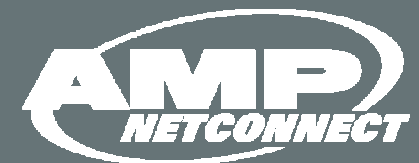


Is Pre-terminated Prudent for Your Project?

A cost model of the associated costs of field termination and pre-terminated cabling technologies

Herb Congdon
Tyco Electronics



Preview

- Why are high-density pre-terminated solutions popular?
- Why develop cost models?
- The Cost Models
 - Assumptions, Inputs and Variables
- Results of Representative Scenarios
- Additional Considerations
- Summary



First...What are Pre-terminated Solutions?

- Solutions using cables that are terminated in the factory, not in the field
- If terminated with standard connectors, it's basically, a collection of long patch cords
 - This is not significantly advantageous
- If terminated with high-density connectors, the dynamics change



High-density Pre-terminated Solutions

- Cables are terminated in the factory with high-density connectivity
- Cassettes, which fan out the high-density connectivity to standard connectivity, are also built in the factory
- “Place and Plug” links are constructed in the field using trunk cables, cassettes and standard patch cords



High-density Pre-terminated Solutions

- Combine
 - The technologies of high-density connectivity
 - The efficiencies of factory termination
 - The simplicity of a “place and plug” installation
- Create
 - A high-speed, high data rate, high-density, reliable solution right out of the box



Traditional Solutions

	Traditional
Cable Placement	Field placement and dressing of multiple cables
Termination	Field termination of each cable at both ends
Testing	Field testing of multiple runs and repairs as needed

How do we break with Tradition?



High-density Connectivity Technology

- High-density connectivity options for fiber and copper have been developed, are in use today and their popularity is growing



MRJ21

MPO

1€

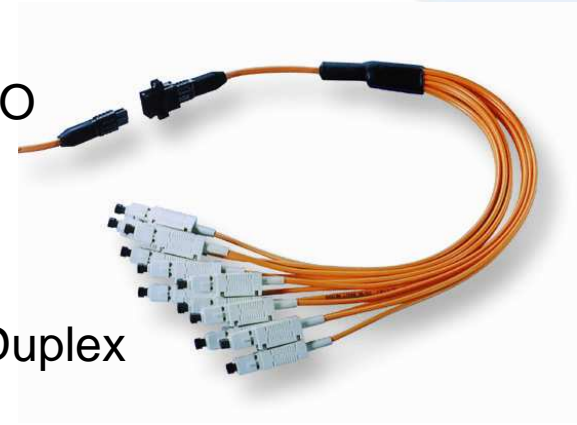


High-density Pre-terminated Fiber

- The MPO
 - FOCIS 5, published in 1997
- 12 fibers in one connector

1 MPO

6 SC Duplex

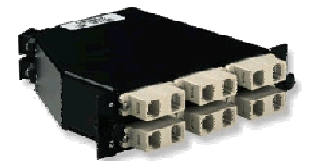


288 Duplex Ports	Area	Rack Units
Duplex Fiber	~798 in ²	24
Duplex Fiber (SFF)	~399 in ²	12
MPO Fiber	~66 in²	2



High-density Pre-terminated Fiber Solutions

- Standard Link (12 duplex ports)
 - One 24F “Trunk” Cable Assembly
 - Two 24F Cassettes (1 each end)



High-density Pre-terminated Copper

- The MRJ21
 - 24-pair Connector
 - 1" x $\frac{5}{8}$ " Footprint



288 4-pair Ports	Area	Rack Units
RJ-45	~399 in ²	12
RJ-45 (High Density)	~266 in ²	8
MRJ21	~200 in²	6



High-density Pre-terminated Copper Solutions

- Standard Link (48 GbE Ports)
 - Eight Trunk Cable Assemblies
 - Two 48-port Cassettes



Bicsi

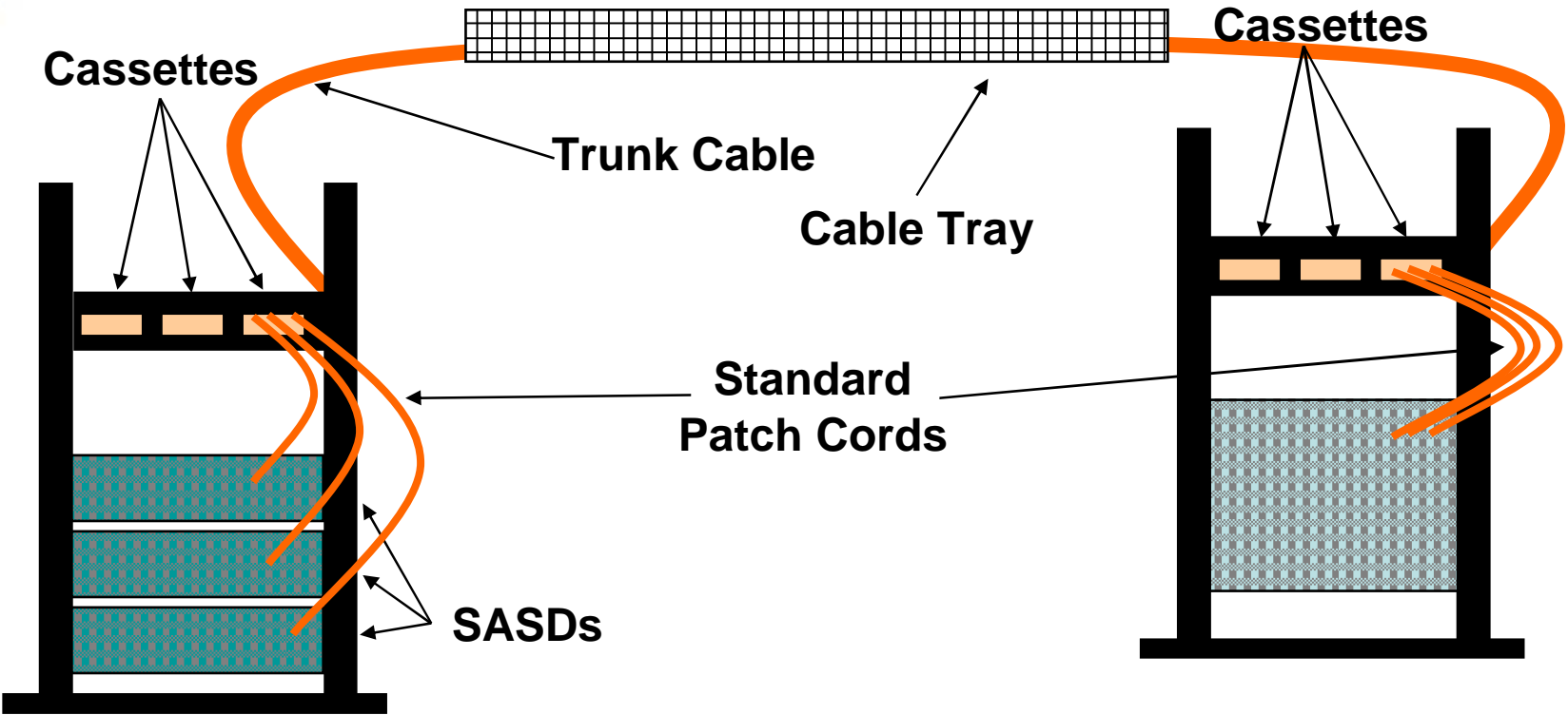
AMP
NETCONNECT

Efficiencies of Factory Termination

- Volume-based Purchasing and Productivity
- Concentrated Expertise
- Labor Consistency
- Fully Implemented Quality Programs
 - Six Sigma, Continuous Improvement, etc.
- High-dollar Test Equipment
 - Better testing than possible in the field



Place and Plug Simplicity



Traditional and Pre-terminated Solutions

	Traditional	Pre-terminated
Cable Placement	Field placement and dressing of multiple cables	Field placement of one cable
Termination	Field termination of multiple cables	Terminations completed in factory
Testing	Field testing of multiple runs and repairs as needed	Testing completed in factory



Why are Pre-terminated Solutions Popular?

It depends on whom you ask...



The IT Manager Perspective

- High-Density (Space Savings)
- Smaller Electronics (Space Savings)
- Improved Cable Management (Space Savings & Standards)
- Speed (Installation and MAC Time Savings)
- Simplicity (Labor Flexibility)
- Security (Site Access)
- Consistency (Reliable)



The CIO Perspective

- Fast Return on Investment
- Continuing Return on Investment
- Cabling Products Retain Value
 - >70% of Initial Cost (not <30%)
- It's a Green Thing to Do
 - Reusable and Re-deployable Products
 - No Scrap



The Installer Perspective

@*#*!& !!



The Installer Perspective

- “Glass is half full” installers see benefits
 - Faster installations → more jobs
 - Cost-effective work force utilization
 - Opportunity to add value between design and purchasing
 - Easier and more accurate job estimations
- Better to learn to live with it than try to fight it

How do you learn to live with it?



Why Develop Cost Models?



Why Develop Cost Models?

- To assist IT Managers and CIOs in selecting a cabling option in a cost-effective manner
 - Efficient Use of Money
 - Efficient Use of Time
 - Efficient Use of Space
- Each of these factors may have different importance at each site



Why Develop Cost Models?

- To assist installers that are or might be involved in a high-density pre-terminated solutions project
 - Understand the Technology and How it is Used
 - Promote Knowledgeable and Effective Bidding
 - How to Grow Services Offered



Why Develop Cost Models?

- Simplify Complex Comparisons & Multiple Factors
 - Trade-offs between product costs & product installation costs
- Simplify Consultant Guidance on Costs with Understanding of Limitations



The Cost Models



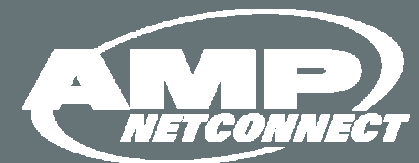
The Cost Models

- Copper Cabling Cost Model
 - Compares pre-terminated to traditional punchdown installations
- Optical Fiber Cabling Cost Model
 - Compares pre-terminated to traditional epoxy/polish and no-epoxy/no-polish installations
- Not intended to compare copper to fiber installations



The Copper Cabling Cost Model

*Comparing Pre-terminated MRJ21 and
Traditional Punchdown Installations*



Copper Cabling Cost Model - Products

- In this corner: **MRJ21**
 - Six 4-pr links
 - One trunk cable
 - Two cassettes
- In that corner: **Punchdown**
 - Six 4-pr links
 - Six 4-pr cables
 - 12 RJ-45 jacks or patch panel ports



Copper Cabling Cost Model - Installation

- In this corner: **MRJ21**
 - Six 4-pr links
 - Place one trunk cable
 - Plug two cassettes
- In that corner: **Punchdown**
 - Six 4-pr links
 - Placing six 4-pr cables
 - Stripping cables at both ends
 - Punching down each wire into jack or patch panel with standard punchdown tool



Copper Cabling Cost Model – Labor Inputs

- Hourly labor rate
- Number of ports
- Estimated Time for RJ45 Jacks
 - Field-termination, labeling and field testing
- Estimated Time for MRJ21 field-connection
 - Tightening two screws



Copper Cabling Cost Model – Product Inputs

- 4-pr bulk cable price and scrap rate
- Average length of cable runs
- Panel, rack, and horizontal management prices



Copper Cabling Cost Model – Output

- Estimated Total Costs
 - Products, installation of those products (cable and connectivity) and testing the links
- Estimated Total Time
 - Cable placement, termination and testing



The Copper Cabling Cost Model - Results

Comparison of Some Representative Scenarios



Disclaimer



Disclaimer

- The material referenced on the following slides is for comparison purposes only and not for budgetary purposes. Actual costs may differ and may depend on project size, location or purchasing practice as well as other variables.



Disclaimer

- In other words:
- “Your results may vary, but it’s not our fault.”



