Society of Tribologists and Lubrication Engineers
Sarnia Section

MEETING ANNOUNCEMENT
WEDNESDAY. MAR 9, 1994

1. MONTHLY MEETING

Topic: Achieving Real Cost Savings in Rotating Equipment

Speaker: Mr. Ken Brown, P.Eng., and STLE Fellow
President, Utility Service Associates, Toronto, Ontario

Location: Holiday Inn
1498 Venetian Blvd. Point Edward, ON

BIOGRAPHY

Ken Brown, P. Eng. has actively been involved in the STLE for many years. Ken received his B.Sc. and M.Sc. in Mechanical Engineering from the University of Waterloo.
After graduating, he joined the Power Equipment Dept of Ontario Hydro beginning as a Design Engineer. For 17 years he worked he provided tribological assistance on nuclear, fossil, and hydroelectric plants for rotating equipment such as pumps. turbines, motors, and fans as well as auxiliary equipment such as filters. purifiers and fuel loading machines. Duties included trouble shooting bearings and lubricants, preparing equipment specifications and championing the causes of improved conditions monitoring and better lubricants. In 1993, Ken left Ontario Hydro to form Utility Service Associates. He remains active in the STLE and is currently chair of the Editorial & Publications Committee.

ABSTRACT

The talk will address the need for improvements with respect to cost savings and hence competitive positions often with little or no significant costs. There will be an overview of how this can be easily accomplished for equipment such as bearings, seals, gearboxes, motors, and compressors. An example will be given of how changing lubricants resulted in a 9% power savings for a 400 HP gearbox.
The presentation will also discuss the methods of calculating paybacks.

ACHIEVING REAL COST SAVINGS IN ROTATING EQUIPMENT

SARNIA STLE SECTION

MARCH 9, 1994

THE NEED

- PROBLEM EQUIPMENT
- ENVIRONMENTAL REQUIREMENTS
- SAFETY
- POOR AVAILABILITY
- HIGHER OPERATING COSTS ARE RESULTING IN A LOSS OF THE PROFIT MARGINS

NATIONALLY

CANADA LOSES MORE THAN $5 BILLION ANNUALLY DUE TO FRICTION AND WEAR.

IT HAS BEEN ESTIMATED THAT $1.3 BILLION OR 25% OF THESE LOSES COULD BE SAVED THROUGH BETTER APPLICATION OF EXISTING TECHNOLOGY AND THROUGH RESEARCH AND DEVELOPMENT.

MAYBE THERE IS NO INCENTIVE TO DO ANYTHING DIFFERENT BECAUSE APPROVAL IMPLIES REAL OR PERCEIVED INDIVIDUAL RISK.

IE. SUITS SHOW TEFLON TENDENCIES.

PEOPLE WITH A VERY GOOD UNDERSTANDING OF STANDARD BUSINESS PRACTISES APPEAR TO HAVE GREAT DIFFICULTY IN UNDERSTANDING THAT SPENDING MONEY WILL SAVE MUCH MORE MONEY IN THE LONGER TERM.

1. CRITICALLY EXAMINING COMPONENTS THAT ARE REPLACED OR HAD FAILED.

THIS MEANS TO PROVIDE FEEDBACK FOR VIBRATION CREWS, LUBE LABS, LUBRICATORS, ETC., AND

GETTING THE INPUT REQUIRED TO DETERMINE THE CAUSE OF "PREMATURE" FAILURES.

