PROGRAM MANAGEMENT IN IMPLEMENTATION

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The application of Program Management in implementation of cable distribution systems is to be recognized as an important tool in the planning and controlling of the ever increasing growth of the cable industry.

Wether the turnkey contractor is a supplier, an independent turnkey implementor or an MSO running a Bill of Material implementation, the planning and control tools are identical.

The report describes Program Management Techniques used by TELE-ENGINEERING CORP. that have been specifically adapted to the implementation of cable distribution systems for the sole purpose to deliver highest system quality and on-time completion with minimum cost overruns.

1.0 Introduction

Any project that consists of many subsystems, products and product interfaces, relies on the wisdom and control of a Program Management Office to meet performance specifications and to assure an on-time completion without cost overruns.

What then is Program Management and how can it be applied to the implementation of Cable Communication Systems.

Tele-Engineering Corp. has adapted the most important program management techniques to cable implementation and utilizes these management tools effectively in all its turnkey programs.

2.0 The Program Office

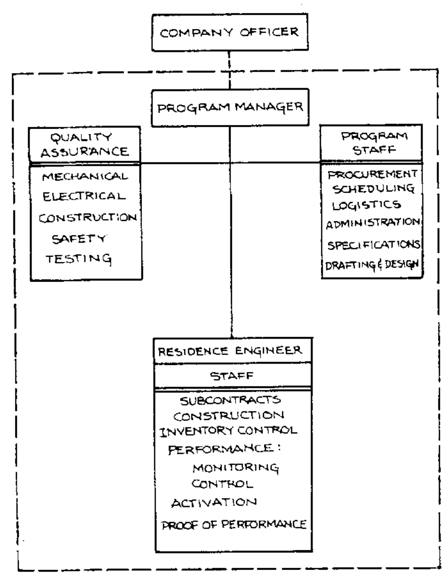
The Program Organization (Fig. 1) should consist of a balanced team of people skilled in

a) Cable system design and performance
b) Construction Practices, Outside Plant
c) Quality Assurance
d) Business Administration

For small projects, this knowhow may be concentrated in a team of two people. Larger and multiple projects may require three people per project that can pool their efforts through centralized business administration.

The Program Manager must be given full authority in the conduct of the daily business and must be held fully responsible for the progress through completion.

FIG. 1
PROGRAM MANAGEMENT ORGANIZATION



3.0 Program Management Techniques

Program Management Techniques consist of a set of management tools that permit accurate planning and control of all project activities from inception through completion of the project.

In order to effectively measure productivity and cost at any point in time during the implementation phase, it is of foremost importance to break the total project into measurable quantities, and to schedule both performance and cost expenditures over time.

Planning Tools in Program Management are:

a) Work Breakdown Structure
b) Work Order Numbers
c) PERT Chart
d) Monthly Cost Budgets
e) Monthly Performance Budget
f) Monthly Cash Flow

Control Tools in Program Management are:

a) Inventory Control System
b) Performance Reporting
c) Cost Collection System
d) Cost Performance Comparison
e) Remedial Activity Programs

Quality Enforcement Tools in Program Management are:

a) Quality Assurance Program
b) Safety Assurance Program

4.0 Project Planning

4.1 Work Breakdown Structure and Work Order Numbers

Most Projects, requiring system ingration, consist of the following four major categories:

Materials
Subcontracts
Labor
Expenses

The Work Breakdown Structure breaks these major categories down to logical subcategories. Even when the procurement of electronics and passives, or other combinations, will be made from a single source, the work breakdown structure of Fig. 2 is recommended to account for the timing of equipment deliveries in accordance with schedule requirements. To simplify cost control, it is also advisable to structure purchase orders and subcontracts in accordance with the breakdown structure.

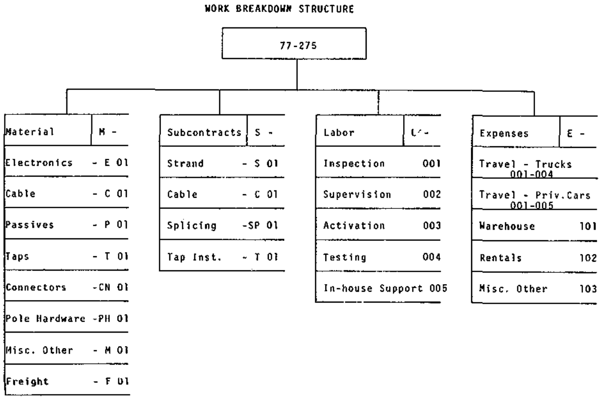
Devise a logical numbering system that establishes good recognition in the project control phase. A number like 15045A is quite meaningless. Establish a main project number, a subcategory number and an identifier.

