Sensor Total Cost of Ownership

Analyzing It, Calculating It

White Paper

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Overview

"There is nothing in the world that some man cannot make a little worse and sell a little cheaper, and he who considers price only is that man's lawful prey."

John Ruskin (1819 - 1900)

The lifetime cost of a sensor or transducer involves more than the initial cost for the item itself. By looking at the total cost of ownership, an optimum purchase decision can be made specific to your application.

Introduction

If you purchase a car, the initial purchase price may only be 60% of the total lifetime cost of the vehicle. Gas, oil, repairs, insurance, maintenance, taxes, license fees, and other costs can exceed the initial purchase price over a 5- to 10-year typical vehicle lifetime.

If your company purchases a PC, the initial purchase price may only be 10% of the total lifetime cost of the computer. Installation, support, training, upgrades, and repairs usually dwarf the initial outlay.

Have you looked at the total cost of ownership for the sensors and transducers you are using? Do you look at these costs before making a specification?

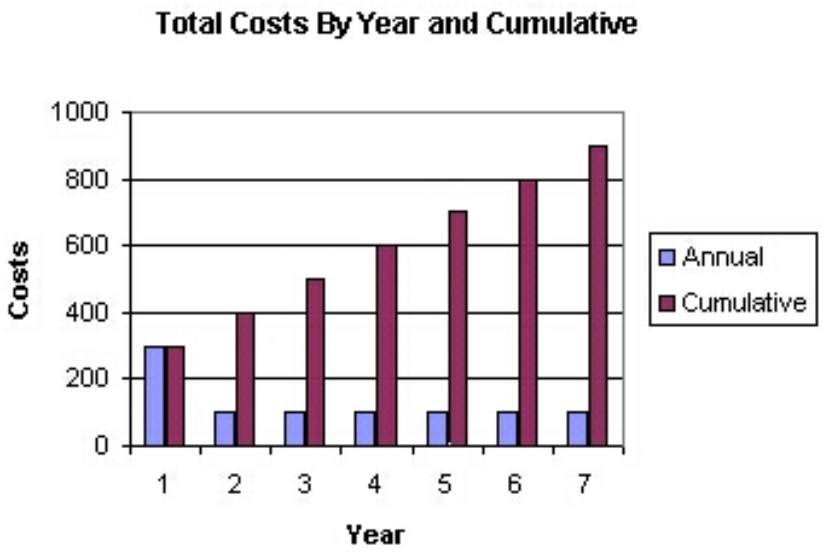


Figure 1 - Total sensor lifetime costs can exceed the initial purchase price.

Typical "Initial Cost" Purchase Analysis

When someone asks you how much did something "cost," you typically state a figure based on what was shown on the quote, invoice, or receipt. In the case of a transducer, this is often only the cost of the transducer and possibly an amount for shipping, taxes, and related transaction costs.

This cost accounting may make the boss and the finance department happy. It can also reduce effectiveness and profitability.

What's Missing

You may say to yourself, "I'm only buying a simple transducer. What other costs could there be?"

I'm glad you asked. Below is a list of other costs that you may incur in the purchasing, maintaining, installing, and use of your transducer. These costs, in total, can become much larger than the initial "invoice" purchase price.

INSTALLATION - Does the transducer design require you to make a special mounting plate or is flexible mounting inherent in the product? How long does installation take? Can installation be performed by a lower-skilled employee or must a higher-skilled technician or engineer perform the task?

