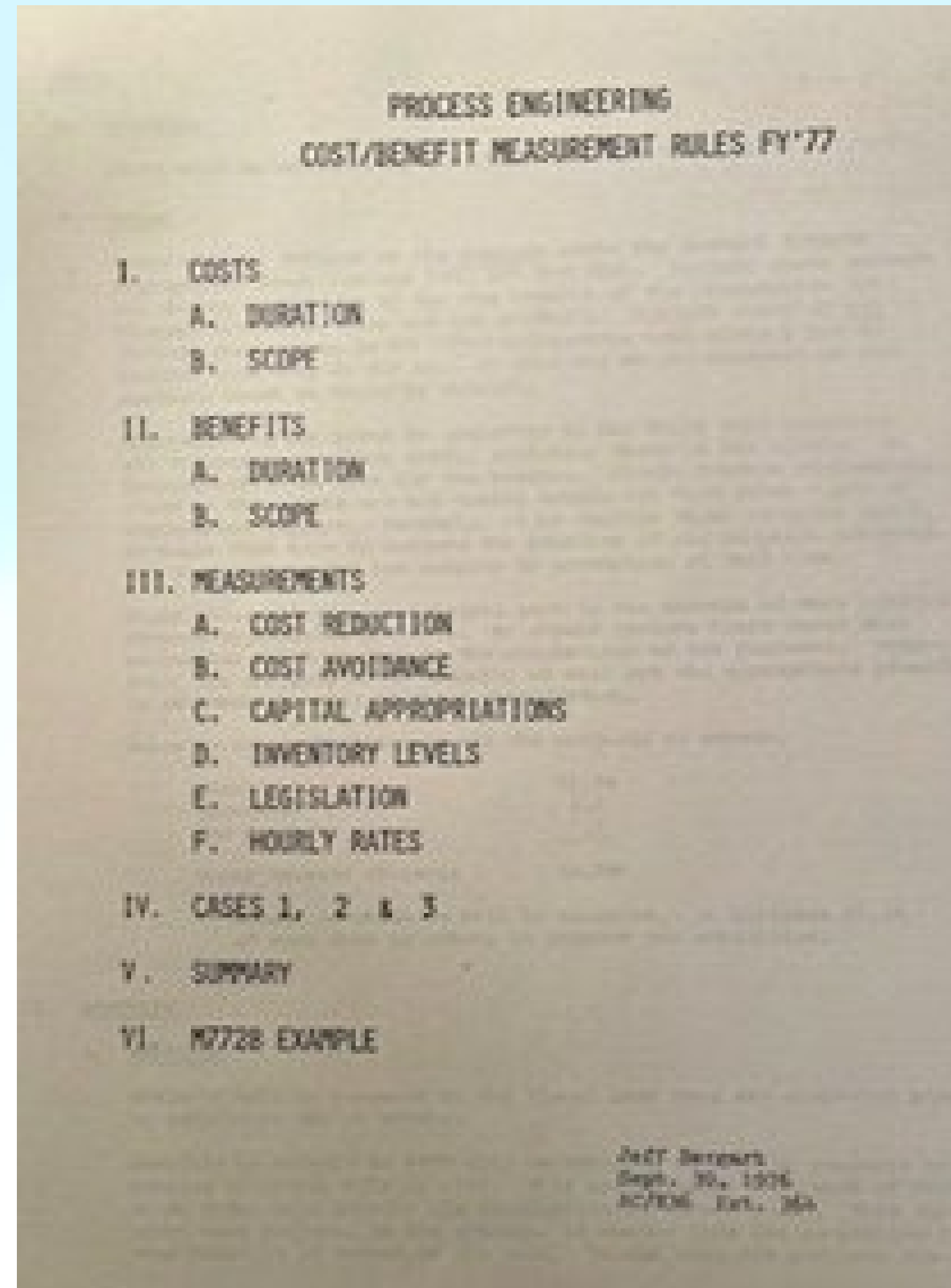
Import Fuel



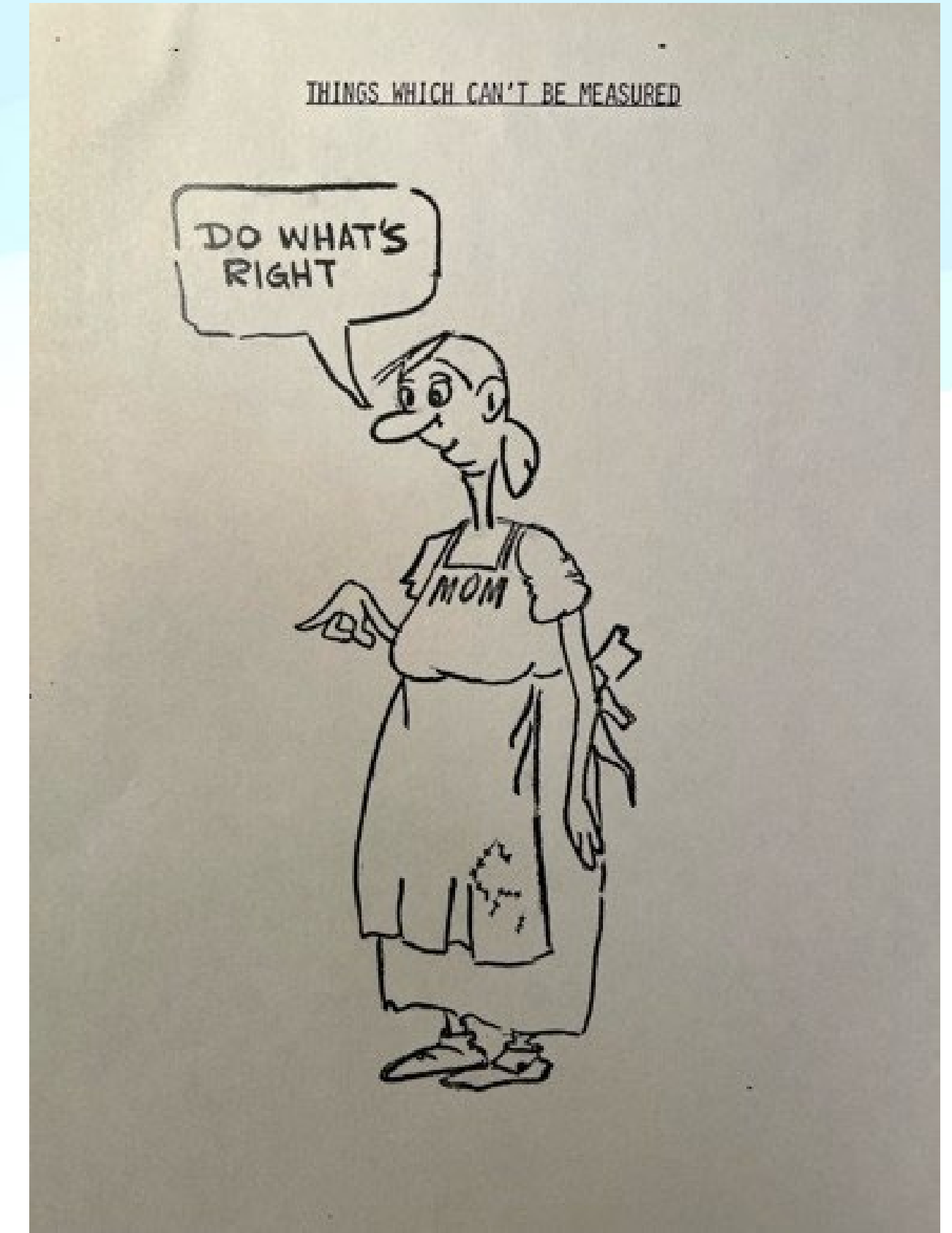