BEARING INSPECTION REPORT
ROLLING ELEMENT BEARINGS (BALL AND ROLLER)
SHORT FORM

DATE (D/M/Y): _____ STATION: _____ UNIT: _____ SCI NUMBER: _____
EQUIPMENT: _____ PUMP ___ FAN ___
_____ MOTOR ___ COUPLING ___
_____ OTHER _____

SHAFT SPEED (rpm): _____ BEARING TEMPERATURE (°C): _____ USE: Continuous ___ Spare ___ Standby ___ Mothballed ___
AMBIENT CONDITIONS: Dry ___ Moist ___ Wet ___ Station Ambient ___ Hotter ___ Colder ___ Clean ___ Dusty ___ Dirty ___

REASON FOR CHANGE: OVERHAUL ___ VIBRATION ___ NOISE ___ TEMPERATURE ___ OIL ANALYSIS ___ OTHER _____
DATE BEARING LAST CHANGED _____ UNKNOWN BUT RECENT ___ LONGER THAN 1 YEAR ___ LONGER THAN 5 YEARS ___
DATE LUBRICANT CHANGED _____ UNKNOWN BUT RECENT ___ LONGER THAN 1 YEAR ___ LONGER THAN 2 YEARS ___

BEARING MANUFACTURER: SKF ___ FAG ___ OTHER _____ BEARING CODE (ie 6312 C3): _____
SEALS: YES ___ NO ___ NDE ___ DE ___ SHIELDS: YES ___ NO ___ NDE ___ DE ___
CAGE: STEEL ___ BRASS ___ PLASTIC ___ OTHER _____

LUBRICANT: CIRC OIL ___ SUMP ___ GREASE ___ SEALED FOR LIFE ___ OIL MIST ___ OTHER _____

OIL CORRECT ___ LEVEL LOW ___ LEVEL HIGH ___ DIRT ___ WATER ___ OIL CLEAR ___ DARK ___ CLOUDY ___ VISCOUS ___ THIN ___
SMELLY ___ OTHER _____

GREASE OKAY ___ TOO SOFT ___ HARD ___ DISCOLOURED ___ PARTICLES ___ WATER ___ OTHER _____

LUBRICANT SAMPLE SAVED FOR ANALYSIS, YES ___ NO ___ BY SITE LAB ___ KIPLING ___ SUPPLIER _____ OTHER _____

NEW OIL ADDED (ie Teresso 46) _____ NEW GREASE ADDED (ie Unirex EP2)

BEARING CONDITION:

COULD BE REUSED ___ WILL BE REUSED ___ EASY TO TURN ___ LOOSE ___ HARD TO TURN ___ SEIZED ___
BRIGHT METAL ___ SOME CORROSION/DISCOLORATION ___ GENERAL CORROSION/DISCOLORATION ___ VERY BAD ___
TRACK PATH: CENTRED ___ SKEWED ___ NONUNIFORM ___ TO ONE SIDE - NDE ___ DE ___
LACK OF LUBRICATION DAMAGE: INNER RACE ___ OUTER RACE ___ ROLLING ELEMENTS ___
INDENTATION DAMAGE: ON INNER RACE ___ OUTER RACE ___ ROLLING ELEMENTS ___
STAINING: ON INNER RACE ___ OUTER RACE ___ ROLLING ELEMENTS ___
FATIGUE PITTING: ON INNER RACE ___ OUTER RACE ___ ROLLING ELEMENTS ___
TRUE BRINELLING: ON INNER RACE ___ OUTER RACE ___ ROLLING ELEMENTS ___
FALSE BRINELLING (FRETTING): ON INNER RACE ___ OUTER RACE ___ ROLLING ELEMENTS ___
ON BORE ___ ON OUTSIDE DIAMETER ___

OTHER: SMEARING ___ ELECTRICAL DISCHARGE ___ SCORING ___ ASSEMBLY DAMAGE ___
OVERHEATING ___ FRACTURE ___ FAILED CAGE ___ OR SPECIFY _____
_____

ON INNER RACE ___ OUTER RACE ___ ROLLING ELEMENTS ___

COMMENTS: _____

COMPLETED BY (PRINT): _____ CREW: _____ BADGE NO.: _____ PHONE: _____

Note:
1. Bearing that are being removed should always be examined to provide feedback to correct problems and to optimize maintenance and lubrication practices. If in doubt the bearings should be saved for examination by the appropriate personnel at site, Kipling, head office or bearing supplier.
2. It should not be assumed that the bearing being removed or taken from stores is correct. If in doubt ask.
3. To assist in latter inspections it is suggested that except for special cases, that the new bearing be installed so that the bearing codes faces out and is at top dead centre. In the case of vertical machines it can be towards the motor leads.

