SYNOPSIS

This case details an approach for measuring technical success. Availability of cost and schedule control systems are discussed and the lack of quantifying technical performance is expressed. Background of the authors' work is given and schedule and cost variances are explained. A cost plus incentive format, with incentives on cost, schedule, and technical performance prompted the development of a process for measuring technical performance. This process is detailed and described for a hypothetical case.

LEARNING OBJECTIVES -"MEASURING SUCCESSFUL TECHNICAL PERFORMANCE: A COST/SCHEDULE/TECHNICAL CONTROL ..."

The objectives to be met in discussion of this case include:

- understanding the process for measuring the technical performance parameters of a project
- examining the interdependence between cost, schedule, and technical performance factors
- identifying the variances associated with cost, schedule, and technical performance
- recognizing how incentive contracting helped to improve t=and measure technical performance in this case

Discussion Point

- Topics which can be discussed within the realm of cost control include: variance analysis (cost variance, schedule/performance, variance since last period, etc.), monitoring actual versus budgeted, and progress analysis.

- <u>Discuss these topics in more detail as a group.</u>

III

Measuring Successful Technical Performance: A Cost/Schedule/Technical Control System

Robert H. Kohrs, Program Manager, Underwater Tests, Westinghouse Electric Corporation
Gordon C. Weingarten, Programs Business Manager, Westinghouse Electric Corporation

PMI Canada *Proceedings*, 1986, pp. 158–64

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- recognizing how incentive contracting helped to improve and measure technical performance in this case.

Discussion Questions and Possible Answers

1. Demonstrate your understanding of the project manager's triangle as presented in the case.
   a. The project manager's triangle consists of three performance factors: cost, schedule, and technical. Balancing and coordinating these factors is critical. Maximization of one factor may result in inefficiencies in the other two.

2. How can cost and schedule variances be measured? Discuss the difficulties in defining technical variance.

   a. Cost variance is measured by comparing actual cost with budgeted using existing financial reports. Key milestones are defined in project plans. Schedule variance is the difference between actual milestone completion and planned milestone completion. It is difficult to measure the success or failure of a technical task. Quantifying technical performance is not as common or discussed as frequently in the literature as measuring cost and schedule performance.

   b. The foundation for measuring technical performance should be based on determining what the customer needs, wants, and expects. That is, successful technical performance is directly dependent on customer satisfaction. ← MANAGING EXPECTATION

3. A successful project is one that not only fulfills the constraints of time, cost, and technical performance but fulfills other requirements such as minimal scope change and customer acceptance. Discuss some of these other requirements.

   measure of how well things really were done in the beginning!

   a. Research in Kerzner, *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*, as paraphrased, shows that a successful project is one that is completed:
      1. within the allocated time period,
      2. within the cost budget,
      3. at the specified performance level,
      4. with acceptance by the customer/user,
      5. with minimum or mutually agreed upon scope changes,
      6. without disturbing the primary work of the organization, and
      7. without altering the corporate culture.

4. The case emphasizes the importance of measuring technical performance. What are the elements to consider in performance reporting in cost, schedule, or technical performance?

   a. *PMBOK Guide*, section 10.3, Performance Reporting, states: "Performance reporting involves collecting and disseminating performance information in order to provide stakeholders with information about how resources are being used to achieve project objectives. This process includes:
      - Status reporting—describing where the project now stands.
      - Progress reporting—describing what the project team has accomplished.
      - Forecasting—predicting future project status and progress.
      - Performance reporting should generally provide information on scope, schedule, cost, and quality. Many projects also require information on risk and procurement. Reports may be prepared comprehensively or on an exception basis."

ADDITIONAL DISCUSSION POINTS:

HEAVY CLASS DISCUSSION

Topics which can be discussed within the realm of cost control include: variance analysis (cost variance, schedule/performance, variance since last period, etc.), monitoring actual versus budgeted, and progress analysis. The instructor may discuss these topics in more detail with the class

The students might also describe a project from their own work or school experience and apply the variance reporting model discussed in the case. They should list the incentive parameters and prepare summary variance report forms.