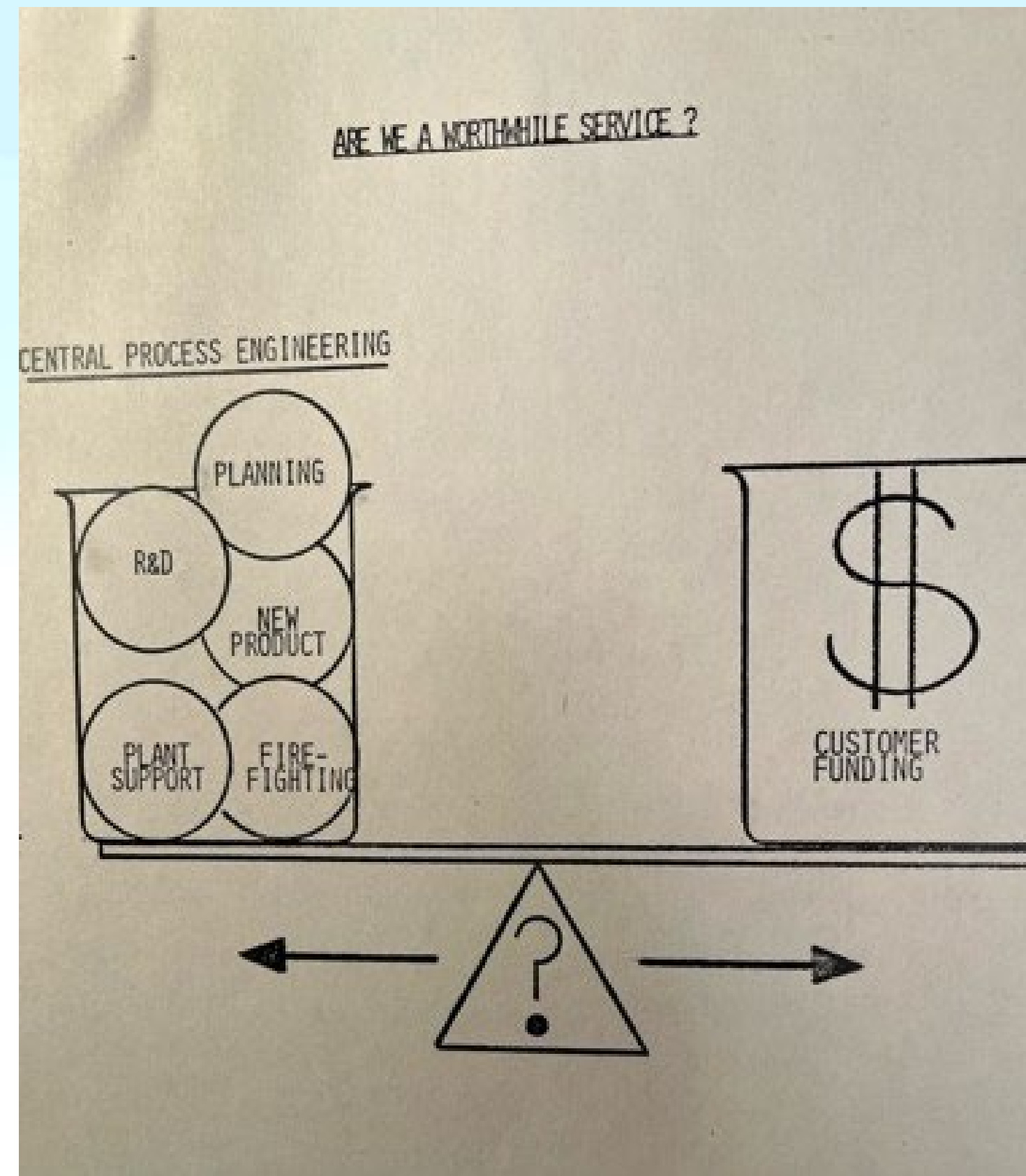
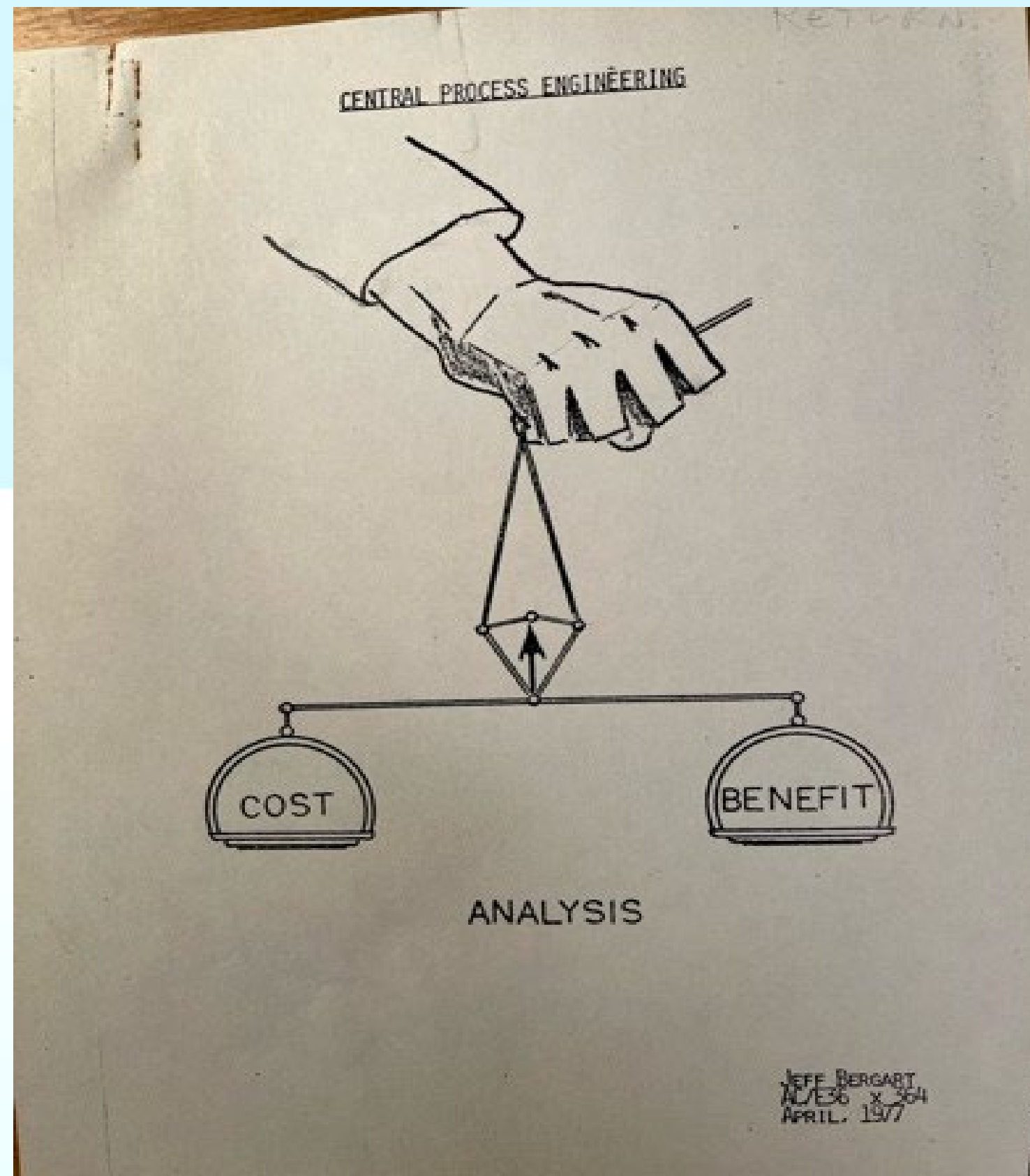
Make the Fuel