Example:

78-358	- M -	EH01
Project No.	Subcategory	Electronics, Housing, 1st purchase order

Fig. 2 shows an example of a Work Order numbering system ready for cost control and with total budget cost assignments.

Fig. 2
WORK BREAKDOWN STRUCTURE



4.2 PERT Chart

A PERT (Program Evaluation Real Time) Chart is the most important planning document for any multi-component project. PERT-charting organizes your mind to think in terms of activities that must be conducted in sequence or that can be accomplished in parallel during a given time frame.

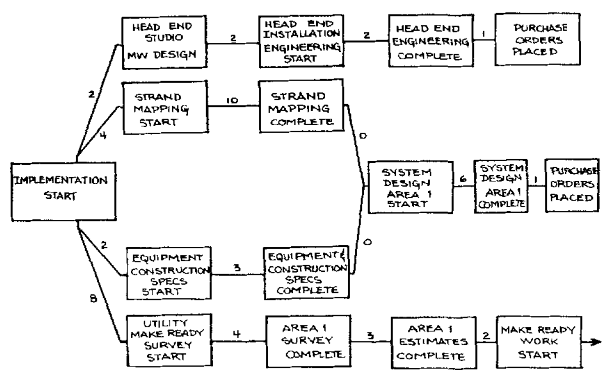
Fig. 3 shows a simplified section of a PERT Chart of a cable distribution system.

Your own ideas on the duration of a particular activity can be expressed in terms of (best) -normal and (worst) time intervals expressed in weeks.

In the preparation of your PERT Chart be fearful of the "uncontrollables" such as make-ready, highway permits, railroad permits, easements, anchors etc. Allow sufficient time to manage these events before construction start, rather than having to stop or slow down construction in the midst of the field activities.

Review the PERT Chart carefully, make changes and allowances at this time - you are determining all important milestones of the program and you want them to be met.

FIG. 3
PERT CHART
PRECONSTRUCTION ACTIVITIES



4.3 Monthly Budget Cost Assignments

Any material and labor item in the work breakdown structure can be assessed as to total costs and then spread over time.

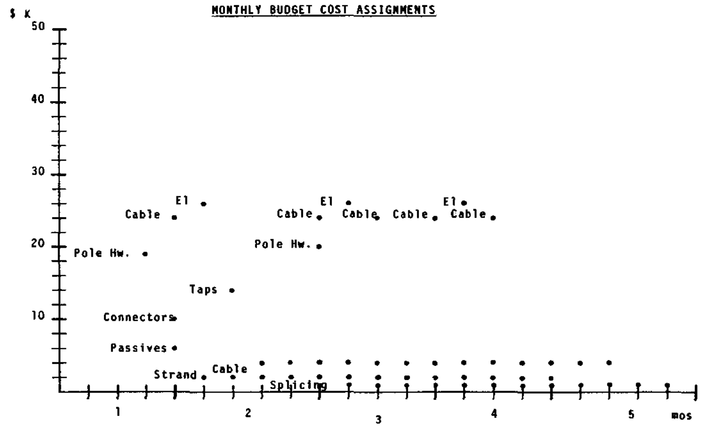
Using the PERT Chart as a guide, we know when we need certain materials. Large dollar items like electronics and cable can be scheduled for three or four shipments.

Fig. 4 shows a graphic presentation of cost expenditures over time for materials and construction activities.

Where budget cost determination over time for materials is simply scheduling of delivery dates, the scheduling and budget cost determination for construction and other labor tasks require a good knowledge of subcontractor ability, construction equipment and manpower.

Fig. 4

MONTHLY BUDGET COST ASSIGNMENTS



4.4 Monthly Performance Budgets

Fig. 5 indicates the performance curves of the stranding, lashing and splicing activities.