kjbrown rev 2 dec/92

2. <u>UPGRADING</u> TRAINING, TOOLS AND PARTS, AND

THIS MEANS A COMMITMENT TO THE FOLLOWING:

TO MAXIMIZE THE EFFECTIVENESS OF EVERYONE,

TO OBTAIN THE REQUIRED TOOLS, AND

TO ENSURE THAT EQUIPMENT AND SPARE PARTS ARE THE MOST COST EFFECTIVE.

3. ONLY DOING THE WORK WHEN YOU <u>KNOW</u> IT IS REQUIRED.

THIS RESULTS IN COST SAVINGS AS PROACTIVE MAINTENANCE IS IN GENERAL LESS EXPENSIVE THAN PREVENTATIVE MAINTENANCE WHICH IS LESS EXPENSIVE THAN FAILURE MAINTENANCE.

NEWTON'S LAWS OF MOTION

I. EVERY BODY CONTINUES IN ITS STATE OF REST OR OF UNIFORM MOTION IN A STRAIGHT LINE EXCEPT IN SO FAR AS IT MAY BE COMPELLED TO CHANGE THAT STATE BY THE ACTION OF SOME OUTSIDE FORCE.

TRIBOLOGICAL LAWS OF PRODUCTION

I. EVERY PIECE OF MACHINERY REMAINS BROKEN OR CONTINUES TO DETERIORATE AT A UNIFORM RATE EXCEPT IN SO FAR AS IT MAY BE COMPELLED TO CHANGE BY SOME OUTSIDE FORCE.

NEWTON'S LAWS OF MOTION

III. TO EVERY ACTION THERE IS ALWAYS AN EQUAL AND OPPOSITE REACTION.

TRIBOLOGICAL LAWS OF MOTION

III. TO EVERY IMPROVEMENT THERE IS ALWAYS AT FIRST AN EQUAL AND OPPOSITE REACTION.

TRIBOLOGICAL RELATIVITY

$$F = m \cdot a$$

WHERE:

F EQUALS THE FUNDS REQUIRED/SPENT

m IS THE PEOPLE MASS INVOLVED

a IS THE NO. OF APPROVALS REQ'D

MAYBE THE TECHNOLOGY IS NOT AVAILABLE.

SOURCES OF TRIBOLOGICAL SOLUTIONS

- READILY AVAILABLE IN 80% OF CASES
- A BIT OF DIGGING IN 15%
- LONGER TERM EFFORTS OR NEVER IN 5%.

MAYBE "THEY" ARE RIGHT AND THERE ARE NOT MANY FAILURES.

MAYBE IT'S TOO EXPENSIVE TO MAKE A DIFFERENCE.

FLUID TO EQUIPMENT COSTS
(940 MW UNIT)

EQUIPMENT	PERCENTAGE COST OIL/EQUIPMENT
BOILER FEED PUMPSET	0.04%
SERVICE AIR COMPRESSOR	0.04%
TURBINE CONTROL FLUID[1]	0.06%
TURBINE MINERAL OIL	0.08%
PHT PUMP MOTOR	0.16%
GAS TURBINE (INDUSTRIAL)[1]	0.63%

Note: 1. Synthetic and or synthesized (PAO) fluids.

BEARINGS

IT HAS BEEN FOUND THAT 90% OF ROLLING ELEMENT BEARINGS WILL NOT REACH THEIR INTENDED LIFE SPAN.

IN THE U.S. THIS AMOUNTS TO $1.3 BILLION FOR THE BEARINGS ALONE.