Representative Scenarios

- Backbone
 - Low port count (48 ports), two locations
- Data Center
 - High port count (960 ports), five locations



Results – Copper Backbone Scenario



Copper Backbone – Input (Constant)

Number of Ports	48
Number of Locations (ends)	2
Average Length	40 meters
Estimated Time for MRJ21 field-connection (two screws)	2 minutes
4-pr bulk cable, panel, rack, assembly and management prices	Market for Cat5e (pre-copper boom)
4-pr bulk cable scrap rate	5%

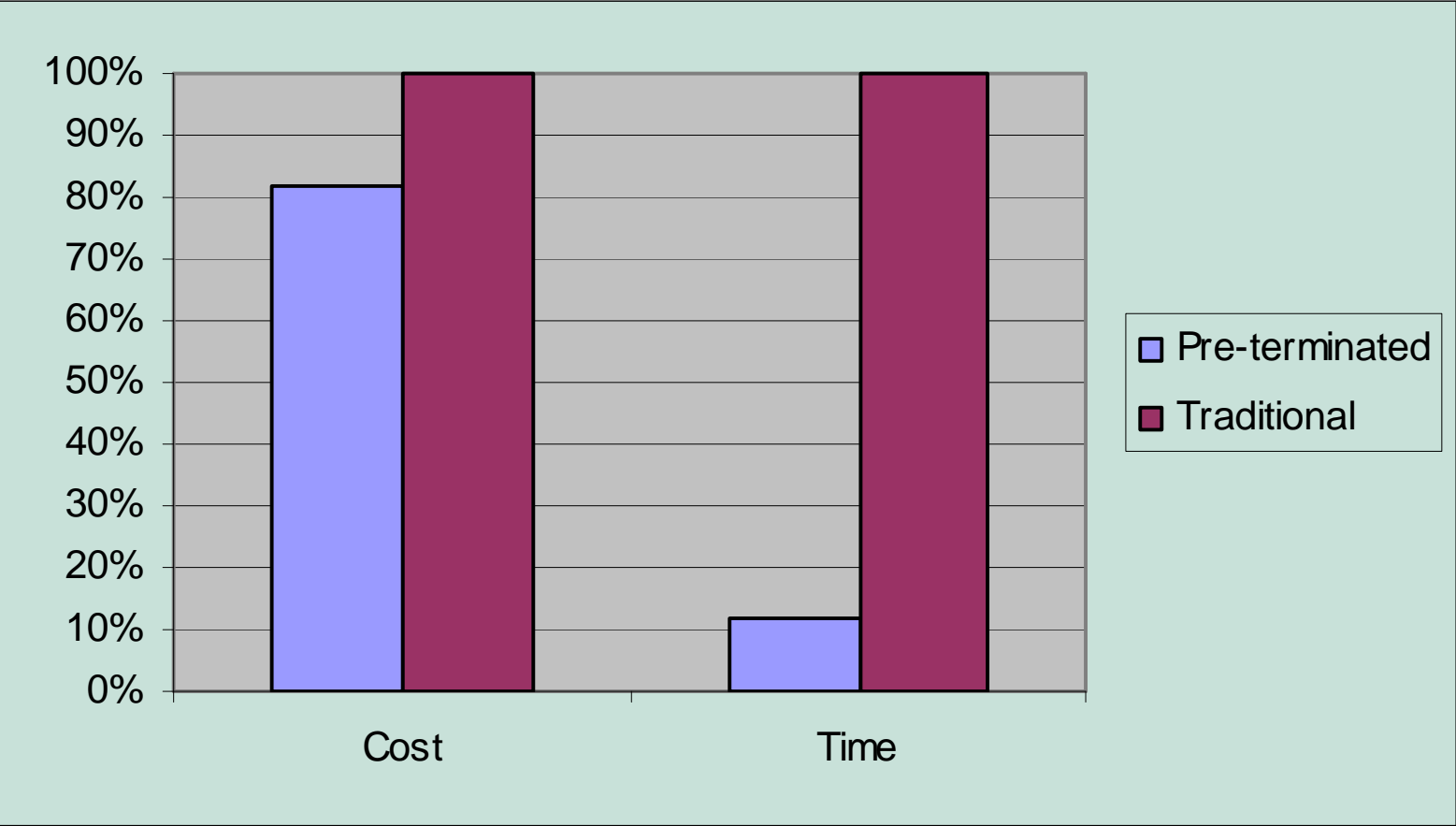


Copper Cabling Cost Model – Baseline

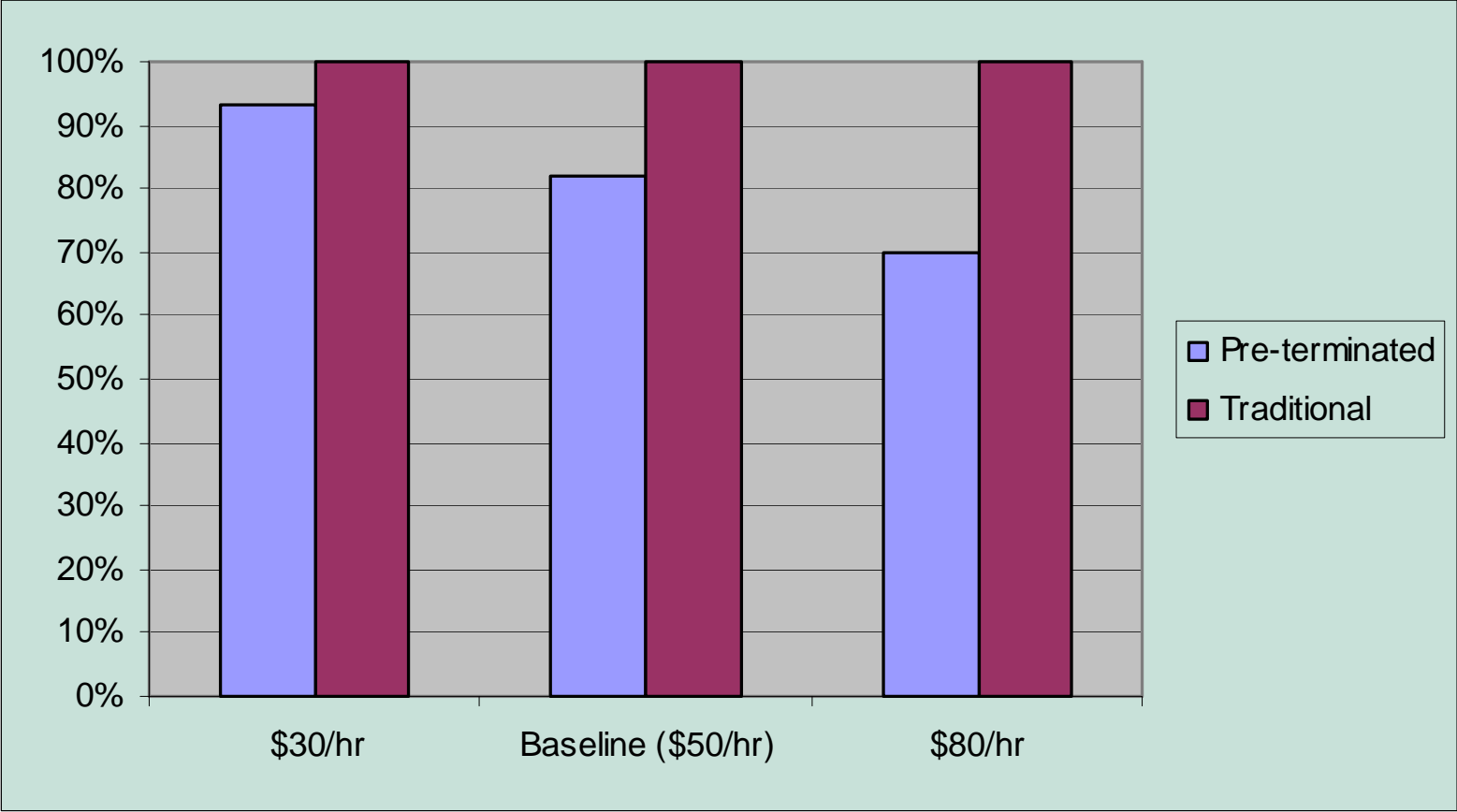
Input	Value
Hourly labor rate	\$50
Estimated Time for RJ45 Jack (termination, labeling and testing)	10 minutes (6+3+1)



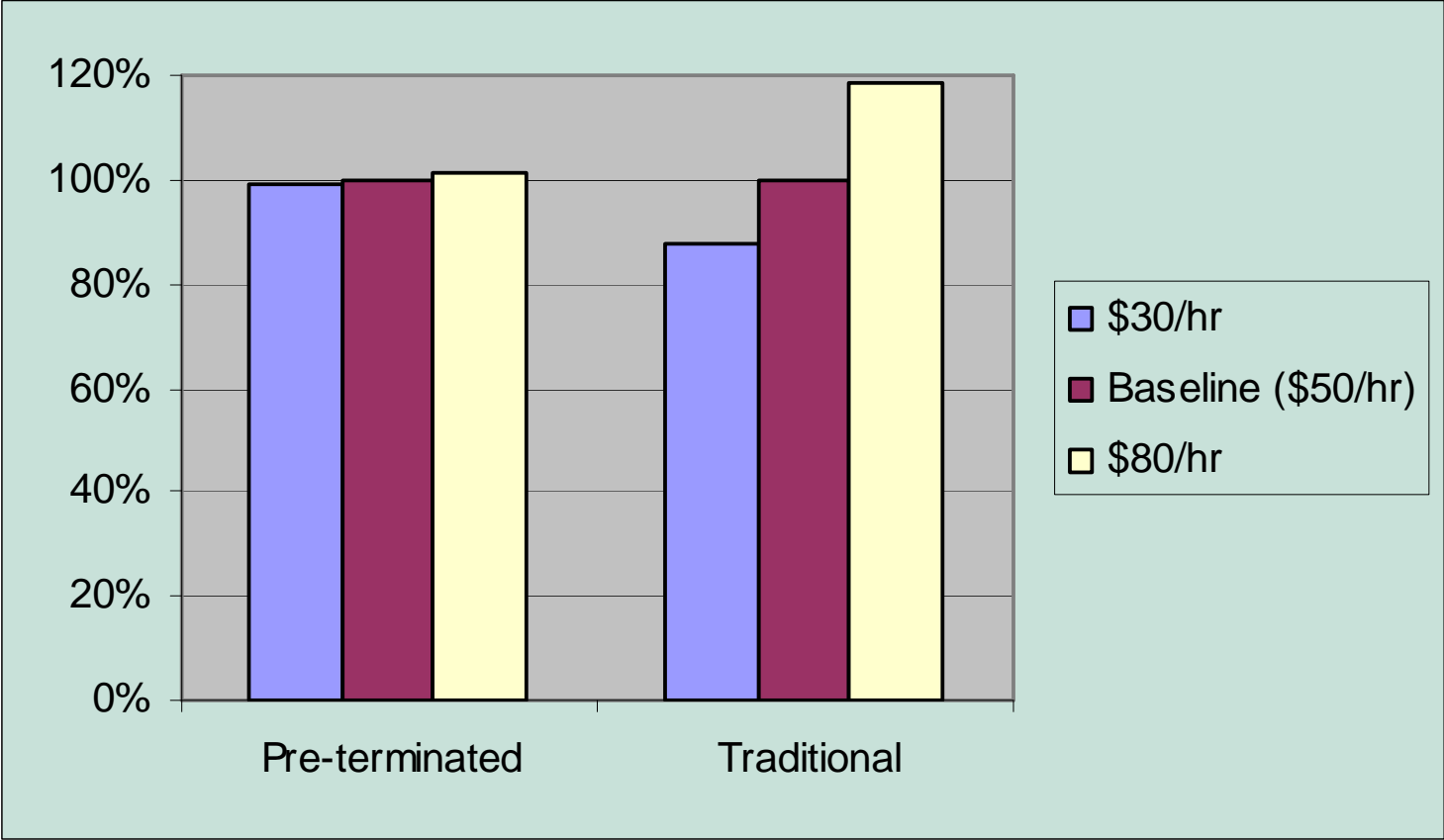
Copper Backbone Baseline Relative Total Cost & Time