The slope of this curve is directly related to the cost per foot and to the time allotments per week.

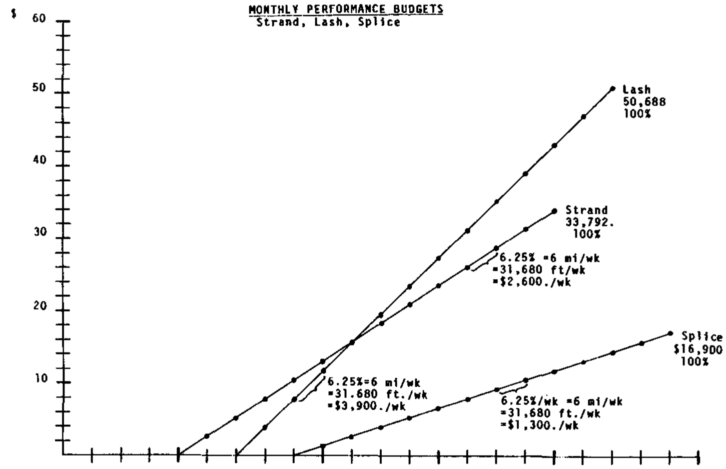
The example shows all three activities budgeted for 31,680 ft. per week. This kind of determination should only be made after an intimite knowledge of construction and splicing crew composition, equipment and manpower availability.

In case where you are working with outside construction companies, it is important to get proper commitments in writing before budgeting the weekly progress. What you are interested in is an average production output that assumes normal weather delays.

The slope of these curves becomes the baseline for progress-monitoring later in the program. It is, therefore, important to spent some time to determine the expected output per week.

Fig. 5

MONTHLY PERFORMANCE BUDGETS
Strand, Lash, Splice



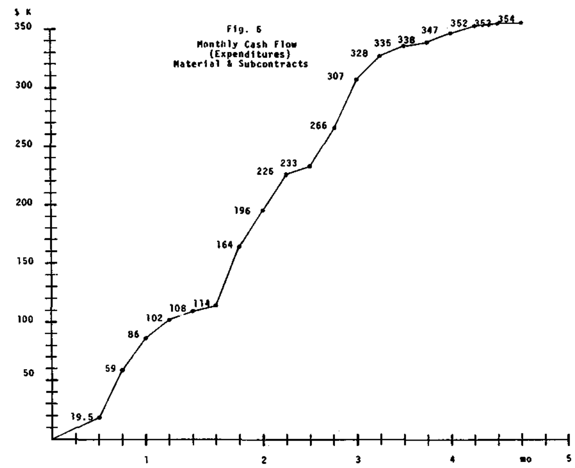
4.5 Cash Flow

Fig. 6 shows the month-by-month cash flow curve of the project. Indicated are only expenditures in order to determine cash requirements over time.

Customer payments or bank loans would reduce the cumulative buildup of cash requirements and determine actual interest and cash requirements.

The weekly cash requirements of Fig. 6 have been determined by adding the weekly components of Fig. 4 (Monthly Budget Cost Assignments) in a cumulative manner.

Since this curve indicates total expenditures over time for the particular project on hand, it can serve as an ideal tool to measure actual cost expenditures against plan throughout the program.



5.0 Project Controls

5.1 Inventory Control System

Shipments of materials and equipment to the project warehouse will have to be inventoried. The inventory control forms for incoming materials are grouped in accordance with work order numbers.

Separate forms, similar to Fig. 7, for pole line hardware should be available for incoming shipments of

- cable
- passives
- connectors
- taps
- electronics

Each inventory control form should contain the purchased quantities in the first column in order to identify full shipments as well as back orders.

At the end of each week all incoming material records are entered in the project inventory log book and the incoming material control forms are forwarded to the home office for comparison with vendor invoices.

Once construction has started, materials are being taken out by the strand crews, by the lashing crews, by splicers and by activation personnel.

Fig. 8 shows a typical material control form for strand materials. The form indicates columns for each day of the week and a weekly total.

The weekly total column is entered into the inventory log book every week and the material-on-hand column adjusted accordingly.

Similar forms are required to permit the monitoring of materials for lashing, splicing and activation.

