

Continuing Trends in Technology
Fiber Optic Research Project
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Introduction

As the technological revolution continues to change our world, PRICE Systems is committed to maintaining and updating the PRICE models to include the latest technological trends. This article describes current research at PRICE Systems in the area of fiber optics.

“A global revolution is in progress. Our method of handling information is changing from electrons and electronics to light beams and photonics. These changes are occurring more rapidly than at any other time in the history of telecommunications. ...Donald B. Check, Director Opt-Electronics Research, Corning Incorporated.

In concert, PRICE Systems research augments the technology factors at the “core” of the PRICE models. In the PRICE-H model, these factors are known as the Manufacturing Complexity of Structure (MCPLXS) and Manufacturing Complexity of Electronics (MCPLXE). PRICE Systems provides various tables and generators allowing estimators to determine the appropriate MCPLXS/E values for a given item by virtue of its technology or manufacturing process. These values are construed as “industry average” values for rough order of magnitude (ROM) estimating and future comparisons. Estimators add continually to the current body of knowledge by calibrating their company’s actual experience into useable MCPLXE/S factors. Calibrated factors are often compared to “book values” for sanity checks.

The goal of PRICE Systems research is to provide analysts with an expanding knowledge base of calibrated MCPLXS values. As trends are discerned from the data, PRICE Systems is developing regression analysis equations that relate physical characteristics to fiber optic MCPLXS values. The research results will take several formats:

- MCPLXS values in EXCEL spreadsheet format
- Regression analysis trend-line equations
- “Conversational” generators
- Incorporation into the PRICE models.

PRICE Systems plans to cover several areas of fiber optic technology. Starting with commercial applications, we are researching the areas of Fiber optic cables, Fiber optic connectors racks/mounts, and test equipment. Over the next year, the research will expand into the military applications, including Tactical Fiber Optic Deployment Systems, MilSpec Cylindrical fiber optic cables, application specific areas such as Naval shipboard fiber optics, and other areas as suggested by clients.

This article presents the completion of the calibration and trend line analysis of fiber optic cables.

Fiber Optic Cables

Examining commercial applications at a high level, there are four basic dimensions that define the cost/complexity relationship. Any intersection of the four dimensions will yield a MCPLXS values.

Table 1 Four Dimensions of Fiber Cable Cost

Environment	<ul style="list-style-type: none"> • Riser/Plenum • Outdoor Aerial/Buried
Cable Type	<ul style="list-style-type: none"> • Interconnect • Breakout • Tight Buffered, Non-Breakout Style, • Loose Tube, Gel Filled
Fiber Count	Denotes the number of fibers in a cable. Drives cost and complexity.
Technology (Bandwidth)	<ul style="list-style-type: none"> • Single-Mode • Multimode

Environment:

Describes where the cable is used. For buildings the cable is placed in risers or plenums. Cable manufactured for plenum use is heavier and more durable. For outside applications cable is either aerial or buried. Cable manufactured for burial is heavier and more durable.

Cable Type:

Depending on the application, different types of cables are required. The major classes of cable researched for this study were:

Table 2 Cable Types

Interconnect Cable	Specially designed cables for voice, data, video and imaging transmission in computer, process control, data entry and wired office systems.
Breakout Cable	The breakout design enables the individual routing, or “fanning” of individual fibers for termination and maintenance. Breakout cables are designed for voice, data, video and imaging transmission in computer, process control, data entry and wired office systems.
Tight Buffered Non-Breakout Cable	These are rugged, high performance optical communication cables. This cable is designed for various indoor and outdoor requirements, including routing between buildings within ducts and inside buildings up riser shafts. The cable’s small diameter, light weight and flexibility allow easy installation and maintenance.
Loose Tube, Gel Filled	Loose tube water blocking, gel filled cables are for general-purpose outdoor use. The loose tube design provides stable and highly reliable transmission parameters for a variety of applications in voice, data and video. The design also permits a high density of fibers contained in a given cable diameter while allowing flexibility to suit many system designs. These cables are suitable for outdoor duct; aerial and direct buried installations and indoor use.

Fiber Count:

Fiber count refers to the number of fibers within a cable type. Fiber count has direct bearing on cost. In some instances it is directly correlated to weight, however, the majority of weight distribution is attributable to the cable type.