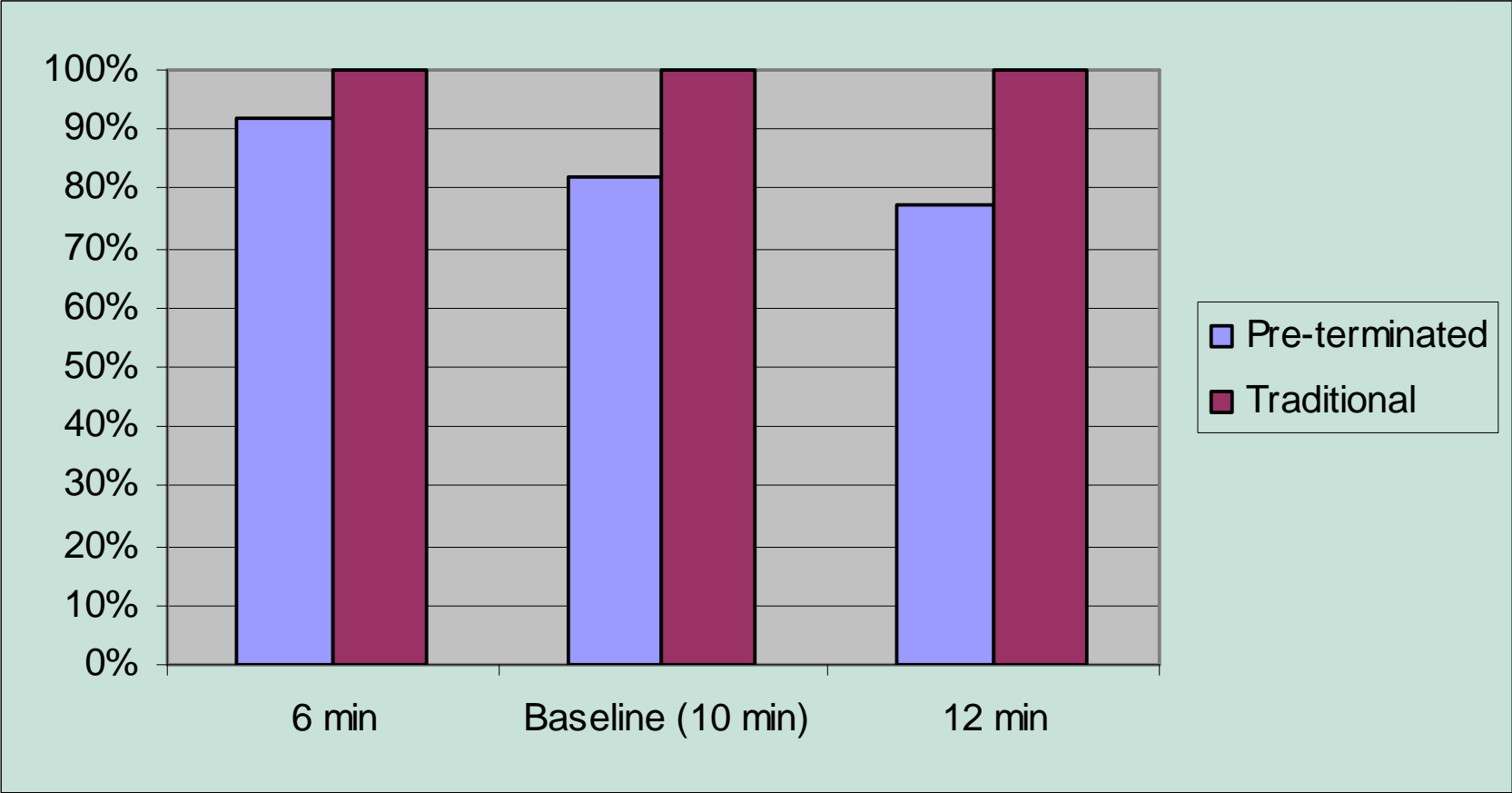
Copper Backbone Relative Total Cost with Labor Rate Variation



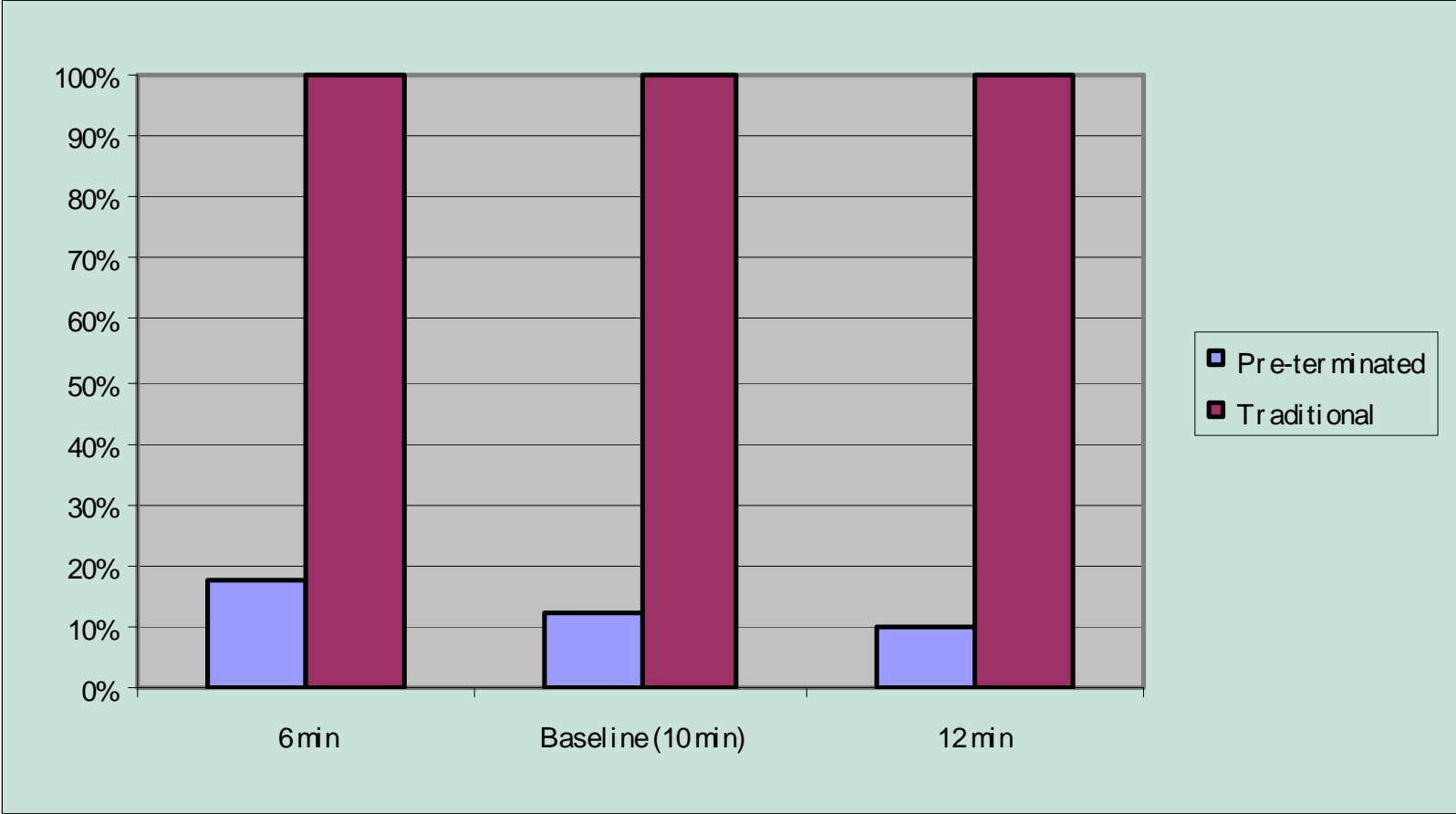
Copper Backbone Relative Cost/Port with Labor Rate Variation



Copper Backbone Relative Total Cost with Est. Time Variation



Copper Backbone Relative Total Time with Est. Time Variation



Copper Backbone Scenario - Summary

- Pre-terminated solutions reduced installed cost by 19%
- Pre-terminated solutions reduced installation time by 88%
- As labor rate increased, pre-term got relatively less expensive
 - From 7% to 30% as labor rate changed from \$30-\$80/hr
- As termination time increased, pre-term relatively lower
 - From 8% to 22% as est. time changed from 6min to 12min
- Pre-terminated showed minor changes with labor rate
 - Should be easier to quote jobs in multiple locations



Results – Copper Data Center Scenario



Copper Data Center – Input (Constant)

Number of Ports	960
Average Length	50 meters
Estimated Time for MRJ 21 field-connection (two screws)	2 minutes
4-pr bulk cable, panel, rack, assembly and management prices	Market for Cat5e (pre-copper boom)
4-pr bulk cable scrap rate	5%