A physical inventory of everything in the warehouse is taken every two weeks to compare with the on-hand column and to reveal any material shortages that may be unaccounted for.

Fig. 9 indicates the Inventory Control Summary. In addition, it is the residence engineer's duty to determine the requirement for any further material purchases from the physical inventory. This can be accomplished by comparing the rate of construction with the completion percentage and by extrapolation to project completion.

Fig. 7

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INCOMING MATERIAL RECORD — Form #1101

POLE LINE HARDWARE

PROJECT No. __________

The following material has been received and all quantities verified. Copies of shipping documents are attached.

DESCRIPTION	PO#	INITIAL	INITIAL
	ORDER DATE ____ ORDER QTYS.	REC. DATE ____ QTY. RECEIVED	REC. DATE ____ QTY. RECEIVED
1/4" Strand No. of reels			
" footage			
Lashing Wire			
J25088 3-Bolt Clamp flat			
J7901A " " curved			
J8808 8"			
J8810 10"			
J8812 12"			
J8814 14"			
J8816 16"			
J8050 10" Thimble Eye			
J8052 12" " "			
J8053 14" " "			
J6510 Thimble Nut			
J8563 Nuts Square 5/8"			
J1075 Washers 2 1/4"			
GDE 1104 Preformed Dead End			
GLS-2104 Splice			
09010 D-type Lash. Clamp			
1602 Beatty 1/2" Spacer			
L891 10" Straps			
L892 16" Straps			
Crossover Clamp			
J7920 Steel Exr. Arm			
Treeguard 6 ft.			
#6 Copper Bare (ft)			
TCS-15-24 Heatshrink			
TCS-17-24 0.75 Heatshrink			
K-1 Bonding Clamp Weaver			
Copper Staples			
Tap Bracket			
Electrical Tape			
Silicone Grease			
Guy Attachment			
8" Screw Anchors			

Fig. 8

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CONSTRUCTION MATERIAL CONTROL — Form #2201

STRAND CREW

PROJECT No. __________ WEEK OF _____

The following material has been provided to crew foreman for pole framing and stranding.

DESCRIPTION	QUANTITY MO	TUES	WED	THUR	FRI	SAT	TOTAL WEEK
1/4" Strand No. of reels							
" footage							
J25088 3-Bolt straight							
J7901A 3-Bolt curved							
J8810 10" Bolt							
J8812 12" Bolt							
J8814 14" Bolt							
J8816 16" Bolt							
J8050 10" Thimble							
J8052 12" Thimble							
J8053 14" Thimble							
J6510 Thimble Nut							
J8563 Nuts 5/8"							
J1074 Washers 2"							
GDE1104 Pref. Dead End							
GLS-2104 Splice							
Crossover Clamp							
J7920 Ext Arm							
Guy attachment							
K1 weaver clamps							
Copper staples							
#6 Bare Copper							

Date: __________

Crew Forman Initial __________

TEC Initial __________

Fig. 9

INVENTORY CONTROL SUMMARY

Material	1 Initial Shipments	2 (-) wk No.1	3 (-) wk No.2	4 Balance wk No.2	5 Physical Inventory wk No.2
Pole Line Hardware					
Cable					
Passives					
Electronics					
Taps					
Connectors					

5.2 Performance-Reporting

A properly devised performance-reporting system consists of the daily collection of completed footages for

- stranding
- lashing
- splicing
- activation

and a weekly compilation that is prepared by the residence engineer and forwarded to the home office.

The daily summaries (Fig. 10) are compiled on a weekly basis and the weekly total entered on the monthly performance budget curves for comparison.

Fig. 11 indicates the progress of stranding made over the first 2 months in a particular project.

Fig. 12 indicates the progress of stranding made over the first 2 months in another project.

A quick glance at this type of presentation will give you the necessary insight into the actual production flow. It is now possible to determine slippages quickly, forecast schedule delays, facilitate remedial actions and, in a general manner, actively control the construction activities.

Cable lashing, splicing and activation can be monitored and controlled in identical manner or by Power Supply Areas.

Fig. 13 indicates a budget vs. actual comparison of activation performance by power supply areas.