But How Are We Going To Measure Our Success?

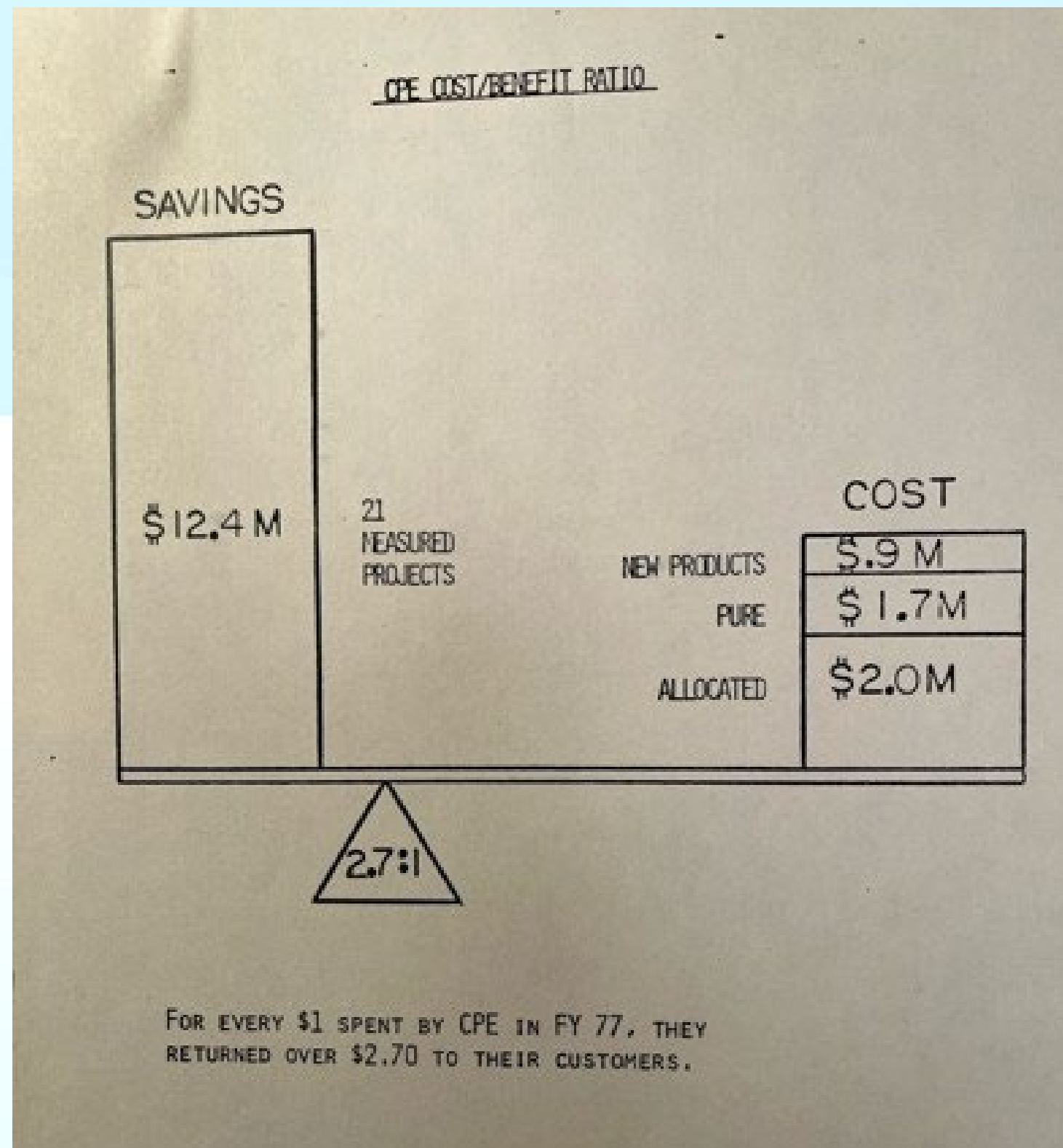


The Big Challenge:



Were we worth it?

YES!



PROCESS ENGINEERING COST/BENEFIT RATIO

EY 76 CARRYOVER PROJECTS

	EY 77		ADD'L CAPITAL AVOIDANCE**
	COST AVOIDANCE*	COST REDUCTION	
• APT SYSTEM IN AG INSTEAD OF ACT	\$ 533K	-	\$ 1.493K
• LA36 (M7726) COST REDUCTION PROJECT	-	\$ 1.121K	-
• SHORTS TESTER	\$ 155K	-	\$ 650K
UNIV. BED OF NAILS (COBONS)			
AUTO. BACKPLANE			
11/70 TESTING	\$ 205K	\$ 937K	\$ 610K
AQUEOUS			
AG SUPPORT			
ECL HEAD FOR GR			
SUBTOTAL	\$ 893K	\$ 2,058K	\$ 2,753K
TOTAL	\$ 2,951K		\$ 5,704K

* INCLUDES 1 YEAR'S DEPRECIATION OF CAPITAL AVOIDANCE
** EXCLUDES 1ST YEAR'S DEPRECIATION

PROCESS ENGINEERING COST/BENEFIT RATIO

EY 77 PROJECT SAVINGS

	EY 77		ADD'L CAPITAL AVOIDANCE**	EY 78 ESTIMATED SAVINGS
	COST AVOIDANCE*	COST REDUCTION		
• REZERO	\$ 175K	\$ 1,710K	\$ 615K	\$ 3,525K
• CAPITAL EQUIPMENT QUANTITY DISCOUNTS	\$ 270K	-	\$ 943K	\$ 1,304K
• PCB GATE (BARE BOARD TESTER)	-	\$ 1,050K	-	\$ 1,900K
• APST (AUTO. POWER SUPPLY TESTER)	-	\$ 1,100K	-	\$ 1,100K
PRODUCTIBILITY				
IN-HOUSE TRAINING				
ZEHNTTEL				
KEYBOARDS				
AUTO INSERT .01's	\$ 489K	\$ 383K	-	\$ 3,210K
E.C.O. INK				
PN LA 36				
AUTO DIP TESTER				
LARGE DIP INSERTER				
TOTAL	\$ 934K	\$ 4,243K	\$ 1,558K	\$11,039K
	\$5,177K			
TOTAL		\$6,735K		

SAVINGS FOR NEXT YEAR'S COST/BENEFIT ANALYSIS

Key Savings were for: REZERO (\$2.5M)

PROCESS ENGINEERING COST/BENEFIT RATIO

REZERO

THIS IS A PHOTO ELECTRIC CELL AND ITS ASSOCIATED SOFTWARE DEVELOPED BY C.P.E., WHICH IS NOW ATTACHED TO ALL AUTOMATIC COMPONENT INSERTERS AT DEC. IT SCANS EACH BOARD LOOKING FOR TWO KNOWN HOLES. ONCE FOUND, THE SOFTWARE DETERMINES IF THE BOARD'S HOLES ARE IN THE PROPER LOCATIONS AND IF NOT A COMPENSATING OFFSET IS CALCULATED TO MAKE THE INSERTER WORK WITHOUT OPERATOR INTERVENTION.

WHY

EXCESSIVE REALIGNMENT OF VCD & DIP INSERTERS DUE TO

- . OCCASIONAL WARPAGE IN BOARDS
- . FLUCTUATIONS IN DRILL SHOP ACCURACY

SAVINGS

- . THROUGHPUT INCREASE - VCD 10%; DIP 30%
 - WHICH MEANS \$1,710K OF LABOR SAVED
 - WHICH MEANS \$ 590K OF NEW MACHINERY AVOIDED
- . GREATER TOLERANCES ALLOWED IN DRILL SHOP
 - WHICH MEANS \$180K OF IMPROVEMENTS AVOIDED
- . DECREASED REWORK, MAINTENANCE & SCRAP COSTS

APT vs ACT (\$2M)

PROCESS ENGINEERING COST/BENEFIT RATIO

APT vs ACT

APT IN AG IS USED TO CONTROL 400+ COMPUTERS WHILE THEY UNDERGO THERMAL CYCLE. UNTIL APT WAS DEVELOPED DEC USED ANOTHER SYSTEM CALLED "ACT".