Measuring Successful Technical Performance: A Cost/Schedule/Technical Control System

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Introduction

It is well established that any successful project is determined by the appropriate balance of technical, schedule, and cost parameters. But that balance is often very difficult to achieve. Perhaps this problem is most simply illustrated by a sign once observed in a co-worker's office which read:

GOOD!
FAST!
CHEAP!
PICK ANY TWO.

Though meant to be humorous, it also illustrates a very common attitude about the difficulty in meeting all constraints imposed on typical projects. Obtaining a balanced output on a project is, in fact, a major responsibility of that individual charged with overall integration, the project manager.

For more than twenty years, project managers have utilized some form or other of a cost and schedule control system. Cost and schedule controls have been thoroughly discussed in the literature, and understood and used to varying degrees of sophistication by almost all project managers. Very extensively developed systems have been applied to projects involving power plants, chemical plants, and defense systems, all typically billion dollar projects. Frequently referred to as a C/SCS (cost/schedule control system), these systems are based on a set of criteria with a rigid structure in organization, systems, and procedures. Among the most sophisticated C/SCS systems are those based on the Department of Defense 7000.2 specification requirements.

Those individuals and agencies who have conceived and implemented these elaborate cost and schedule systems have done an excellent job; but, in most cases have failed to include the measurement of perhaps the key factor in the entire project ... technical performance! Will the project work? Will the pumping system pump enough fluid? Will the missile reach optimum speed? In other words, when the project is done on schedule and within budget, will the technical performance be grossly over designed or less than satisfactory?

The developers of these cost and schedule control systems considered two-thirds of the program management triangle and stopped. They had systems and organizations in place, disciplines established, and reports designed that could have been adopted to handle the entire problem, but did

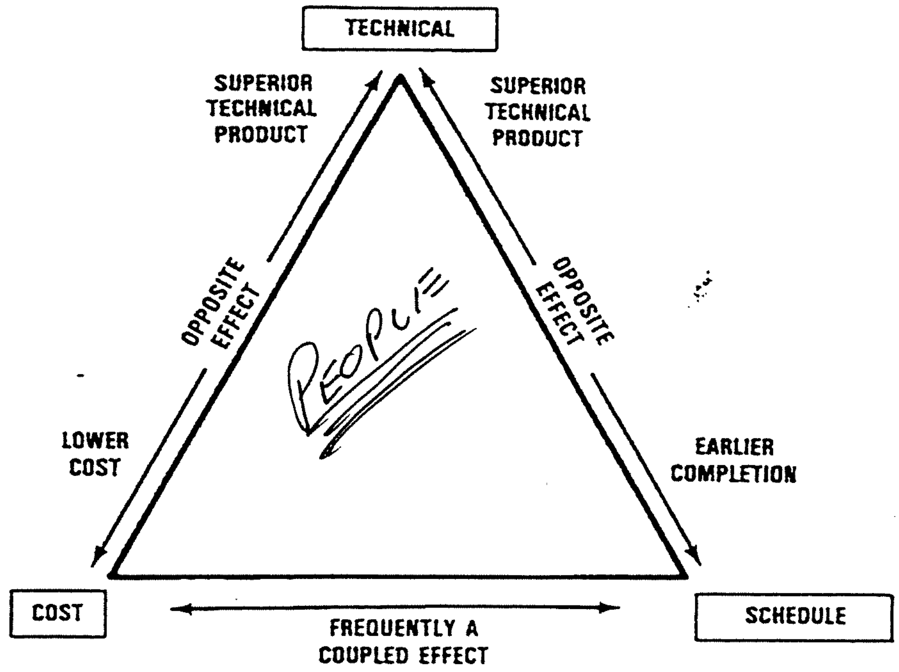

FIGURE 1 THE PROJECT MANAGER'S TRIANGLE

not complete the process. The project management process demands a balanced, coordinated effort between cost, schedule, and technical factors. This desired balanced output of a project can be diagramed as shown in Figure 1.