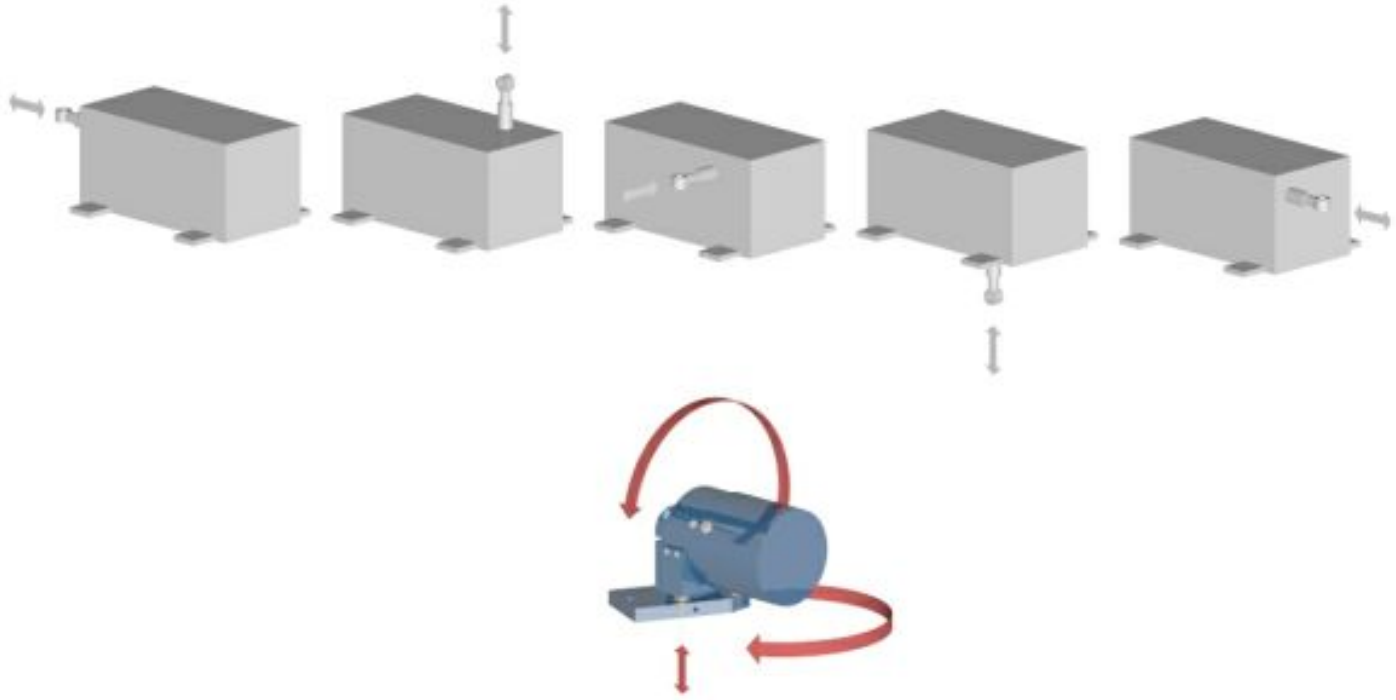


Figure 2 - Installation flexibility can eliminate special mounting fixtures and reduce installation time from hours to minutes. It can also reduce the number of unique parts purchased. For example, the above shows how one part with flexible mounting can replace the five parts with less flexible mounting.

CABLING, CONNECTORS, AND SIGNAL CONDITIONING - Does the sensor require the purchase of additional electrical cable, electrical connectors, signal conditioning, and related instrumentation?

RELIABILITY - What is the stated lifetime of the product? Does it have an MTBF (mean time before failure) rating? Does the vendor have reliability statistics of the product being used in an environment similar to your own? Unscheduled downtime costs can be huge in factory automation, aviation, and capital-intensive applications.

SCHEDULED DOWN TIME - Is calibration or scheduled maintenance required? How will this downtime affect your operations? Will alternate sensors need to be installed? Can this work be done during other maintenance periods?

REPAIRS - Is the product repairable or is it discarded at the end of its lifetime? Are there costs associated with its disposal? Can the repair be performed on site or must the item be returned to the manufacturer?

CALIBRATIONS - Can calibrations be performed on site or is factory return required? How often are calibrations required and what is the cost?

USABILITY - Is the signal from the product easy to work with or does it require specialized power supplies, amplifiers, and related equipment that must be procured, installed, learned, and configured?

LEAD TIME - Longer lead times require you to spend more time scheduling and may require you to stock sensors to avoid stock out situations.

ON-TIME PERFORMANCE - Does the sensor get delivered on time? If you planned for receiving the item in 7 days but the shipment does not show up for 21 days, you will spend valuable time re-scheduling resources and nagging the vendor to get the product to you.

ENVIRONMENTAL RATING - Unintended uses can often make environmental protection an important feature. A misplaced cup of coffee or an inadvertent blow from a steel-toed shoe can wreak havoc on your "office environment" sensor. And increase your costs. And if you plan to add environmental protection yourself, remember to add this cost to the solution's total cost.