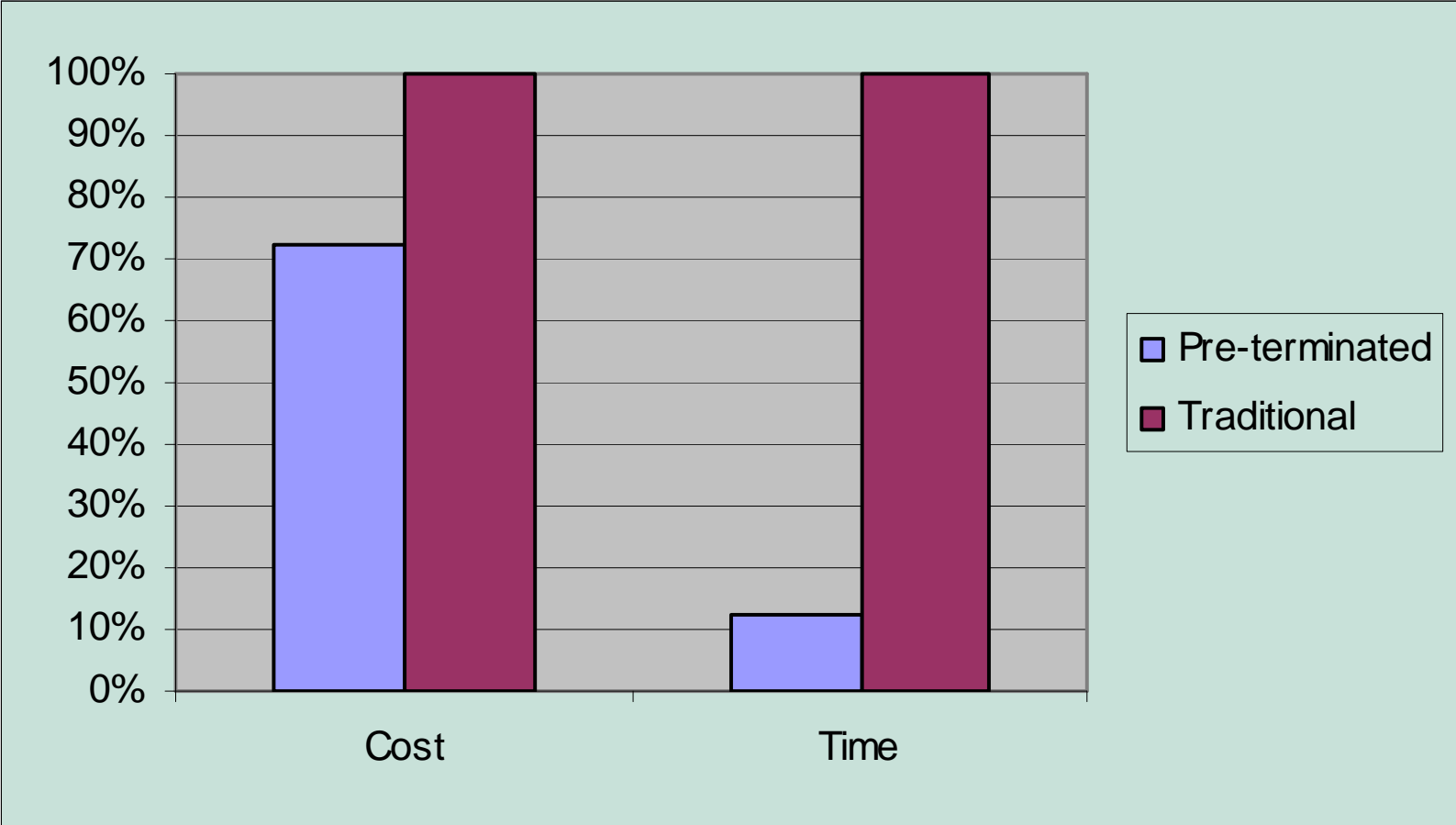


Copper Data Center – Baseline

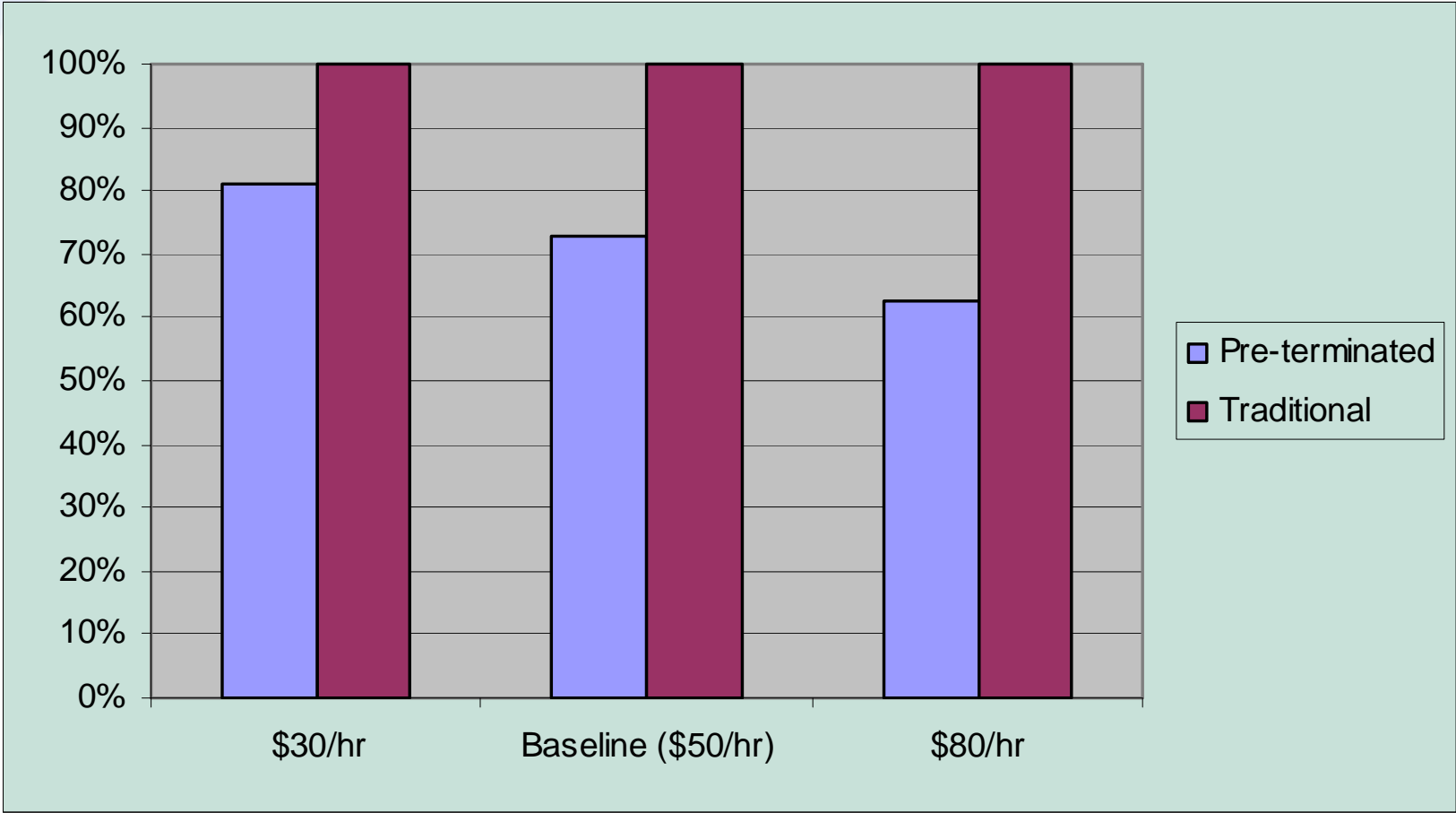
Input	Value
Hourly labor rate	\$50
Estimated Time for RJ45 jack field-termination, labeling per cable end and jack field-test	10 minutes (6+3+1)



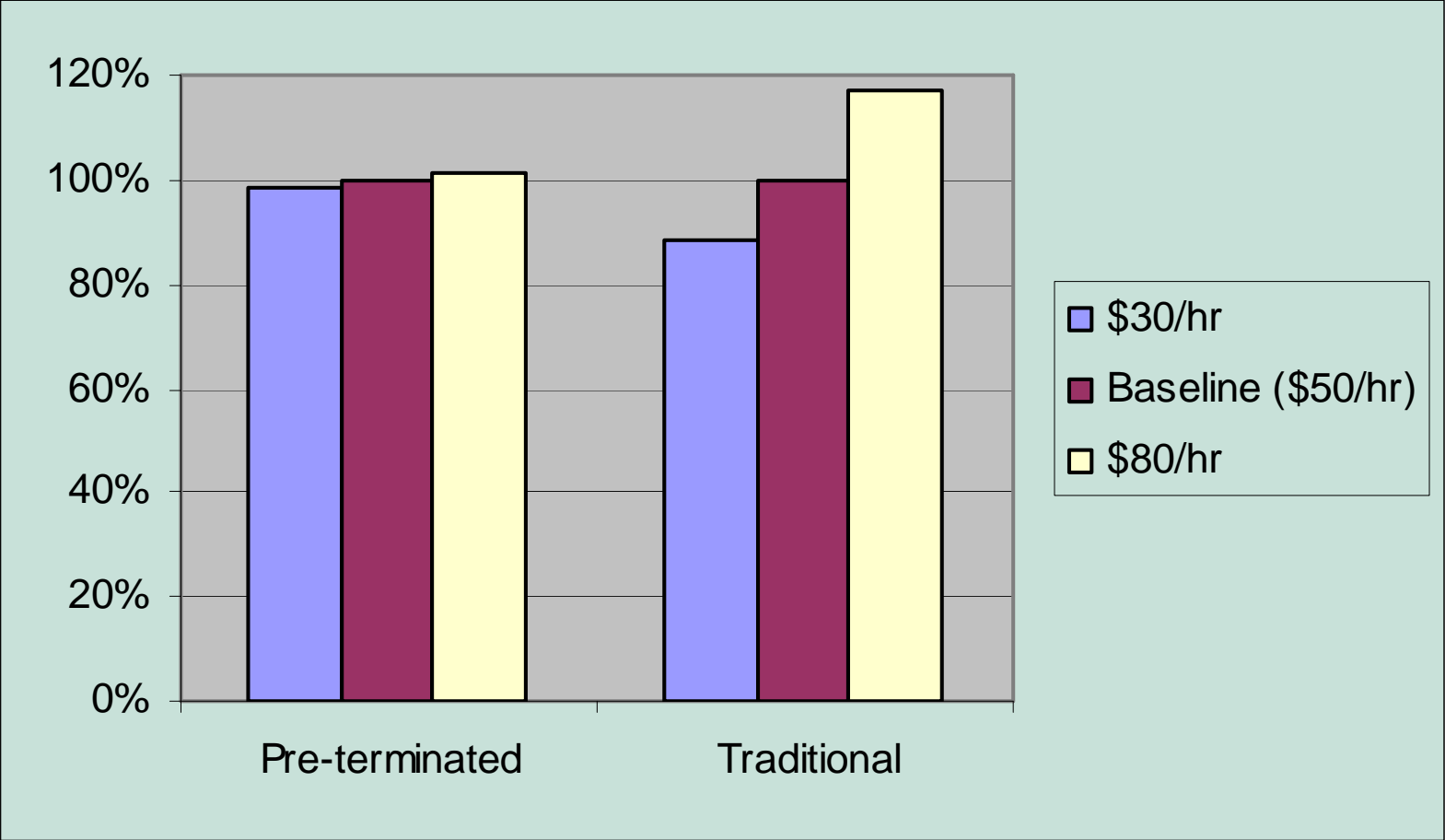
Copper Data Center Baseline Relative Total Cost and Time



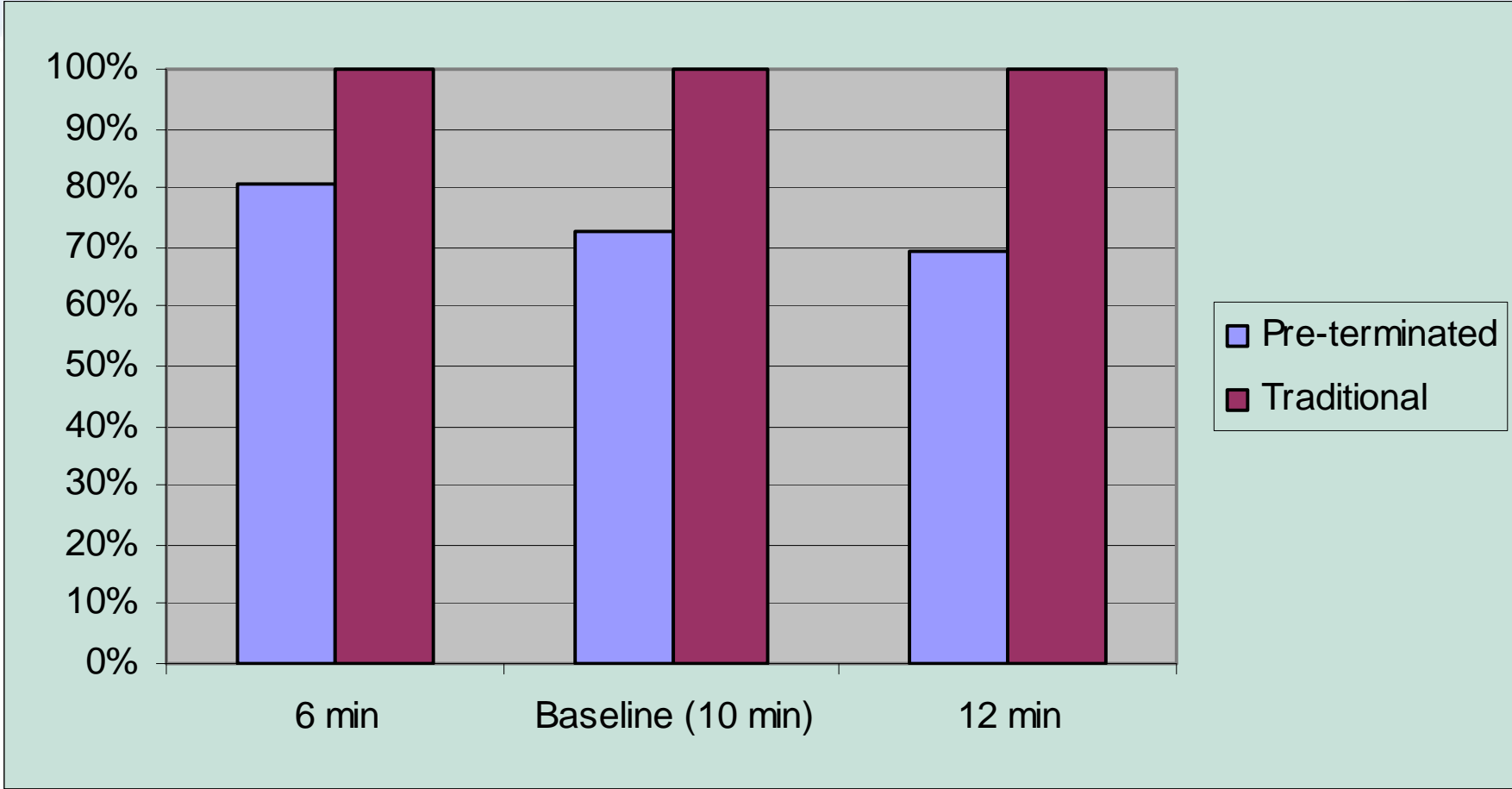
Copper Data Center Relative Total Cost with Labor Rate Variation