Fig. 10

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DAILY PRODUCTION RECORD   Form #2401
CONSTRUCTION
PROJECT No.________ DATE:_____

This form shall be submitted on a daily basis by the construction company supervisor and initiated by all responsible crew foremen.

STRANDING
No. of poles framed____________
Strand footage completed____________

LOCATION

Street	Pole #	Street	Pole #

Construction Co. Initial____________
Date:____________

LASHING
0.75 cable footage____________
0.5 cable footage____________
0.412 cable footage____________
Cable bearing strand (ft)____________

LOCATION

Street	Pole #	Street	Pole #

Construction Co. Initial____________
Date:____________

SPLICING
Splicing Footage____________
Taps installed____________
Bonds installed____________

LOCATION

Street	Pole #	Street	Pole #

Construction Co. Initial____________
Date:____________

EXTRA SCOPE ITEMS

Construction Co. Initial____________
Date:____________

Fig. 11

Project No: A

STRAND CREW PERFORMANCE

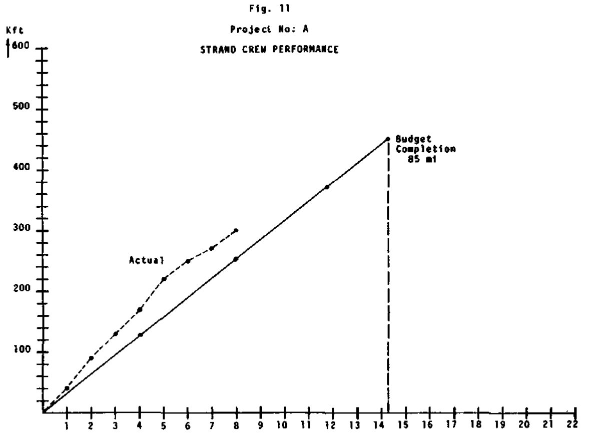


Fig. 12

Project No: B

STRAND CREW PERFORMANCE

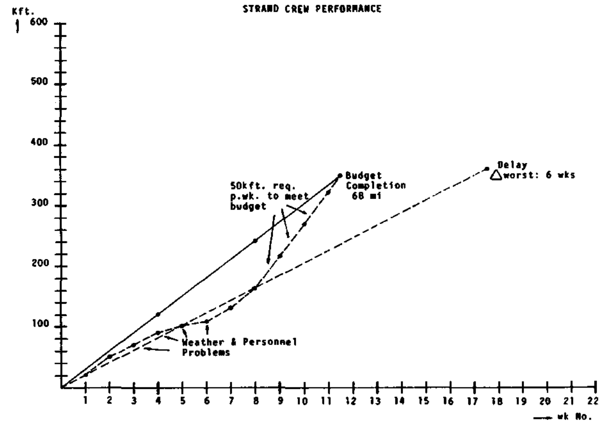
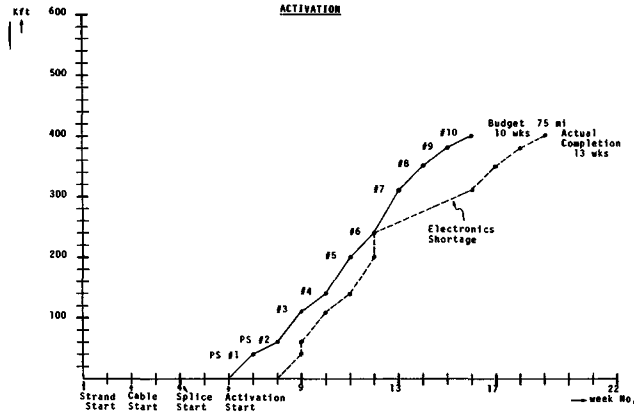


Fig. 13

Project No: C

ACTIVATION



5.3 Cost Collection System

The work order numbers and associated budget cost amounts form the baseline of the cost collection system.

Project planning has already determined the project cash flow and the monthly or weekly expected expenditures in each category.

It is now important to collect vendor invoices for materials, subcontractor invoices for construction, and labor and expense records of your personnel in a systematic manner.

Fig. 14 shows the Project Cost Summary with sample entries for stranding and labor.

The form should be prepared for total budgets of all work order numbers and with the appropriate budget entries for month No.3.

Actual costs incurred through month No.3 are now entered and compared to the budget.