CAUSES OF PREMATURE ENGINE FAILURE

DIRT	44.9%
MISASSEMBLY	13.4%
MISALIGNMENT	12.7%
LUBRICATION	10.8%
OVERLOADING	9.5%
CORROSION	4.2%
OTHER	4.5%

MOTORS

A U.S. SURVEY FOUND THAT BEARINGS WERE THE NUMBER ONE CAUSE OF ELECTRIC MOTOR FAILURES.

IN FACT, BEARINGS WERE MENTIONED FIVE TIMES AS OFTEN AS ANY OTHER CAUSE OF MOTOR FAILURE.

HYDRAULICS

IT HAS BEEN REPORTED THAT 70% OF HYDRAULIC SYSTEM FAILURES ARE DUE TO FLUID CONTAMINATION.

ELECTRIC POWER INDUSTRY

FOR BOILER FEED PUMPS IT WAS FOUND THAT 21.8% OF OUTAGES WERE BECAUSE OF THE BEARINGS. POOR DESIGN WAS THE LEADING CAUSE.

SIMILARLY FOR UTILITY MOTORS 41% WERE BECAUSE OF THE BEARINGS. REASONS WERE DESIGN 39%, WORKMANSHIP 27%, MISOPERATION 20% AND MISAPPLICATION 14%.

WHAT ARE "COST SAVINGS"?

YOUR GROUP ONLY?
THIS WORK LOCATION?
CORPORATE?
IMAGE?
ENERGY?
SAFETY?
ENVIRONMENT?

	Energy Saving
400 Hp 20:1 Worm Gear Ore Crusher	8%
150 Hp Screw Air Compressor	7%
600 Ton Metal Stamping Press	9%
750 Hp Centrifugal Air Compressor	3.5%

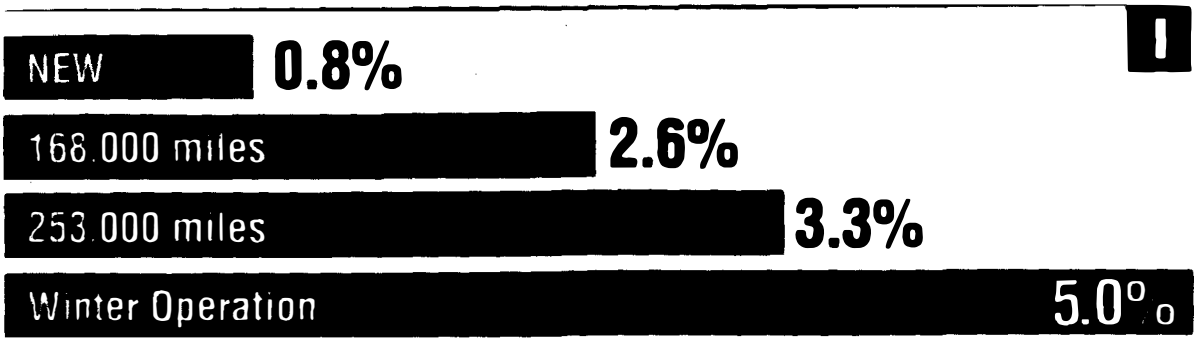
The cost of an initial fill with synthetic lubricant vs. mineral-based

	Mineral	Synthetic Lubricant
Transmission lubricant: 3.1 gallons x (cost/gallon) +	$ 12	$ 32
Labor cost to change lubricant: 1 hour x $38/hour =	38	38
Total cost for transmission lubricant =	$ 50	$ 70
Axle lubricant: 9.75 gallons x (cost/gallon) =	$ 37	$ 99
Labor cost to change lubricant: 1 hour x $38/hour =	38	38
Total cost for axle lubricant =	$ 75	$137