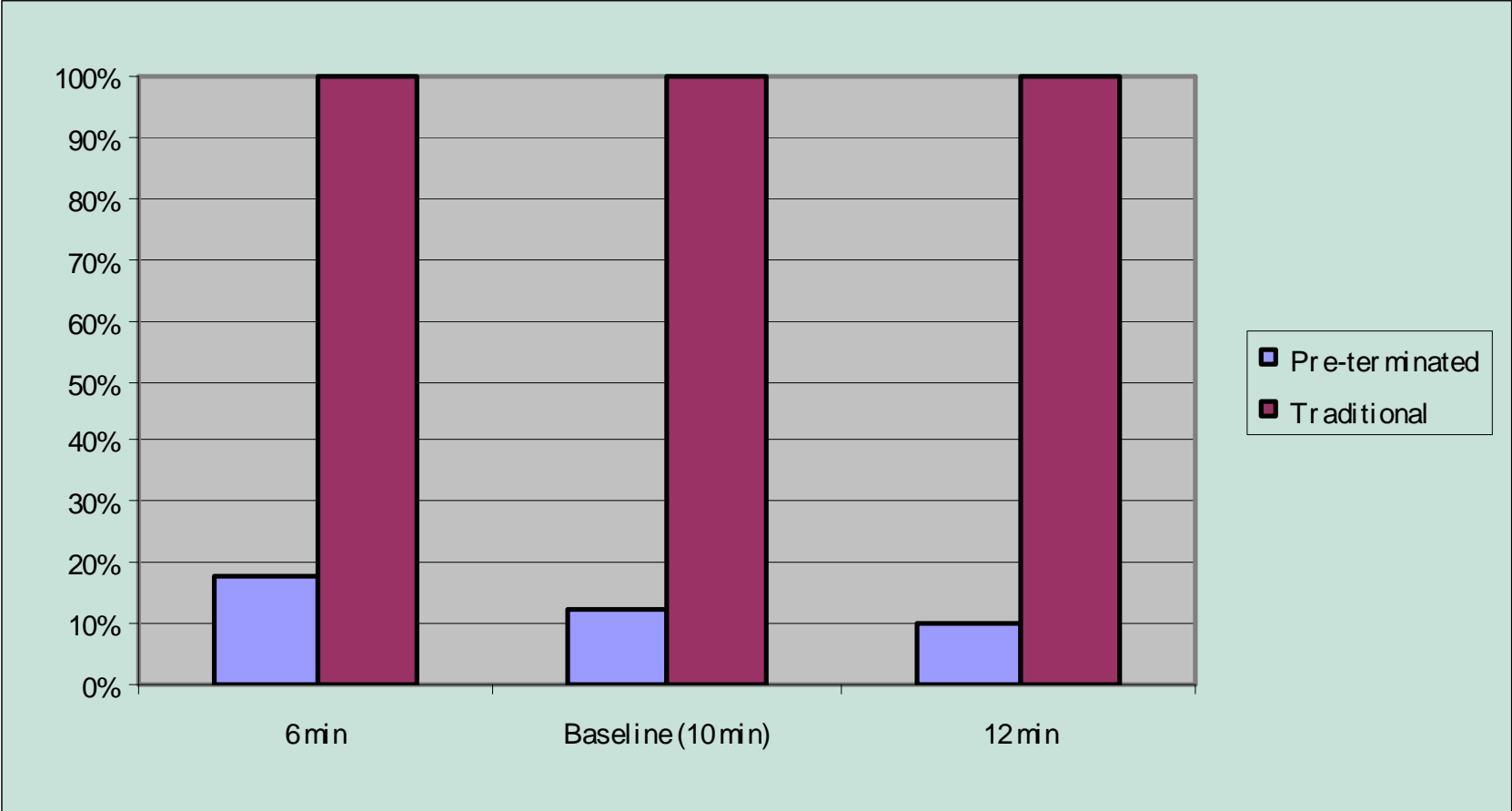
Copper Data Center Relative Cost/Port with Labor Rate Variation



Copper Data Center Relative Total Cost with Est. Time Variation



Copper Data Center Relative Total Time with Est. Time Variation



Copper Data Center - Summary

- Pre-terminated solutions reduced installed cost by 27%
- Pre-terminated solutions reduced installation time by 88%
- As labor rate increased, pre-term relatively less expensive
 - From 19% to 36% as labor rate changed from \$30-\$80/hr
- As termination time increased, pre-term relatively lower
 - From 19% to 30% as est. time changed from 6min to 12min
- Pre-terminated showed minor changes with labor rate



The Copper Cost Model - Summary



Copper Cost Model Summary

	Small Job	Large Job
Total Cost	19%	27%
Total Time	88%	88%
Low Labor	7%	19%
High Labor	30%	36%
Slower Crew	22%	30%
Faster Crew	8%	19%



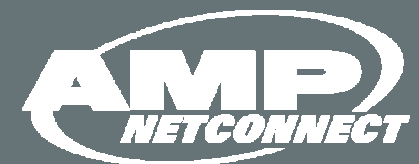
Copper Cost Model Summary

- Relative costs got lower for high-density pre-terminated solutions as jobs got larger
- Small jobs with low labor rate fast crews are comparable
- Relative time differential basically stable, but significant
 - If you're bidding traditional "per port" on a pre-terminated job – you're likely to be left out



The Fiber Cabling Cost Model

*Comparing Pre-terminated MPO and
Traditional Termination Installations*



Fiber Cabling Cost Model - Products

- In this corner: **MPO**
 - 12 duplex links
 - One 24-fiber trunk cable
 - Four (SC) or two (LC, MT-RJ) cassettes
 - 36 duplex links
 - One 72-fiber trunk cable
 - Twelve (SC) or six (LC, MT-RJ) cassettes
- In that corner: **Field Term**
 - 12 duplex links
 - One 24-fiber cable
 - 24 duplex connectors
 - Adapters and adapter plates
 - 36 duplex links
 - One 72-fiber cable
 - 72 duplex connectors
 - Adapters and adapter plates
 - Tool kits, consumables and test kit assemblies



Fiber Cabling Cost Model - Installation

- In this corner: **MPO**
 - 12 duplex links
 - Place one 24-fiber trunk cable
 - Plug four (SC) or two (LC, MT-RJ) cassettes
 - 36 duplex links
 - Place one 72-fiber trunk cable
 - Plug twelve (SC) or six (LC, MT-RJ) cassettes
- In this corner: **Field Term**
 - 12 duplex links
 - Placing one 24-fiber cable
 - Stripping all fibers
 - Terminating with duplex
 - Inserting connectors into adapters (for SC and LC)
 - 36 duplex links
 - Placing one 72-fiber cable
 - Stripping all fibers
 - Terminating with duplex
 - Inserting connectors into adapters (for SC and LC)



Fiber Cabling Cost Model – Labor Inputs

- Hourly labor rate
- Number of ports
- Number of technicians
- Number of locations



Fiber Cabling Cost Model – Product Inputs

- Average length of runs
- Connector type



Fiber Cabling Cost Model – Output

- Total cost of products, labor, consumables, test kits and tool kits
- Total time of field termination



The Fiber Cabling Cost Model - Results

Comparison of Some Representative Scenarios



Disclaimer



Disclaimer

- The material referenced on the following slides is for comparison purposes only and not for budgetary purposes. Actual costs may differ and may depend on project size, location or purchasing practice as well as other variables.



Representative Scenarios

- Backbone
 - Low port count (48), two locations
- Data Center
 - High port count (480), five locations



Results – Fiber Backbone Scenario



Fiber Backbone – Input (Constant)

Number of Ports	48
Number of Locations (ends)	2
Average Length	40 meters
Bulk fiber cable, adapter plates, and assembly prices	Market for 50-micron
Installer Experience	Intermediate
Number of Technicians	2
Number of Tool Kits and Test Kits	1 each