	<u>APT</u>	<u>ACT</u>	<u>COST AVOIDANCE</u>
CAPITAL EQUIPMENT	\$500K	\$2,418K	\$1,918K
SPACE NEEDS	4K SQ FT	20K SQ FT	\$ 48K/YR
PERSONNEL	6	11	\$ 60K/YR
TOTAL 1ST YEAR SAVINGS			\$2,026K

PCB Gate (\$1M)

PROCESS ENGINEERING COST/BENEFIT RATIO

PCB GATE
(ALIAS: BARE BOARD TESTER)

THE BOARD SHOP IS PRODUCING BOARDS WITH DENSER LINES, AND DEC IS PUTTING MORE EMPHASIS ON MULTILAYER BOARDS. THIS CREATES A GREAT DEAL OF PRESSURE ON THE BOARD SHOP VISUAL INSPECTORS TO CATCH ALL DEFECTS. IN THE PAST, MANUFACTURING HAD TO WAIT UNTIL MODULE TEST (AFTER MODULE ASSEMBLY) TO FIND BOARD RELATED DEFECTS. THE PCB GATE IS A TESTER WHICH AUTOMATICALLY AND ELECTRICALLY TESTS THE BARE BOARD BEFORE IT LEAVES THE BOARD SHOP. IT IS A VERY EFFECTIVE TESTER AND RELIEVES THE INSPECTORS OF A GREAT DEAL OF EYE STRAIN.