Note that moving toward the "superior technical product" typically can move the project away from "lower cost" and "earlier completion." How far up towards the "superior technical product" apex could, or more importantly, should, the project be driven? Furthermore, having made some implicit judgmental answer to that question, how are the three parameters measured and compared to assure that the proper positioning has, in fact, taken place?

In order to obtain a meaningful balance, factual information on each of the three key parameters must be obtained. Cost data and schedule information gathering methods have been developed over the years and are normally available to the project manager. But how can technical data be obtained on a summary basis without including all the complex information fully understood only by the technical specialist? How is this information to be transformed into parameters which permit comparison to the cost and schedule constraints of a project?

This paper discusses one way technical, schedule, and cost parameters and variances may be measured and compared on a common basis, so that the project manager may, in fact, make properly balanced decisions during the evolution of the project.

BACKGROUND

The approach discussed herein has evolved naturally from observations in a project management environment characterized by an incentive contract for a large defense-oriented project. This approach could, however, be applied to both smaller and commercially oriented applications. Simply stated, what has been observed is that when cost, schedule, and technical performance are all incentivized, an inherent and implicit system is fortuitously created which permits quantitative measurement of technical performance. For purposes of this discussion, incentivized means the addition of cash incentive awards to enhance contractor performance.

Cost is always measured in dollars. Although schedule is best measured in time, time is converted to dollars and schedule performance is measured in terms of dollars in these cost and schedule control systems. Therefore, if a measure of technical performance in terms of dollars could be made, then all three parts of the project manager's triangle would be expressed in a common denominator suitable for top management review and analysis. Therefore, balanced decisions in the inevitable compromises between cost, schedule, and technical performance may be made by the project manager and executive level management on the basis of this common parameter.

How do these components get measured to provide data to assure that the desired balance is, in fact, achieved? To answer these questions, it is constructive to go back to the beginning of a project and examine the steps followed in the formulation of a project plan.

Initially in a project, objectives are communicated to the team, and a plan for successful completion of those objectives is formulated, generally in the following order.

Step 1: What? Define technical tasks; what specific analysis, design, procurement, fabrication, assembly, and test will be performed to accomplish objectives of the project.

Step 2: When? Put the technical tasks into a framework; link together into a schedule; define dependencies; calculate a network; define dates for start and finish of individual tasks and for the project as a whole; adjust and define parallel efforts in order to meet project end date requirements.

Step 3: How Much? Define resources (manpower, machinery, space, etc.) for each task; add together using schedule data; examine resources constraints; adjust schedule and technical tasks to be consistent with available resources, and/or initiate action to provide additional resources as required.

At this stage, the project manager's planning role is well formulated, and his role in monitoring and measuring progress begins.

Cost Variance

Costs are readily summarized and reported back to project management via the financial community which exists in every company to take care of payroll, billing, subcontracts, etc. In a typical project management environment, the one extra step of comparing the planned budget to the actual expenditures on a periodic basis (weekly, monthly, etc.) is readily accomplished. This gives rise to the first measure of successful performance, the cost variance, defined herein as:

Cost Variance = Budget – Actual

This variance is evaluated on a periodic and project-cumulative basis. So, typically, the last of the three major evaluation parameters to be established in a project plan (cost) is the most readily measured, because a large accounting support function inherently exists in every company.

How does the cost data assist in measuring technical success, the subject being investigated herein? Obviously costs are one important part of the project triangle; but, costs are really an outgrowth or derivative of the two other parts of the triumvirate planning process, schedule and technical tasks, which preceded costs in the planning of the project. To get to that elusive measurement of technical success, the process must march backward along the path that created the project. The next step to be examined is the schedule, step two, in the planning process.