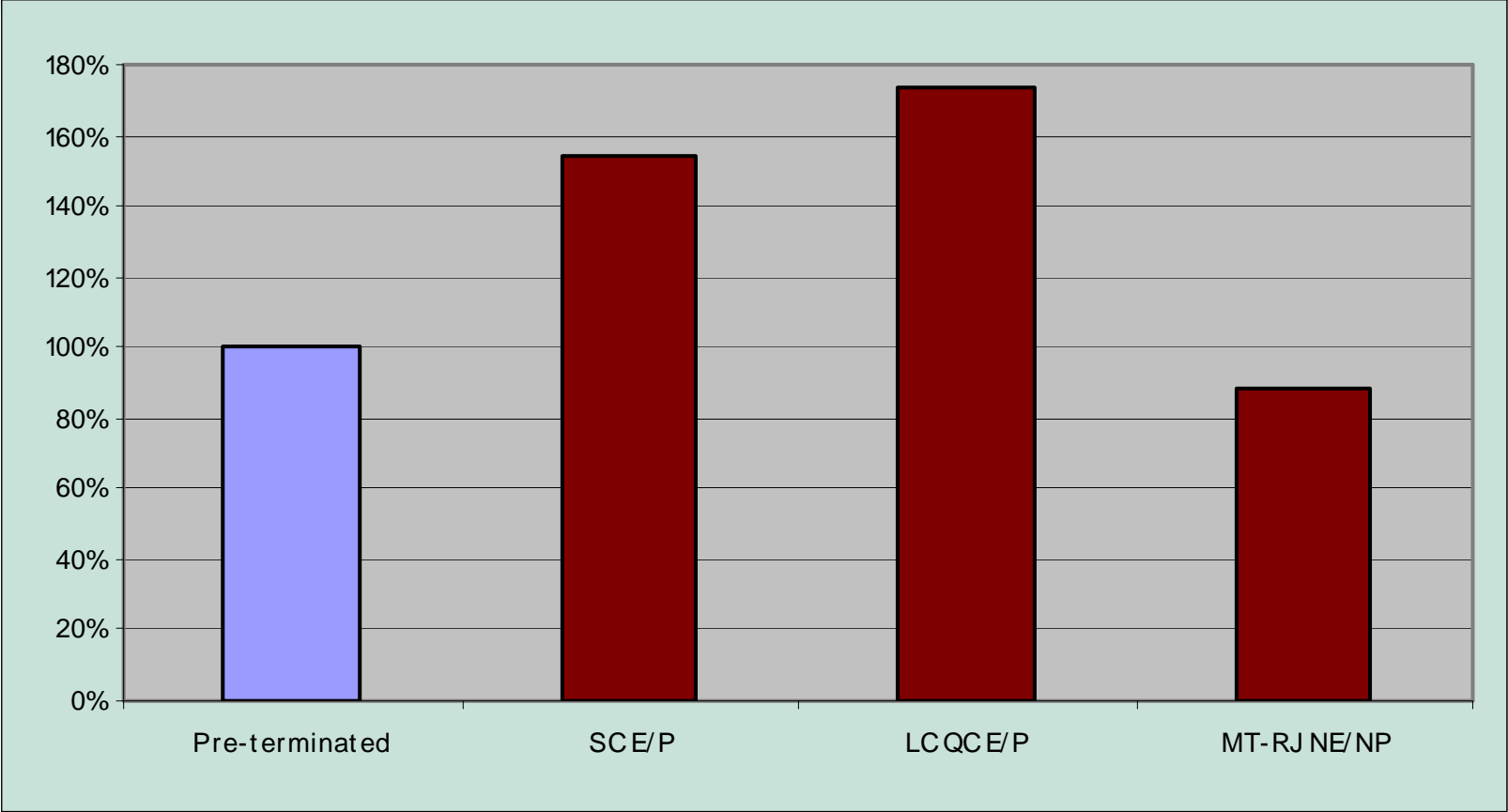
Fiber Backbone – Baseline

Input	Value
Hourly labor rate	\$50

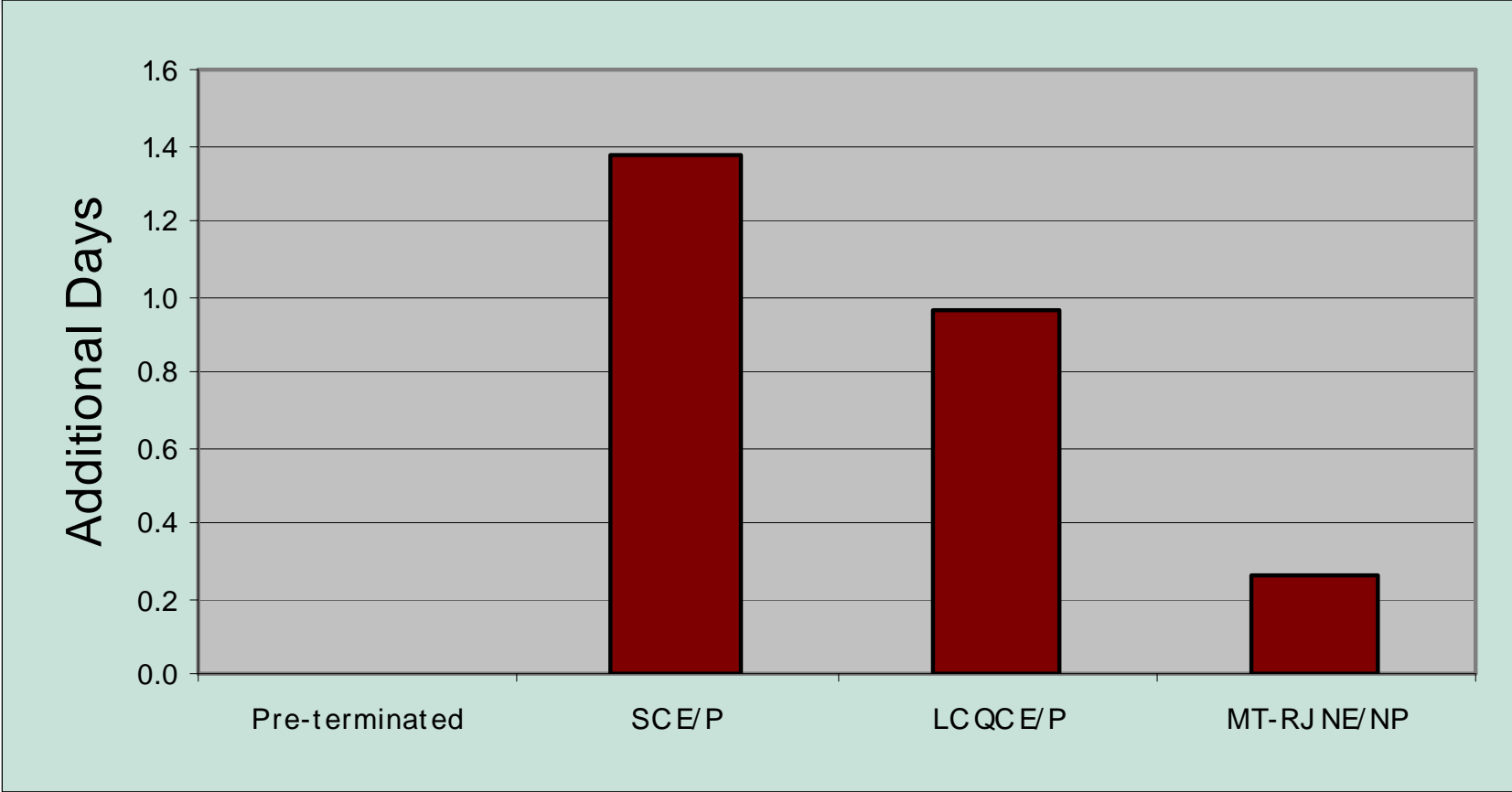
- Connector Technologies and Types
 - SC E/P = SC epoxy/polish connector
 - LC QC E/P = LC quick-cure epoxy/polish connector
 - MT-RJ NE/NP = MT-RJ no-epoxy/no-polish jack



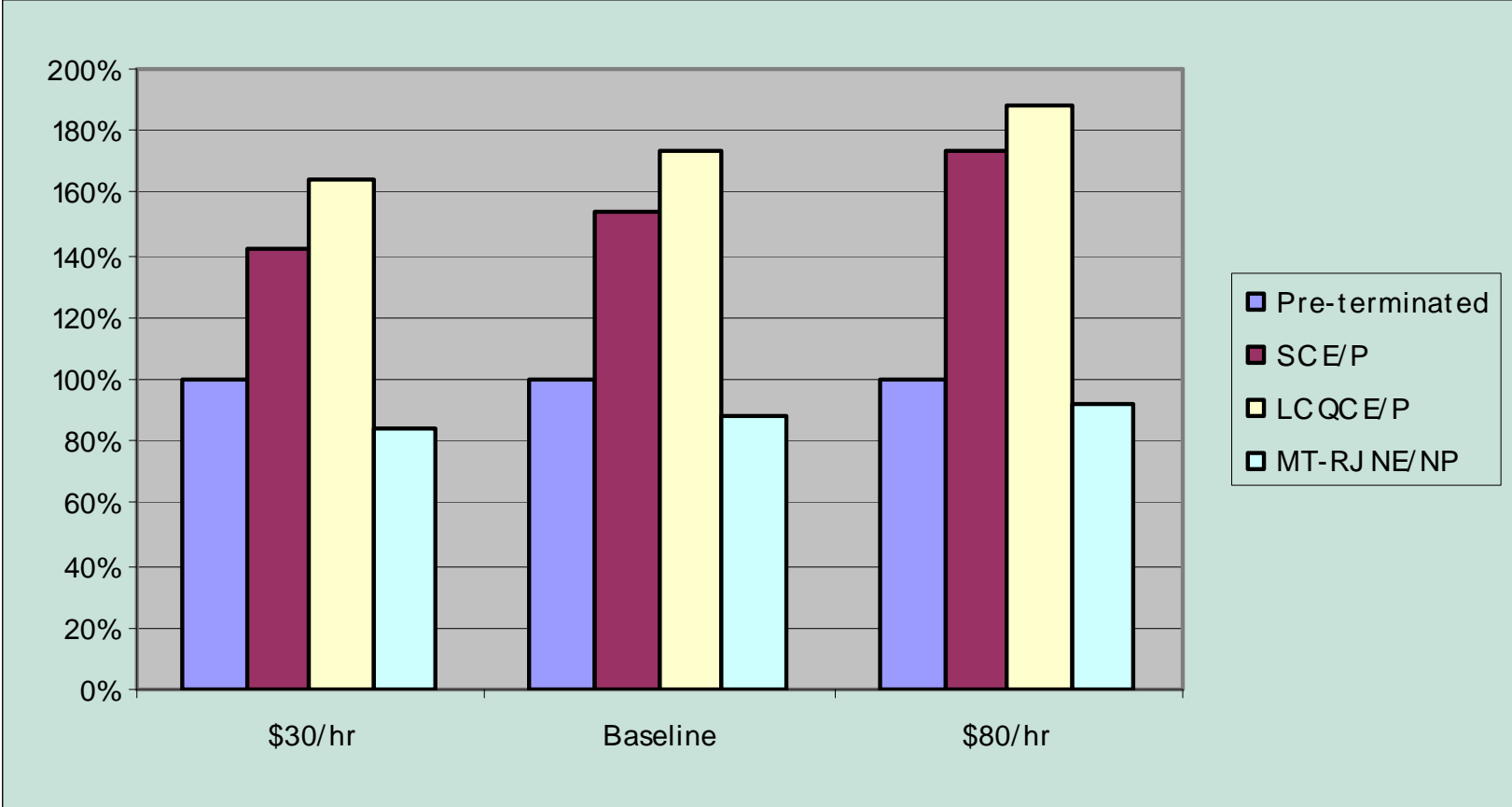
Fiber Backbone Baseline Relative Total Cost



Fiber Backbone Baseline Time Differential



Fiber Backbone Relative Total Cost with Labor Rate Variation



Fiber Backbone Scenario - Summary

- Pre-terminated solutions
 - Reduced installed cost by ~60% compared to epoxy/polish
 - Only ~10% cost premium over no-epoxy/no-polish
 - Reduced installation time by ~1.2 days compared to epoxy/polish
 - Reduced installation time by one-third day compared to no-epoxy/no-polish
- As labor rate increased, pre-term relatively less expensive
 - From 50-70% as labor rate changed from \$30-\$80/hr



Results - Fiber Data Center

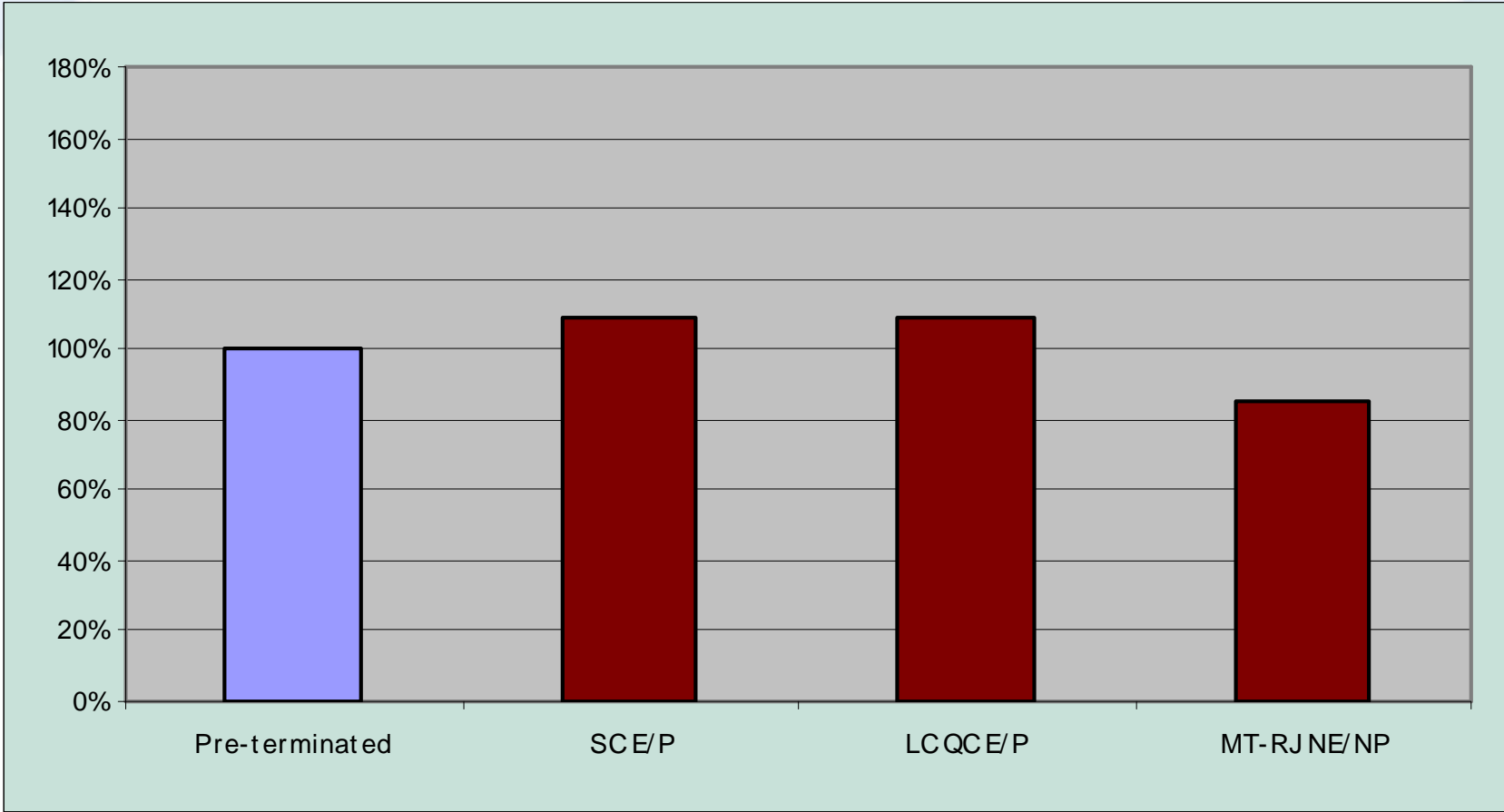


Fiber Data Center – Input (Constant)