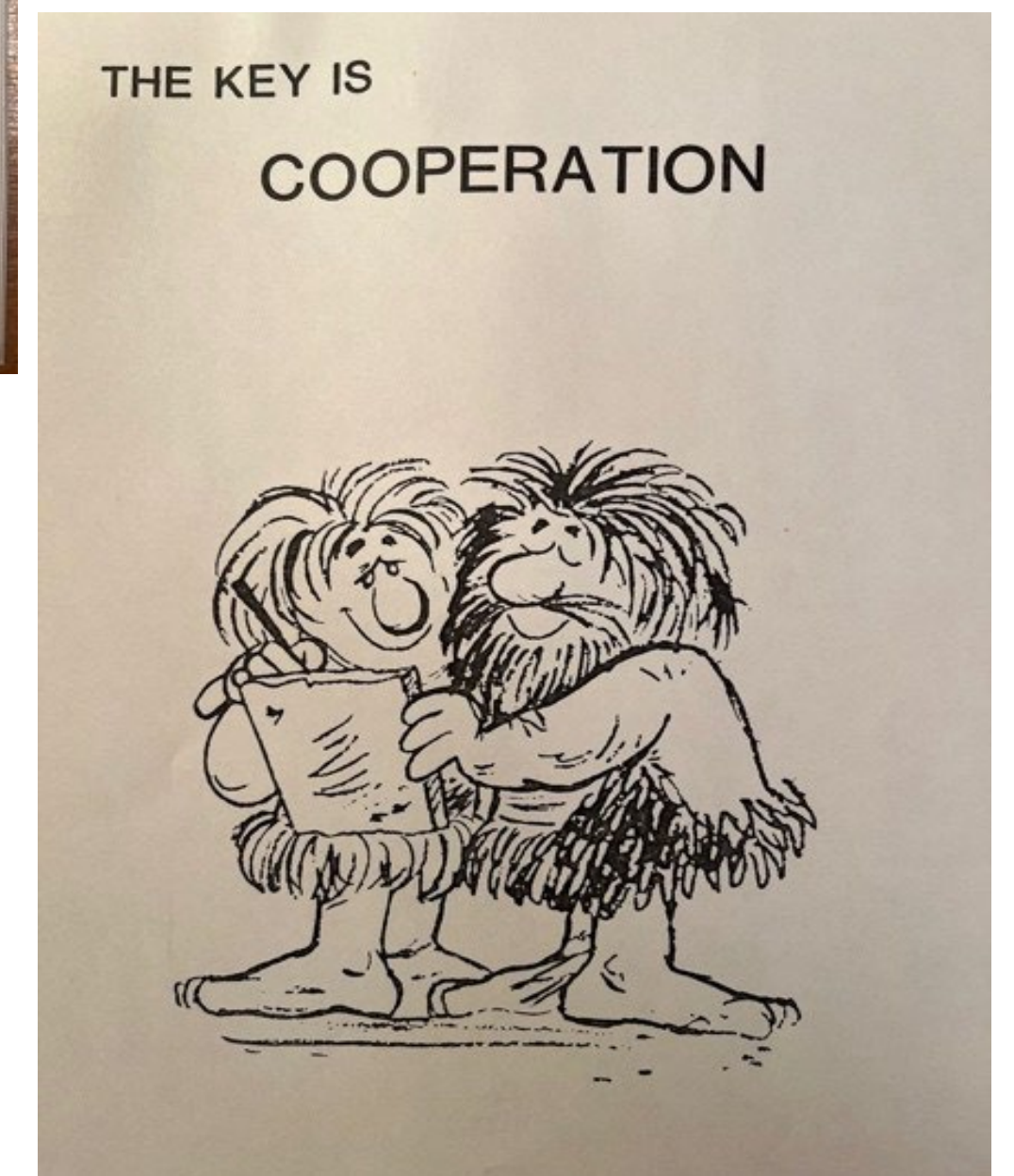
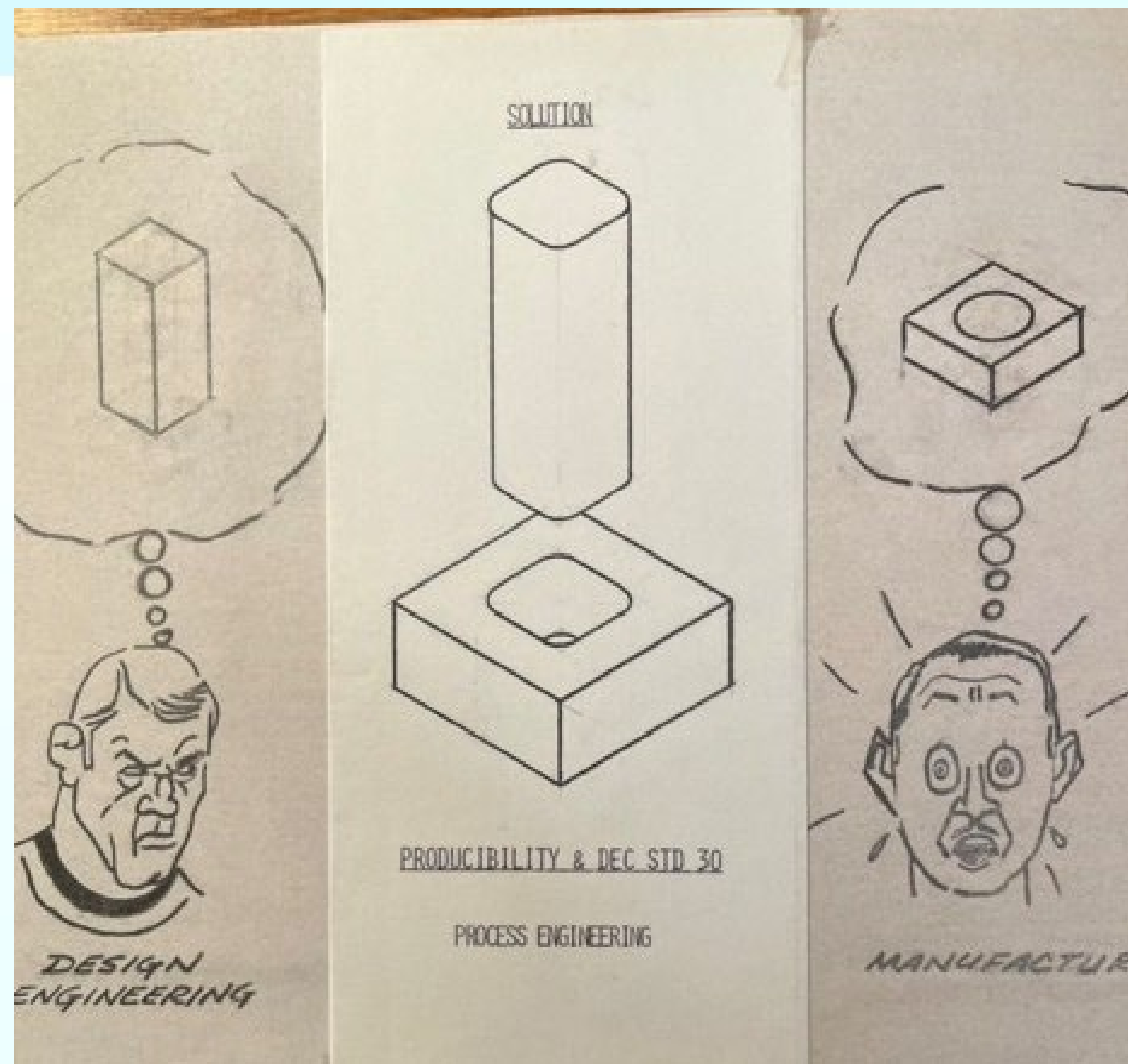
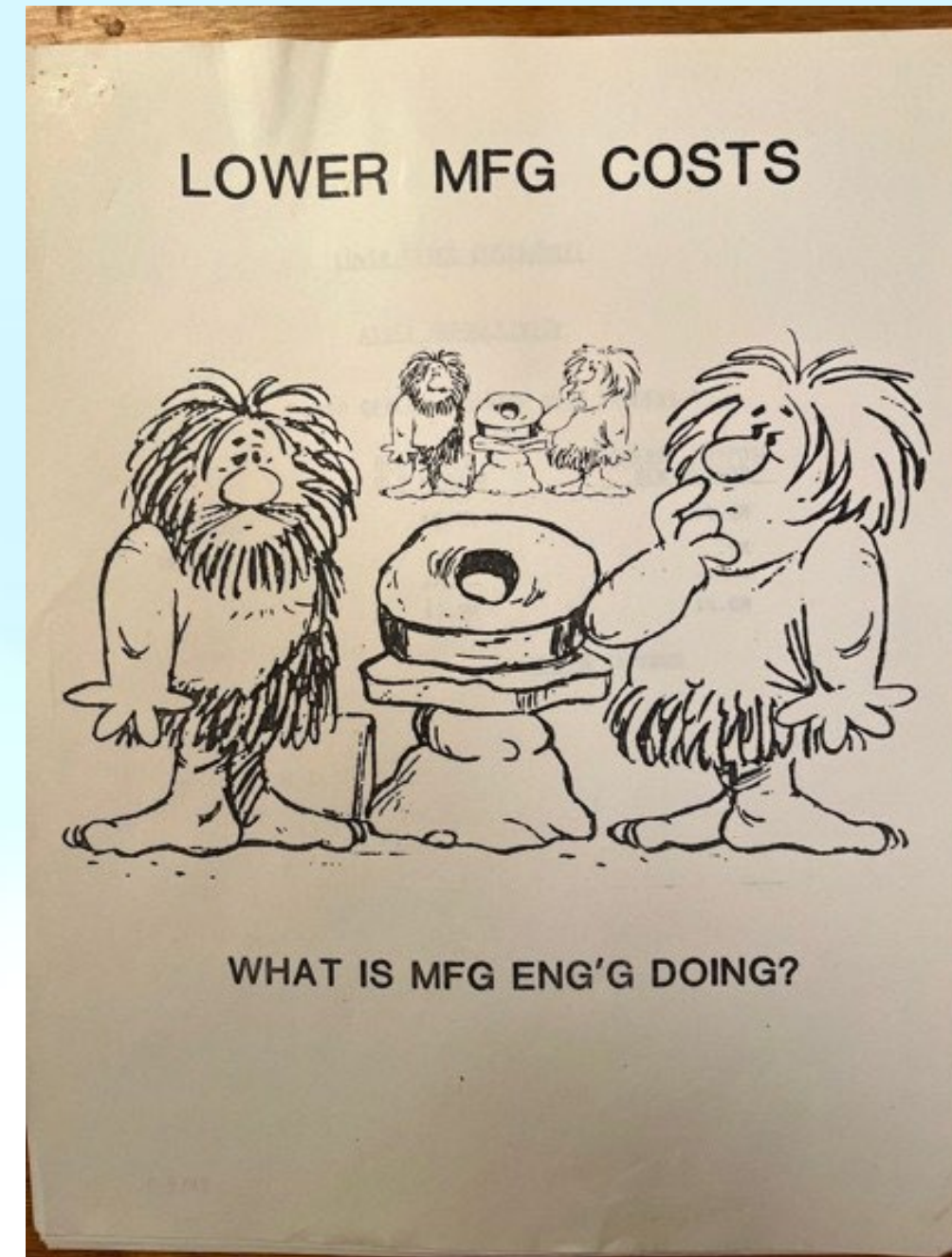
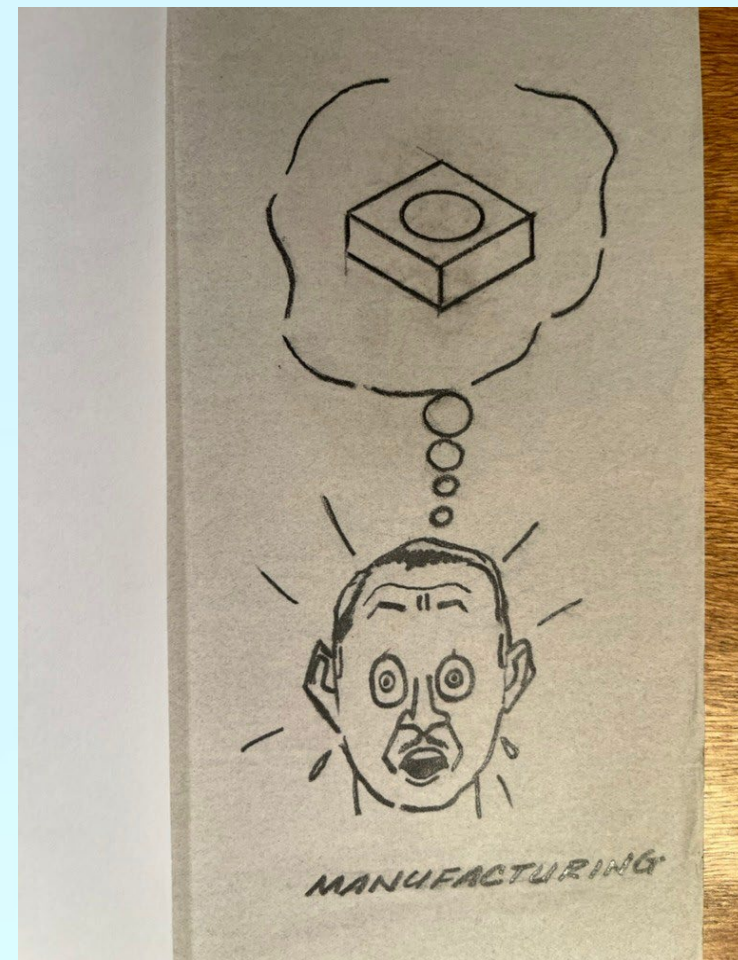