SHIPPING - It may not seem like much to pay a flat small fee for shipping. But add that flat small fee over spare parts, factory calibrations, repairs, and replacements and the amount can become substantial.

If shipping is based on weight and volume, look at the products you are considering specifying. Are there any size or weight differences? Are there are tariff differences related to the products originating from different countries?

STOCKING REQUIREMENTS - Lead time, reliability, repairability, ontime shipping and other factors influence the stocking (inventory) levels required for the transducer.

A rule of thumb is that annual inventory carrying costs are 25% with ranges from 18% to 75% (pdf file). Your carrying costs may be higher than 25% based on this analysis:

Cost of Money	6 to 12%
Taxes	2 to 6%
Insurance	1 to 3%
Warehouse Expenses	2 to 5%
Physical Handling	2 to 5%
Inventory Control	3 to 6%
Obsolescence	6 to 12%
Deterioration and Pilferage	3 to 6%
Total	25 to 55%

Source: Richardson, Helen: Transportation & Distribution, "Control Your Costs Then Cut Them," December 1995.

To reiterate, the above are *annual* carrying costs that will continue as long as you hold the products in your inventory.

WARRANTY - What is the length of warranty? What are the terms of the warranty? Are extended warranties available? What are the warranty restrictions?

TRAINING - Are there extraordinary education or training requirements to use the sensor and related instrumentation? Is calibration straightforward is a course required?

DOCUMENTATION - Are adequate user manuals and application notes available? Do users need to

spend valuable time learning and documenting the product?

CUSTOMER SERVICE - Is customer service readily available? What are the hours of operation? How responsive is customer service to your inquiries regarding pricing, shipping information, and repairs? Is Web site pricing and ordering available?

TECHNICAL SUPPORT - Is technical support available 24/7/365? Are there fees associated with technical support? Is the information provided complete, accurate, and timely?

Still Not Convinced?

Do you believe total cost of ownership is not relevant in your application? Consider the experience of an airline who went with "an affordable" choice only to find out 15 months later that the transducers were surviving for only 12 months on average and needed to be replaced annually. The replacement transducer selected did cost 20% more but was available off-the-shelf and was previously qualified for aircraft use. There have been no failures with the replacement transducers and no replacements have been required after 36 months of continuous use.

The Bottom Line

To do an interactive comparison of sensor and transducer total lifetime costs, use the Total Cost of Ownership Calculator at calctco.htm.

Conclusion

The selection of the proper sensor or transducer for a given application includes an evaluation of the costs of the sensor or transducer. Initial purchase costs can be less than 20% of the product's lifetime costs.

Only by considering the lifetime costs can you ensure you are specifying an optimum solution.

Reference Materials

For an analysis on downtime costs, see *The Hidden Cost of Downtime* (SmartSignal Corporation). These documents provide additional information on the selection and use of cable position transducers:

- String Potentiometer and String Encoder Engineering Guide (s054b.htm)
- Sensor Total Cost of Ownership (s054a.htm)
- Application Note for Aircraft/Aerospace (s004a.htm)
- Application Note for Ground Vehicles/Transportation (s005a.htm)
- Application Note for Draw Wire Transducer Accuracy (s054j.htm)
- Application Note for Motorsports (s054k.htm)
- Selecting Position Transducers (selpt.htm)
- UAV Displacement Sensors (s085a.htm)