It becomes apparent that stranding costs are under budget by $ 4,400.-, which means that the stranding operation is late. On the other hand, supervisory labor and activation is overrunning the budget.

The cost-to-complete estimate indicates that stranding will not overrun at the end of the project, but we can draw the conclusion that completion will be delayed.

Vendor and subcontractor costs must be incurred in accordance with budget to keep a project on target.

Supervision and activation labor shows a total budget variance of $3,500.- and takes recognition of the fact that construction will be late and that supervision and activation periods have to be extended.

These two-line entries tell the whole story:

a) Completion will be late
b) Cost overruns are being incurred

The project cost summary cannot provide any information as how much delay will be incurred. Inputs from the performance-reporting are required to get the full picture. It is also possible to update Fig. 6, the Monthly Cash Flow presentation, by plotting the Total of the column entitled "Actual Cost to-date".

Fig. 15 shows the first 3 months of costs cumulative plotted over time. The actual cost expenditures indicate that the project is \$ 102,000. underspent and 4 weeks late.

The reason for this can be late deliveries of equipment, late invoicing, construction delays etc. It is time to take a closer look.

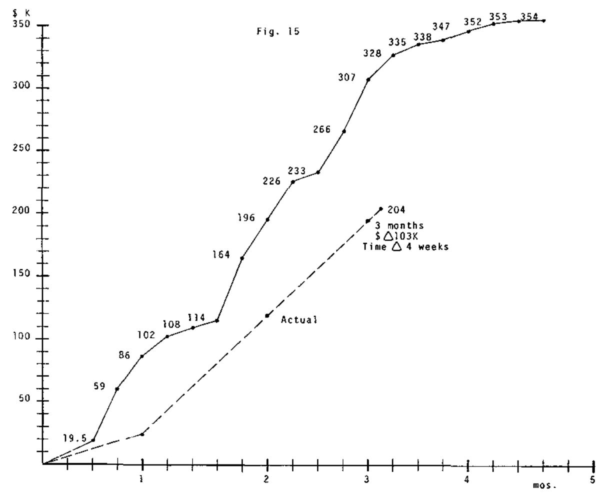
Fig. 14

PROJECT COST SUMMARY

Project No. 77-275 Month No. 3 Week No. 13 Date

Work Order Nos.	Total Budget	Week No. 13 Budget	Actual Cost to-date	Present Variance (-) +	Cost to Complete Estimate	Total Budget Variance (-) +	Reason for Change
S - S01	31.7	23.8	20.3	(3.5)	11.4	0	Crew/Weather
L - 003	18.7	10.8	12.2	1.4	11.4	4.9	Eqmt. Probl.
			*				

* enter total on Monthly Cash Flow TEC 77-275



TEC 77-275

5.4 Cost/Performance Comparison

First, it is important to analyze all entries in the Project Cost Summary.

Fig. 16 shows a summary with completed entries. A large portion of the cost underrun is caused by late material deliveries (about \$ 90,000.). The rest is due to late construction. A review of the strand and cable crew performance curves would show that the construction is about 2 to 3 weeks behind schedule.

The project cost summary also indicates positive cost variances in the labor area for inspection, supervision and activation.

These are caused by equipment problems and, indirectly, by the extension of the construction activities.

The overall conclusion that can be reached is that the project will be completed four weeks late and that it will cost \$ 11,000., or about 2.6% more than it was originally estimated.

The importance of remedial action cannot be stressed enough. Late completion is costly to the turnkeyer and the operating company. A four week delay of completion may mean a substantial revenue loss of installation fees and monthly rates.