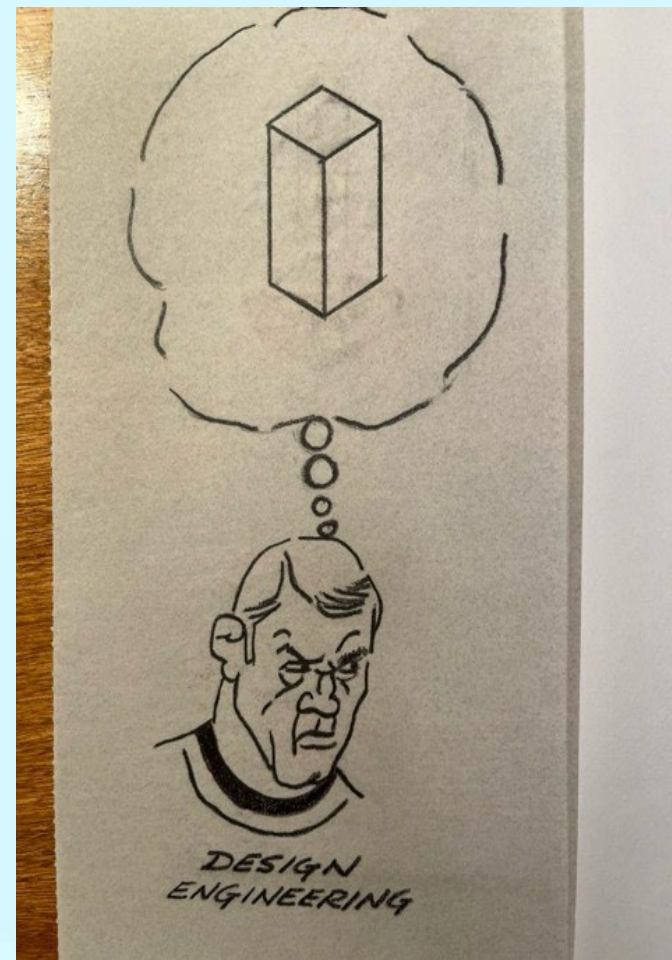
	<u>WITH PCB GATE</u>	<u>W/O PCB GATE</u>
DEFECT DETECTION:	ELECTRICAL TEST	VISUAL INSPECTION
DEFECTS FOUND:		
HIGH DENSITY	98%	85%
MULTILAYER	98%	60%
COST TO FIND AND REPAIR		
BOARDSHOP DEFECTS:	\$4/BOARD	\$7/BOARD
FEEDBACK TO BOARDSHOP	IMMEDIATE	RARELY & TOO LATE