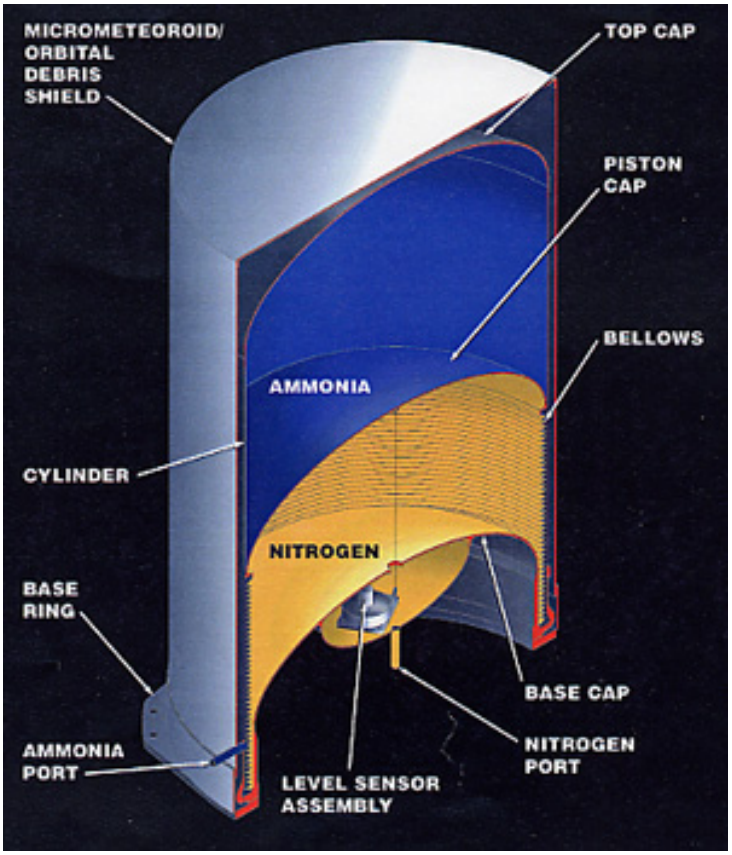
A Word from the Sponsor

Firstmark Controls is the only company in the world focused exclusively on robust string potentiometers and string encoders. We invented the miniature string potentiometer in 1968. We have been perfecting it ever since.

This has been our business for over 35 years. We have the design skills, application knowledge, and quality system to meet your requirements on time, on budget, and with your complete satisfaction. To evaluate these products for your application at no risk, consider the Evaluation Transducer Program (reqevalpt.htm).

Some high-profile and unique products, applications, and features include:

A Few Firstmark Controls Highlights

first CPT aboard the International Space Station and the virtual standard for space-based applications	

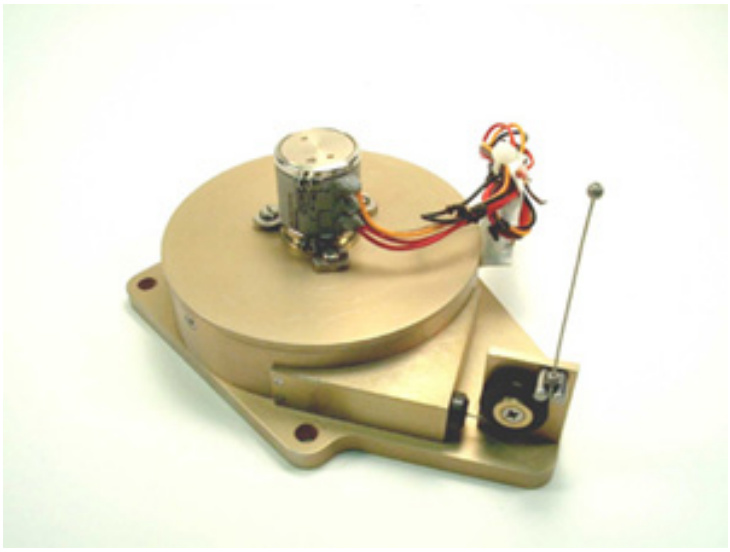
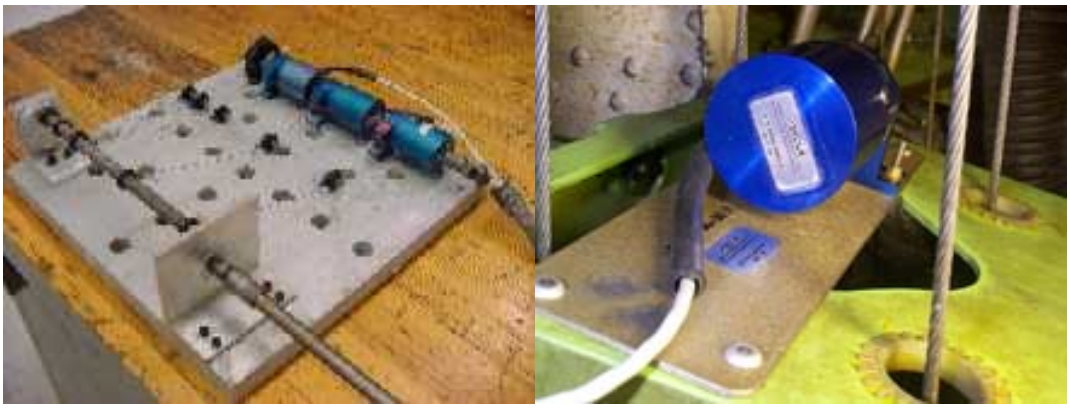
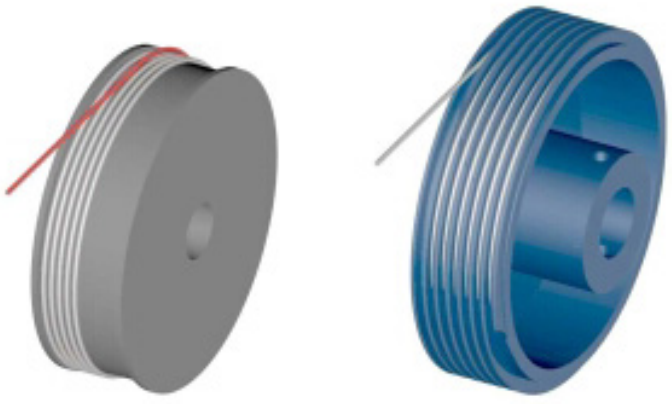