Fig. 16

Project No. 77-275

PROJECT COST SUMMARY

Work Order Nos.	Total Budget	Week No. 13 Budget	Actual Cost to-date	Present Variance △(-) +	Cost to compl. Estimate	Total Budg. Variance △(-) +	Reason for Change
M - E 01	65.0	65.0	30.5	(34.5)	34.5	-	Late Delivery
- C 01	88.5	88.5	42.2	(46.3)	46.3	-	Late Delivery
- P 01	7.5	7.5	7.5	-	-	-	
- T 01	26.3	26.3	16.3	(10.0)	10.0	-	Late Delivery
- CN 01	13.2	13.2	13.2	-	-	-	
- PH 01	39.0	39.0	40.2	1.2	-	1.2	Add. Requirement
- M 01	4.5	4.5	3.5	(1.0)	1.0	-	
- F 01	3.0	3.0	3.5	0.5	0.5	1.0	Higher Costs
S - S 01	31.7	23.8	20.3	(3.5)	11.4	-	
- C 01	47.5	23.8	16.5	(7.3)	31.0	-	
- SP 01	15.8	6.7	5.4	(1.3)	10.4	-	
- T 01	12.6	5.8	4.8	(1.0)	7.8	-	
	354.6	307.1	203.9	(103.2)	152.9	2.2	
L - 001	8.6	6.5	6.8	0.3	2.3	0.5	
- 002	10.5	5.0	6.8	1.0	7.2	3.5	Equipment Problems
- 003	18.7	10.8	12.2	1.4	11.4	4.9	Late Construction
- 004	12.5	6.5	5.2	(1.3)	7.3	-	
- 005	6.5	3.5	3.0	(0.5)	3.5	-	
	411.4	340.2	237.9	(102.3)	184.6	11.1	

5.5 Remedial Activity Programs

In the last paragraph, we have tried to explain the interdependency of deliveries, construction performance and costs.

It has become apparent that even short delays in material deliveries can cause long delays of the project completion date and incur substantial cost overruns.

Remedial actions have to be harsh to offer relief. There is no time to waste.

Here are some of the steps that can be taken, sorted by degree of the magnitude of the problem:

a) Late Deliveries
- request shipment by air
- request partial shipment
- request critical items shipment
- find substitute supplier and supplement
- cancel order after finding substitute supplier who will deliver on time

b) Late Construction
- request to add manpower to construction crews
- request additional strand lashing crews
- supplement construction with 2nd construction company
- set deadline for production improvement and change construction companies

c) Late Splicing
- request additional splicer
- supplement splicing by employing additional independent personnel or company employees

The applicability of any of the above remedial procedures depends upon the circumstances at hand. Whatever the decision may be, it must be made within the shortest possible time frame and it must assure a higher production rate than originally budgeted.

6.0 Quality Control Tools

6.1 Quality Assurance Programs

The quality of the implementation program has to be safeguarded throughout the life of the project.

Quality Assurance measures have to be structured and timed in accordance with the progress of all activities:

a) Incoming Inspection
b) Construction Inspection
c) Splicing Inspection
d) Activation Records

Forms for good record-keeping of these tasks shall be developed to assure conformance to all construction and performance specifications, and to assure a distribution plant that requires minimum maintenance.

6.2 Safety Assurance Programs

Safety can only be stressed in a general sense as part of this presentation. It is truly a topic by itself and much too important to be treated lightly. Too many accidents have already happened in our industry that could have been avoided, had proper precautions been taken.

The residence engineer must be a safety-minded individual and enforce the following ground rules:

a) Construction Crews
- placing of "men working" signs
- placing of safety cones
- use of beacon on trucks
- use of hard-hats
- use of safety vests
- use of gloves
- use of a running ground during stranding
- flag man
- state or local police details on heavily traveled roads

b) Power Companies
- tree-trimming in primaries
- fast remedial response in cases of hot street light brackets, bare secondaries, broken neutrals, and other electrical shock hazards.

It is recommended that the residence engineer devotes at least a few minutes every day to enforce the safety rules with the construction crews. Habitual offenders should be warned and removed if required.

7.0 Summary

This presentation has tried to explain the importance of program management in the implementation of cable distribution systems.

Our industry has sufficiently matured not to tolerate badly run turnkey projects that are not planned properly and that cannot be controlled to guarantee an on-time completion.

Even if it is not possible to prevent all delays, it is essential to apply the proper tools to minimize delays and maximize the quality of our product.

Both the turnkeyer and the operating companies must recognize that a few dollars per-mile spent for planning, control and quality assurance will go a long way to minimize cost overruns, loss of subscription revenues and maintenance expenditures.

It is time to take a look at our mistakes in the past, remove the "low-bidder-will-do-it-somehow" principal and insist on accurately planned program implementation already in the proposal phase, so to assure timely completion and quality system performance through proven program management techniques.