More Cool Successes!

- **Rezero**
- **Aqueous Cleaner**
- **Eng'g Change Order (ECO) Ink**
- **Printable Key Caps**



How Do We TELL THE WORLD What We Do?



I am forever grateful to the folks at Process Engineering. It was my first real job. I got to learn, experiment with out-of-the-box thinking, and experience the best that Matrix Management had to offer.

I went on to work in US Field Service Mktg: Ishak, Adrian, Poulsen, Zereski

Terminal Manufacturing (TMG): Forsyth, Dutta, Anderson

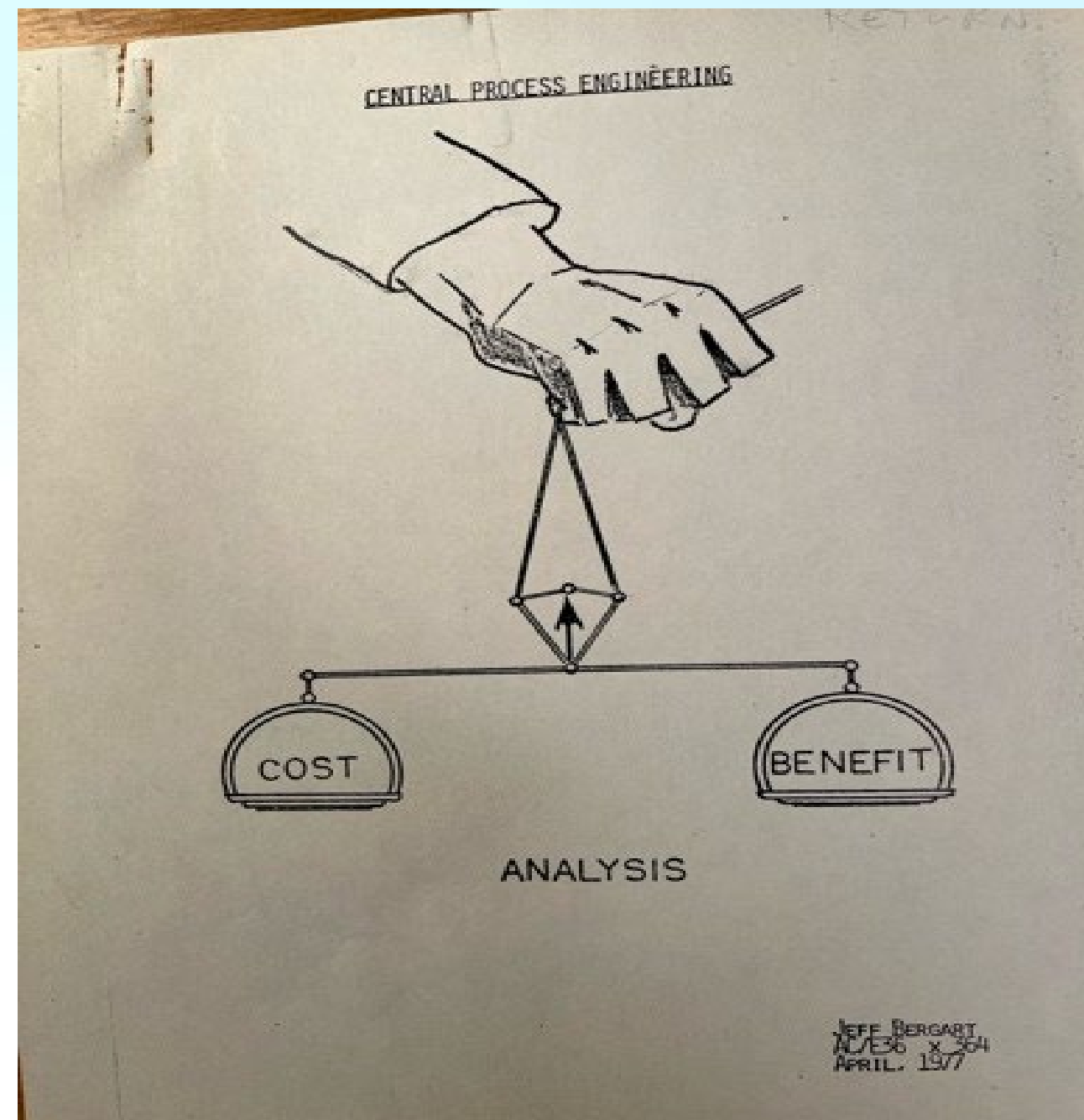
Word Processing Product Line: Brooks, Killheffer, Bunker, Dole

Printing Business Unit: Sweeney, Perry, Flanagan

BUT, my most FUN at DEC was with US CSS 1985-1993

STAY TUNED for my DECConnect presentation in the **SPRING 2025**

Please join me now and share your memories of Process Manufacturing Engineering



**But wait -- There's More!!
(In case there aren't more stories...)**

1) DECTalk

2) "SUPER" Poulsen Budget
Presentation



But wait -- There's More!! DECTalk



This is a demonstration of DECTalk Software text-to-speech technology.

DECTalk Software comes with an easy to use Force Computers Application Programming Interface, as well as Microsoft's Speech API, so you can make your applications speak.

The standard voices are Paul, [;nb] Betty, [;nh] Harry, [;nd] Dennis, [;nf] Frank, [;nu] Ursula, [;nr] Rita, [;nw] Wendy, [;nk] and I'm kit.

[;np] DECTalk Software can play sound files, [;play demo.wav] dial telephone numbers, [;dial 1-800-297-4863] or generate tones. [;tone 440,1000][;tone 880,1000]

DECTalk software has over 1,400 letter to sound rules, as well as extensive text preprocessing, so it can properly

[Open full sized image](#)

: \$1.25,

But wait -- There's More!!

“SUPER” Poulsen Budget Presentation



DEC Connection

Website: www.deconnection.org

Email for all inquiries: info@deconnection.org

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