Cost difference of mineral-based vs synthetic lubricant

	INITIAL FILL*	50	100	150	200	250	300	350	400	450	500,000 MILES
Axle											
Mineral	75		75		75		75		75		75	**$450**
Eaton Roadranger Lubricant	137					137						$271
Transmission											
Mineral	50	50	50	50	50	50	50	50	50	50	50	**$550**
Eaton Roadranger Lubricant	70					70						$140

Dynamometer and road testing of synthetic lubricant fuel efficiency*



Impact of 1% fuel savings on fuel volume and expense per vehicle

Gallons Consumed

Miles Traveled	Mineral-based	Synthetic Lubricant	Est. Savings @ $1/gal.
100,000	20,000	19,800	$ 200
200,000	40,000	39,600	400
300,000	60,000	59,400	600
400,000	80,000	79,200	800
500,000	100,000	99,000	1000

**Based on tests run by RCCC, ALI and the Canadian Forest Service*

4.0 UNIT SAVINGS

Unit 3 of the Lambton Thermal Generating Station contains 6 coal pulverizer gear boxes, at any one time 5 of these gearboxes are in operation. Assuming the coal pulverizers usually run on a 60% average loading at 7.17 kg/s and that the oil change out period will probably be doubled, the energy savings and payback period may be easily calculated.

Price of	$6.85/L
Price of Mineral 320	$1.50/L
Annual Usage	7500 hrs.
Electricity Charge	$0.075 per kWh
Coal Pulverizer Lubricant Capacity	1025 L

A. Lubricant Cost

Mineral:

Lubricant cost per fill	$1537.50
Number of fills per year	1.0
Lubricant cost per year	$1537.50

Synthetic:

Lubricant cost per fill	$7021.25
Number of fills per year	0.5
Lubricant cost per year	$3510.63

Therefore there is an incremental lubricant cost of $ 1973.13 per year for each gear drive.

B. Energy Cost

Mineral:

Average Pulverizer Energy Consumption Rate = 6.011 kVAh/min

Average Power Factor = 0.787

$$\text{Yearly Energy Consumption} = \frac{7.17\ \text{kg}}{\text{s}} * \frac{0.835\ \text{kVAh/min}}{\text{kg/s}} * 0.787 * \frac{60\ \text{min}}{\text{hr}} * \frac{\$0.075}{\text{kWh}} * \frac{7500\ \text{hrs}}{\text{year}}$$

$$= \$\ 159\ 020.88$$

Synthetic:

Average Pulverizer Energy Consumption Rate = 5.255 kVAh/min

Average Power Factor = 0.796

Yearly Energy Consumption = $\frac{7.17\ kg}{s} * \frac{0.762\ kVAh/min}{kg/s} * 0.796 * \frac{60\ min}{hr} * \frac{\$0.075}{kWh} * \frac{7500\ hrs}{year}$

= **$ 146 778.00**

Energy savings per gear drive = **$ 12 242.88.**

C. Total Unit Savings

Incremental lubricant cost for the six gear drives = $ 1973.13 * 6.00 = $11 838.75

Energy savings for the 5 operating gear drives = $12 242.88 * 5.00 = $61 214.40

Total Energy Savings = **$49 375.65**

5.0 Payback Period Calculated for an Individual Gear Reducer

Daily Energy Cost (Mineral) = $\frac{7.17\ kg}{s} * \frac{0.835\ kVAh/min}{kg/s} * 0.787 * \frac{60\ min}{hr} * \frac{\$0.075}{kWh} * \frac{24\ hrs}{day}$

= $ 508.87 per operating day

Daily Energy Cost (Synthetic) = $\frac{7.17\ kg}{s} * \frac{0.762\ kVAh/min}{kg/s} * 0.796 * \frac{60\ min}{hr} * \frac{\$0.075}{kWh} * \frac{24\ hrs}{day}$