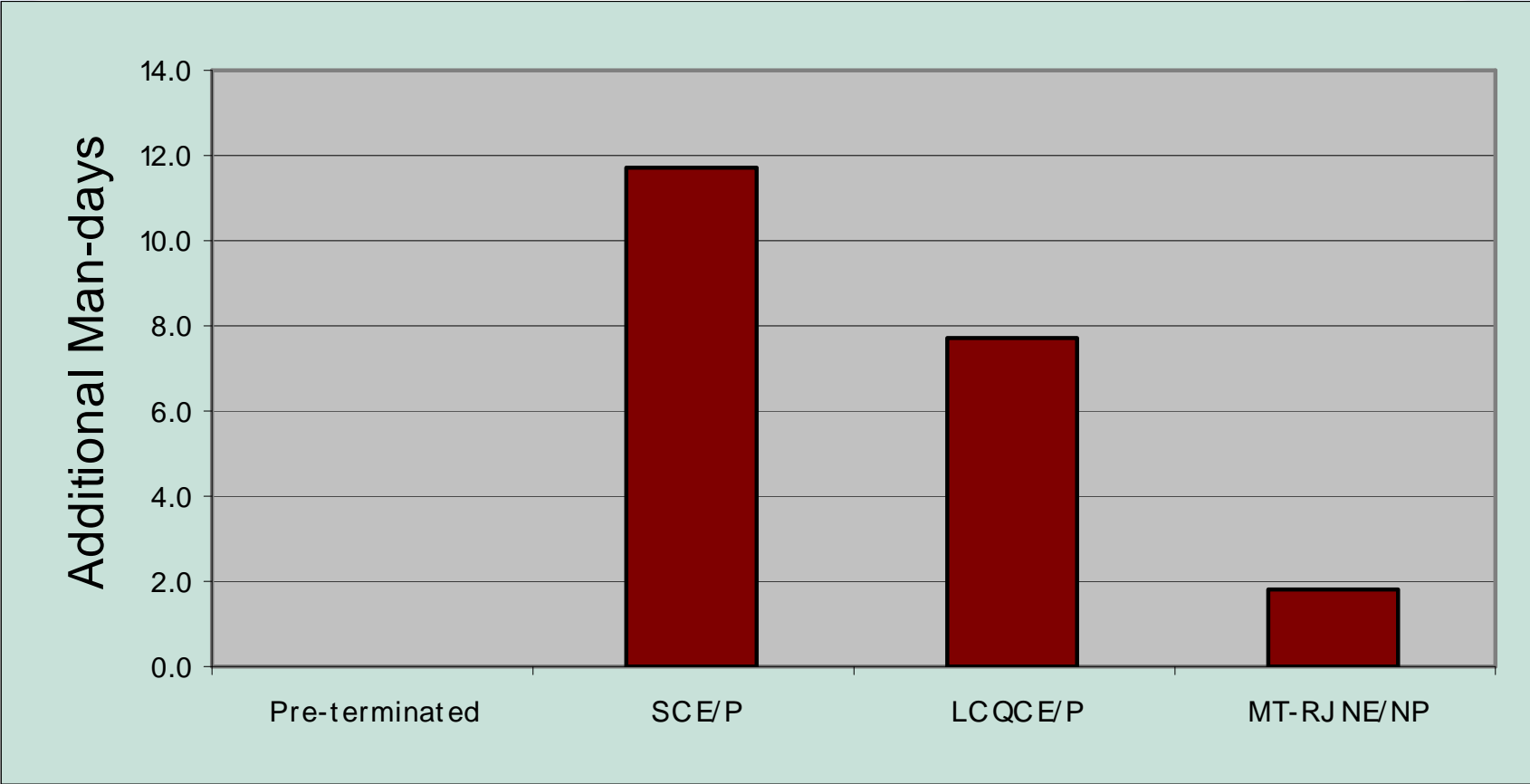
Number of Ports	480 (960 fibers)
Number of Locations (ends)	5
Average Length	60 meters
Bulk fiber cable, adapter plates, and assembly prices	Market for 50-micron
Installer Experience	Intermediate
Number of Technicians	2
Number of Tool Kits and Test Kits	1 tool kit, 2 test kits



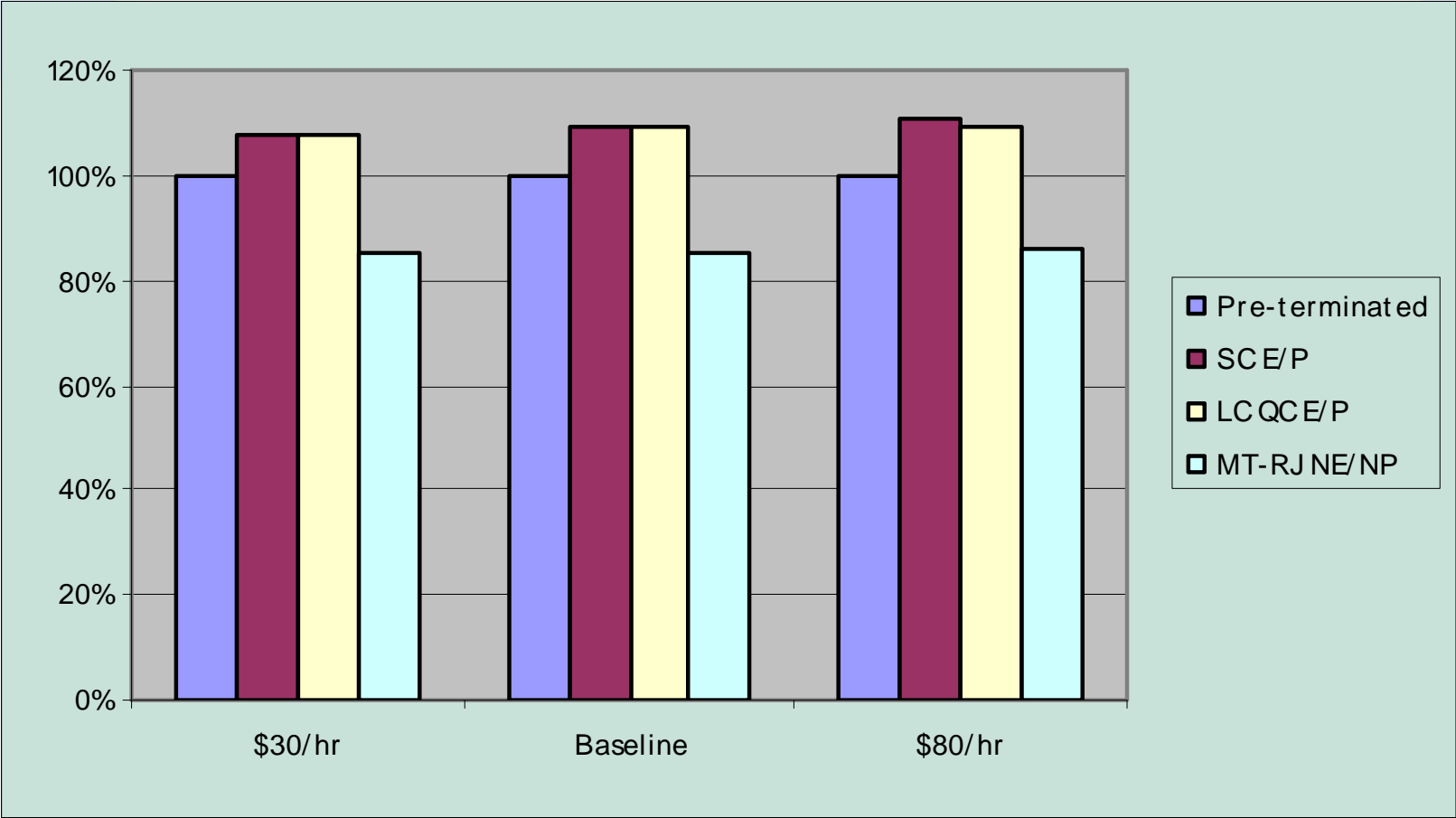
Fiber Data Center Baseline Relative Total Cost



Fiber Data Center Baseline Time Differential



Fiber Data Center Total Cost with Labor Rate Variation



Fiber Data Center Scenario - Summary

- Pre-terminated solutions
 - Reduced installed cost by ~10% compared to epoxy/polish
 - ~15% cost premium over no-epoxy/no-polish
 - Reduced installation time by ~10 days compared to epoxy/polish
 - Reduced installation time by ~2 days compared to no-epoxy/no-polish
- As labor rate increased, pre-term got relatively lower
 - ~10% as labor rate changed from \$30-\$80/hr



The Fiber Cost Model - Summary



Fiber Cost Model Summary

	Small Job	Large Job
Total Cost	~60% E/P +10% vs. NE/NP	~10% E/P +15% vs. NE/NP
Total Time Delta	~1 day	~10 days
Low Labor	50%	10%
High Labor	80%	10%



Fiber Cost Model Summary

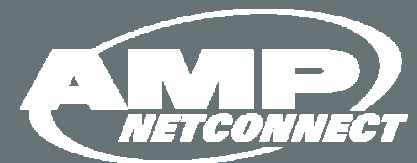
- Small jobs with low labor rates are more comparable
- Large job costs seem to approach parity
- Always a time premium for field-termination
 - Again, if you're bidding traditional "per port" on a pre-terminated job – you're likely to be left out
- Watch out for small, high labor rate field termination jobs



Other Factors Not Included in the Cost Models

It may not be solely a cost-based decision...

Space, Weight, Time, Security



Other Factors - Space

- Cable Pathway

- Smaller pre-terminated cables require less pathway space
 - → less money on pathways
- Six 4-pair cable has an effective area of 0.741in^2
- 25-pair cable has an effective area of 0.5in^2

A 30%
Reduction in
Cable Space !



Other Factors - Space

- Cable Pathway

- Smaller pre-terminated cables require less pathway space
 - → less money on pathways
- Six 4-pair cable has an effective area of 0.741in^2
- 25-pair cable has an effective area of 0.5in^2

A 30%
Reduction in
Cable Space !