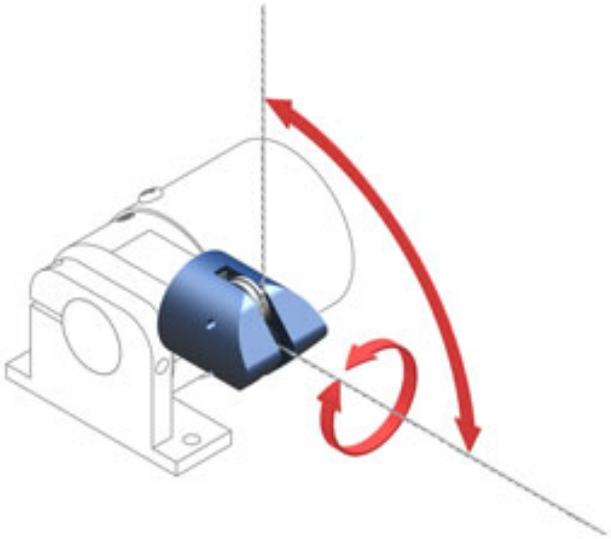
Figure 10 - Firstmark Controls position transducers for man-rated space vehicles assist in the control of life-critical environmental control systems.

only CPT qualified for crash test dummies (knee, chest, ribcage, and abdomen)

Figure 11 - Crash test dummies get smart with Firstmark Controls position transducers

CPT standard for vehicle testing inlcuding passenger, truck, offroad, heavy equipement, and Formula 1, IRL, CART, and NASCAR racing	 Figure 12 - Passenger, truck, offroad, heavy equipment, NASCAR, IRL, CART, and Formula 1 vehicles push the limits of technology with Firstmark Controls displacement sensors
displacement sensor of choice for flight data recorder upgrades	 Figure 13 - Airlines and militaries across the world rely on Firstmark Controls position transducers to reliably obtain data

only CPT fully qualified to DO-160D / ED-14D and MIL-STD-810E	 Figure 14 - DO-160D test fixture and on-aircraft installed sensor
pioneered the use of the non-geared, non-clutched, servo-mount sensor that allows easy zeroing and ensures no backlash (DirectConnect™ technology)	 Figure 15 - DirectConnect™ technology is emulated worldwide today.
only manufacturer of AccuTrak™ CPTs that virtually eliminate non-repeatability from cable side-to-side and overlap motion	 Non-Threaded Drum Threaded Drum Figure 16 - AccuTrak™ threaded drums (right) give superior repeatability as compared to non-threaded drums.

developed patent on universal mounting base offering 360° of rotation about 2 axes for unparalleled mounting flexibility	 Figure 17 - The universal base, patented in 1974, provides unparalled mounting flexibility and ease of use with 360° rotation in two axes.
developed patented RoundAbout™ cable guide for superb cable exit flexibility	 Figure 18 - The RoundAbout™ cable guide allows the displacement cable to exit the sensor at virtually any angle.

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