= $ 469.69 per operating day

Incremental Lubricant Cost = ($6.85 - $1.50)/L * 1025 L

= $ 5483.75

Payback Period = $\frac{\$5483.75}{\$39.18/day}$ = **139.96 Days**

SAVINGS FORMULA

(VOLTS X AMPS)/1000 X PF X $/KWH = $/HR

EXISTING **4160 X 38/1000 X 0.8 X 0.065 = 14.24**

PROPOSED **4160 X 24/1000 X 0.8 X 0.065 = 8.99**

SAVINGS **14 AMPS** **80.7 KW** **5.25 $/HR**

SAVINGS 5.25 $/HR X 12 HOURS/DAYS = 63.00 $/DAY

63.00 $/DAY X 365 DAYS PER YEAR = 22,995 $/YEAR

LUBRICANT COST COMPARISON

PRESENT 2.30 X $/GALLON X 9 GALLON CAPACITY = $20.70

PROPOSED 13.54 X $/GALLON X 9 GALLON CAPACITY = $121.86

$101.16

NET ENERGY SAVINGS

GROSS SAVINGS PER YEAR $22,995.00

LESS COST DIFFERENCE $101.16

NET ENERGY SAVINGS $22,893.84

BREAK EVEN POINT

$101.16/$63.00 = 1.60 DAYS

OIL CHANGES

STANDARD CHARGES CONSIDERED
ARE AS FOLLOWS;

LABOUR TO CHANGE OIL +
DISPOSAL COSTS +
COST OF NEW OIL

BUT THERE ARE OTHER
SIGNIFICANT HIDDEN COSTS

1. AVAILABILITY:

1.1 EQUIPMENT IMPACT: First if the oil is being changed the equipment is unavailable not for just the time to change the oil but from when it is isolated to when isolation is removed. In some cases there is not redundant equipment as for example with the drive for increased power output at some stations, all three 50% pumps have to be run. The impact of unavailability is estimated to be one day or 0.3% of the annual usage as attempts to get a dollar value have not been successful, mainly because the cost depends where in the cycle the equipment is located.

ESTIMATED COST IS $200.

2. LABOUR COSTS CONT'D:

2.3 LABOUR COST TO BE BASED ON REAL AVERAGES NOT EXPECTED AS WRENCH TIME CAN BE VERY LOW: Include time waiting to be assigned work, to go to location, get drums, get transfer pumps, get spill containment equipment, get new fluid, take used fluid to storage area and complete required documentation, clean up area, dispose of empty product drum, return equipment. Estimates of actual wrench time for mechanical maintainers is 12.5%. Consequently, if a job takes one hour the nonproductive time is eight times as much but this factor is conservatively taken as 2 as it is hoped that many lube changes can be lumped together with other work.

THE SUGGESTED FACTOR IS 2.

3. OIL DISPOSAL:

3.1 DISPOSAL COSTS: This is cost to pay an independent trucker and waste disposal company to pick up nonactive waste oil. Active waste can be about $2000 a drum.

COST IS CONSERVATIVELY ESTIMATED AT $1.50 PER LITRE OR $310 A DRUM

3. OIL DISPOSAL CONT'D:

3.2 TRANSFER COSTS: To include all incurred expenses this should consider costs for temporary storage site, safeguarding, costs to moving to the shipping truck or to a secondary sites and finally transfer to the loading dock or long term storage.

THIS IS ESTIMATED AS BEING 1 HOUR PER DRUM.

3. OIL DISPOSAL CONT'D:

3.3 LAB COSTS: Laboratory space and equipment, labour and tracking costs for the initial oil sampling of all drums and the costs for testing for radiation, PCB's, water and solvents.

THIS IS ESTIMATED AS BEING $100 A DRUM.

3. OIL DISPOSAL CONT'D:

3.4 SOLID WASTE: Plus when oil is changed solid waste will also be generated that should be costed. This includes gloves, filters, wipes, solid adsorbents, plastic bottles and hoses for sampling and the empty oil drums.

ESTIMATED AT $25.