A significant thermal management issue



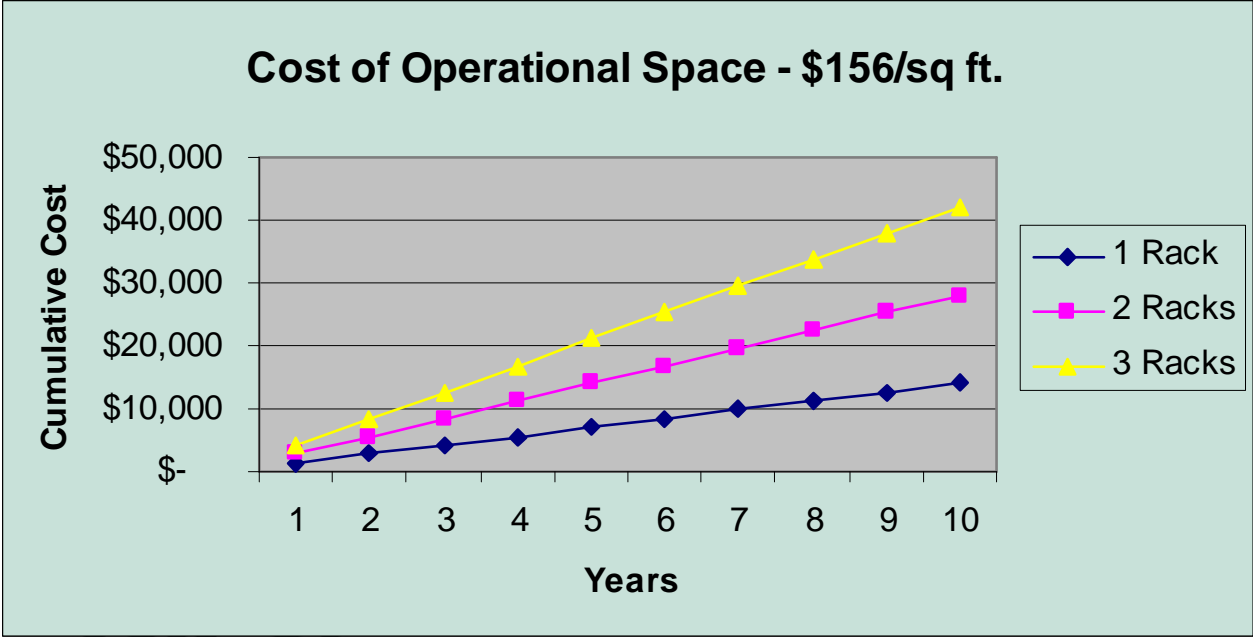
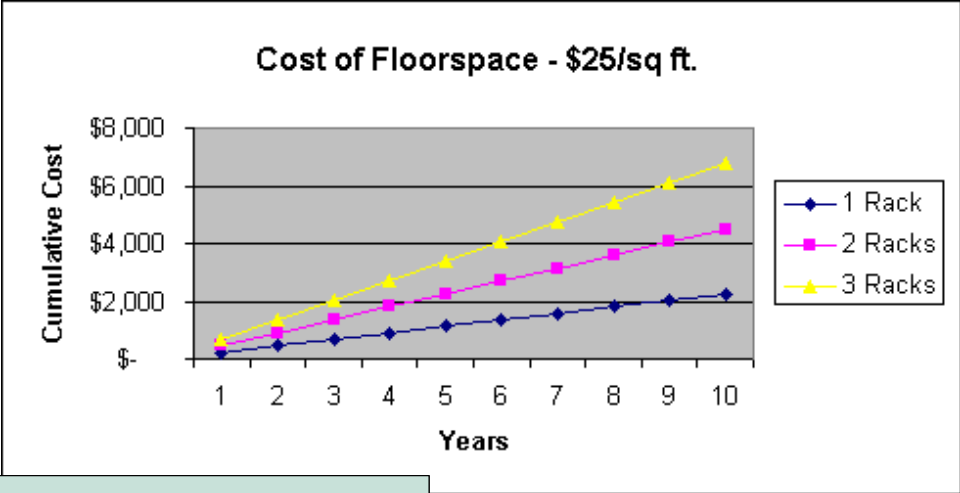
Other Factors - Space

- High-density Connectivity
 - Saves Patch Panel Space → Rack Space → Floor Space
 - 960 ports in one-half of a 7' rack instead of two racks
 - Ongoing floor space savings of up to \$4.50/port per year
 - High rent district factor



Other Factors - Space

960 Ports



Other Factors – Space

- Coming Now on Your End Equipment
 - This is where space savings really take off...



**1260 ports in
3 feet of Rack Space!**

**1260 Ports
Populated in a Rack**



Bicsi

**AMP
NETCONNECT**

Other Factors - Time

- Recovery of 48 ports
 - Disconnect, change out switch, and reconnect
 - RJ-45 takes 1-2 hours per switch onsite
 - MRJ21 takes 15 minutes per switch onsite – an 80% reduction
- Switch upgrades are faster and easier with high-density pre-terminated solutions



Other Factors - Weight

- Copper Cable
 - Six 4-pair cable is 168lbs/1000ft
 - 25-pair cable is 135lbs/1000ft

A 20%
Reduction in
Weight!



Other Factors - Weight

- Copper Cable
 - Six 4-pair cable is 168lbs/1000ft
 - 25-pair cable is 135lbs/1000ft

A 20%
Reduction in
Weight!

Floor loading is a significant issue



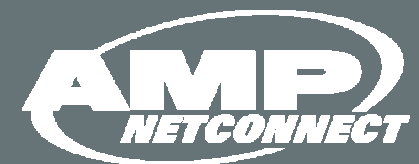
Other Factors – Security and Access

- Offsite personnel spend less time in secure areas when installing pre-terminated solutions
 - Fewer chances of an accident that can cause a critical outage
 - IT and Data Center Managers sleep better when there's no one in the data center



Some Words of Advice

Pre-terminated solutions do have limitations



Some Words of Advice

- Lead Times & Planning Issues
 - Pre-terminated solutions require advance planning and detailed bills of material
 - Be wary of short-fuse installations using pre-terminated products
 - Keep a few spare cassettes and trunk cables



Some Words of Advice

- Compare installed costs – parts and labor
 - The “normal” method of pricing products first won’t tell the whole story
 - Get accurate “per port” costs for installation
 - Traditional per port labor plus pre-terminated products causes sticker shock!



Some Words of Advice

- MPO Solutions work with all fiber types
 - Even single-mode and XG (850nm LO 50-micron)
 - Single-mode MPOs are almost always angled
- MPO Polarity can be done several ways
 - TIA 568-B.1 Addendum 7 provides guidance
 - Choose a polarity method, order to it and stick with it

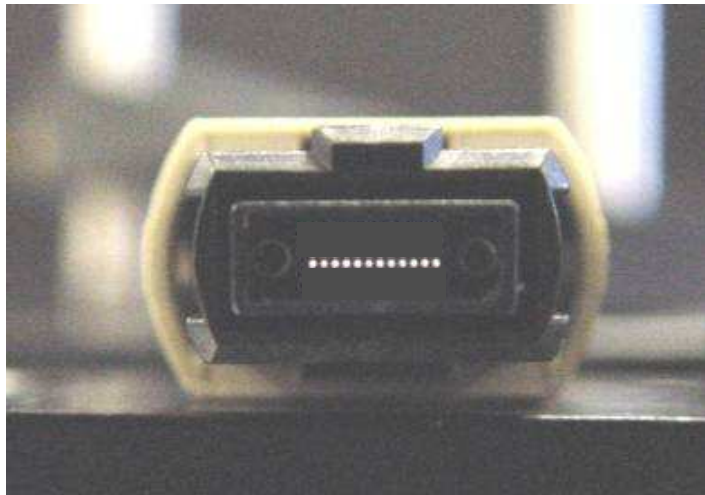


A Look into the Crystal Ball

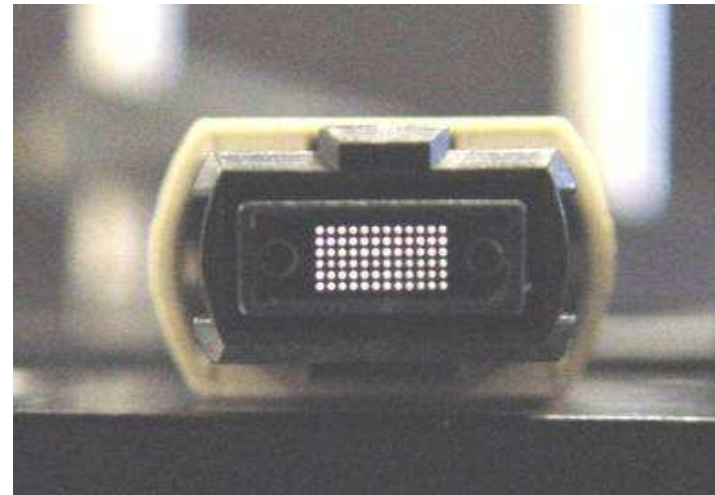
What's coming?



Ultra High-density Fiber Connectivity



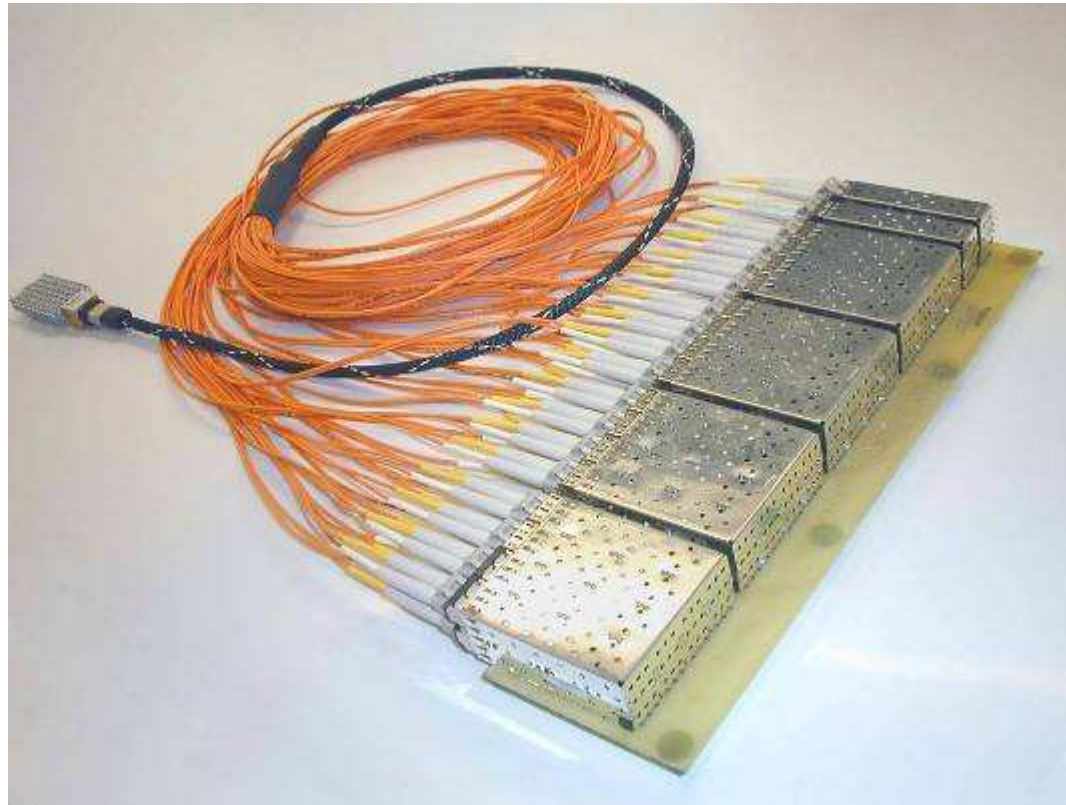
12-fiber MPO



72-fiber MPO



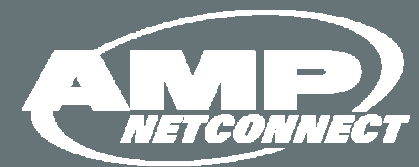
Ultra-high Density Fiber Connectivity



**One 72-fiber connector terminated to 72
LC (SFF) connectors**



Summary



Summary

- Pre-terminated solutions are here and are popular for many good reasons
 - May not be the best solution for every installation
- Two cost models were developed to assist in evaluating when these solutions make the most sense



Summary

- Based on several iterations, pre-terminated solutions can be very cost-effective
 - Additional features and benefits may justify selection even with a cost premium



Special Thanks

- Ken Hall, Tyco Electronics



Is Pre-terminated Prudent for Your Project?

Thank You for Your Attention

Herb Congdon
Tyco Electronics
www.ampnetconnect.com