Technology:

There are two types of optical fiber: single-mode and multimode.

Multimode fiber was the first type of fiber to be commercialized. It has a much larger core than single-mode fiber, allowing hundreds of rays, or modes, of light to propagate through the fiber simultaneously.

Single-mode fiber, on the other hand, has a much smaller core that allows only one mode of light to propagate through the core.

While it might appear that multimode fibers have a higher information carrying capacity, in fact the opposite is true. Single-mode fibers retain the integrity of light pulse over longer distances, allowing more information to be transmitted.

This high bandwidth has made single-mode fiber the ideal transmission medium for most applications. Multimode fiber today is used primarily in premise networks, where transmission distances are less than two kilometers.

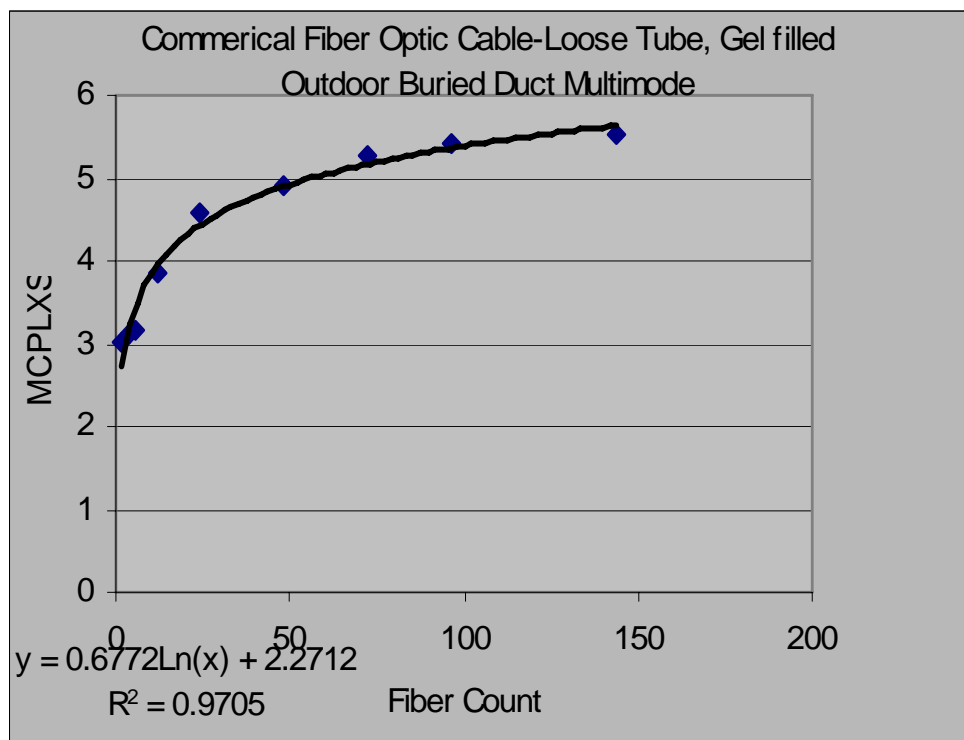
Calibration Methodology

After the high level dimensions were defined, we started the data collection process. Fibertron Inc., a leading supplier of fiber optic components provided all data for commercial applications.

The data consisted of cost at a set economic order quantity. Where several manufacturers provided cable pricing (CY98) Fibertron provided a representative price. The entire database consisted of 92 distinct cable types. Fibertron provided the data to us in EXCEL template format. PRICE Enterprise was used to transfer the data directly from EXCEL into PRICE-H, populate the EBS and extract the results back to the EXCEL template.

Calibration Results

After the cables were calibrated, a regression analysis was performed within each dimension of the cable serving as cost drivers. The results reflect MCPLXS values consistent with highly automated commercial manufacturing processes. The regression equation relates the fiber count within the cable application to a MCPLXS value. An *example* of a regression trend-line analysis for Commercial Fiber Optic Cable is displayed below.



Conclusion-Fiber Optics

In total, fourteen trend line equations portray the fiber optic cable relationship to . The majority of these trend line equations showed a highly correlated relationship between fiber count and MCPLXS. The results of this research will provide our clients with a rich database in which to find specific cable MCPLXS factors as well as trend-line equations to develop new fiber optic cable applications.

References

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