4. REPLACEMENT OIL:

4.1 NEW OIL COSTS: The list price for new oil is estimated to be $1.73 per litre. This will be less for bulk steam turbine oil but more for hydraulic oil and gear oils. The price does not include taxes so PST and GST is added. Note that in some cases the PST can be avoided.

COST PER DRUM IS $355

4. REPLACEMENT OIL CONT'D:

4.2 NEW OIL OVERHEADS: These include the interest on inventory and the costs of storage areas. Costs for the heated storage is known to be about $70/year/cubic metre although for oils the cost would be higher because for oil storage and the local oil rooms extra fire protection, venting and grounding is provided. Further a typical supply and stores staff total ? people for a large plant. For the latter the dollar value of the material per year is ? and typically a drum of oil costs $355.

COSTS PER DRUM ARE ESTIMATED AT $100.

4. REPLACEMENT OIL CONT'D:

4.2 PURCHASE ORDERS: To prepare and send out, to review, to select the successful bidder, to maintain bid lists, to keep track of the sales tax and the GST, to contact technical units if questions arise, etc. Estimates for this range from $250 to $1500.

COST IS ESTIMATED AT $400 PER PURCHASE ORDER.

A = Cost of equipment not being available ($200)
P = Paper and administration costs associated with permits (taken as one hour, ie H)
H = Labour cost per hour for a maintainer (used $27)
WO = Waste oil disposal cost per litre (ie $1.50)
Q = Quantity involved in litres (ie one 205 litre drum)
T = Waste oil transfer costs per drum (one hour)
L = Lab costs per drum ($100)
SW = Solid waste ($25)
LW = Liquid waste ($25)
N = New oil cost (ie $1.73 x 205 litres)
NO = New oil overheads ($100)
PO = Purchase order issuing ($400)
E = Equipment failures ($20)
S = Safety costs ($20)

CALCULATION

Availability + Labour + Oil Disposal + Replacement Oil + Equipment Failures and Spills + Safety

(A + P) + (Hx1.5x1.2x2) + (WO(Q) + T + L + SW + LW) +(N + NO + PO) + E + S

EXAMPLE

For an oil change requiring 1 drum of oil, which is estimated to take two people 3 hours each at a hourly rate of $27 and a cost of new oil at $1.73 per litre

($200 + $27) + ($27x1.5x1.2x2) + ($310 + $27 + $100 + $25 + $25) + ($355 + $100 + $400) + $20 + $20 = $1706.20

THIS IS ALMOST 5 TIMES THE COST OF JUST THE NEW OIL.

THE KEYS TO ALL OF THIS ARE AS FOLLOWS;

1. KNOW YOUR REAL LIFE CYCLE COSTS.

2. BENCHMARK TO KNOW WHAT OTHERS ARE DOING.

3. KNOW WHAT OR KNOW WHO KNOWS WHAT IS AVAILABLE.

4. FOSTER A LEARNING ENVIRONMENT.

5. HAVE PROOF OF SAVINGS OR LEAST GOOD JUSTIFICATION.

CONCLUSIONS

1. SIGNIFICANT IMPROVEMENTS AND COST SAVINGS ARE AVAILABLE THROUGH THE APPLICATION OF TRIBOLOGICAL TECHNOLOGY.

2. IMPLEMENTATION IS BEING INADVERTENTLY IMPEDED BY MANAGEMENT AND/OR ORGANIZATIONAL STRUCTURES.

3. CHANGE CAN BE ENCOURAGED THROUGH CO-OPERATION TO PRODUCE BETTER DOCUMENTATION.

SO WHY DOESN'T IT HAPPEN?

THOSE WHO WANT TO MAKE SIGNIFICANT TRIBOLOGICAL CHANGE COULD BENEFIT FROM WORKING TOGETHER.

ACTIONS COULD BE TO COMPILE INDEPENDENT DATABASES ON COSTS, CONTACTS AND SAVINGS AS WELL AS TO PREPARE GUIDELINES FOR EVALUATIONS.