Schedule Variance

Measuring scheduler success is somewhat of a subjective departure from the hard, cold cost data in that special information must be set up in the plan to identify key milestones thought to be significant to the project. Furthermore, these milestones must be of sufficient quantity and small enough periodicity to provide management with a quantitative measure, i.e., the second variance in the project, defined herein as:

Schedule Variance = Milestones Completed – Milestones Planned

In a two-dimensional measurement system consisting of cost and schedule, the schedule parameter is typically "converted" to equivalent dollars by taking financial credit for work accomplished through an earned value, based on original planning. Although the transformation does tend to distort the pure scheduler nature of the measurement, useful information is created for management in that a measure of whether cost or schedule variances are more significant at any given time can be made on the same numerical basis.

Technical Variance

It is in the attempt to measure technical success that many problems arise for the project manager. Much more so than for schedule measurement, it is difficult to attempt to regiment to a common denominator the success or failure of a technical task. Not at all minor in this process is the prevalent attitude of the functional engineering analyst, designer, and manufacturing or production specialist that draws a protective barrier between the technical task and the project manager's inquiries. It is understandable for the project manager to track financial accounting data and status of defined milestones (as long as the milestones are major events and not too specific or personalized). But quantitative measurement of technical performance by a project group is simply not a well-accepted procedure.

Then how is a project manager to satisfy himself, upper management, and the customer that not only are the costs and schedule on track, but so is the technical job itself? This is especially significant when it is recalled that the technical job is, in reality, the driver for the schedule and the costs, and in that sense the foundation for the success (or failure) of the entire project.

Cost variances are measured in planned to actual dollars. Schedule variance is somewhat more subjectively measured in number of key milestones realized compared to planned, converted to dollars by earned value judgments. But what are the quantitative parameters to measure technical success?

Technical Variance = ?????

Discussion

The organizational and contractual framework for the discussion to follow on a process for measuring technical performance is characterized by:

• a large group (1,000 people) of engineering and manufacturing personnel
• matrix project organization across multiple disciplines (see Figure 2)
• design and manufacturing effort, with major subcontractors for one half the work
• defense product contract of $100 million/year for several years
• contract in a cost plus incentive format, with incentives on cost, schedule, and technical performance.

It is this last characteristic—a fully incentivized contract, with all three parameters on the project manager's cost/schedule/technical triangle represented in the incentives—that has led to a straightforward way to provide measurement of technical status of the project.

The technical portion of the project incentive was fully negotiated with the customer and placed in the formal contract. The objective of the incentivization was to provide performance margins above the basic technical specification requirements to allow for future expansion of the system, lower maintenance, added reliability, and added manufacturing quality. To cover this range of goals, a multitude of technical parameters, appropriate to this product, were incentivized. Typical parameters used are listed below to illustrate the spectrum. Naturally, these parameters are system dependent, but the list gives a perspective on the kind of items to consider.

Typical incentive parameters could be:

• acceleration
• velocity
• time
• shock mitigation
• vibration
• temperature
• structural loads
• factors of safety
• bearing pressures
• burst pressures
• mean time between failure.

Many of these parameters were applied to several subsystems in the work breakdown structure (WBS) for the project. This particular combination of parameters for which the customer desired additional margin or greater assurance in meeting basic requirements was then incentivized proportional to the judged value to the customer. Dollar values for the incentives tended to be a few percent of the cost of that subsystem, (but the dollar values were substantial when compared to an individual's frame of reference).

This contractual format has been found to be a natural, inherent way to obtain a measurement of technical performance. Each cognizant technical manager is asked periodically to quantify the technical status of her component or subsystem by comparing whatever test and/or analytical information is currently available, to the incentivized goals. In making this evaluation, many technical factors are implicitly integrated into the rating, with the output being a technically based prediction of the expected incentive which would be realized if the product were made at the current level of development.

The results are obvious; each component or subsystem ends up being rated simply by the technical staff, but in terms of dollars. These units are, of course, the same as those available to the project manager for cost performance, and with an earned value system in place, also for schedule performance. At this

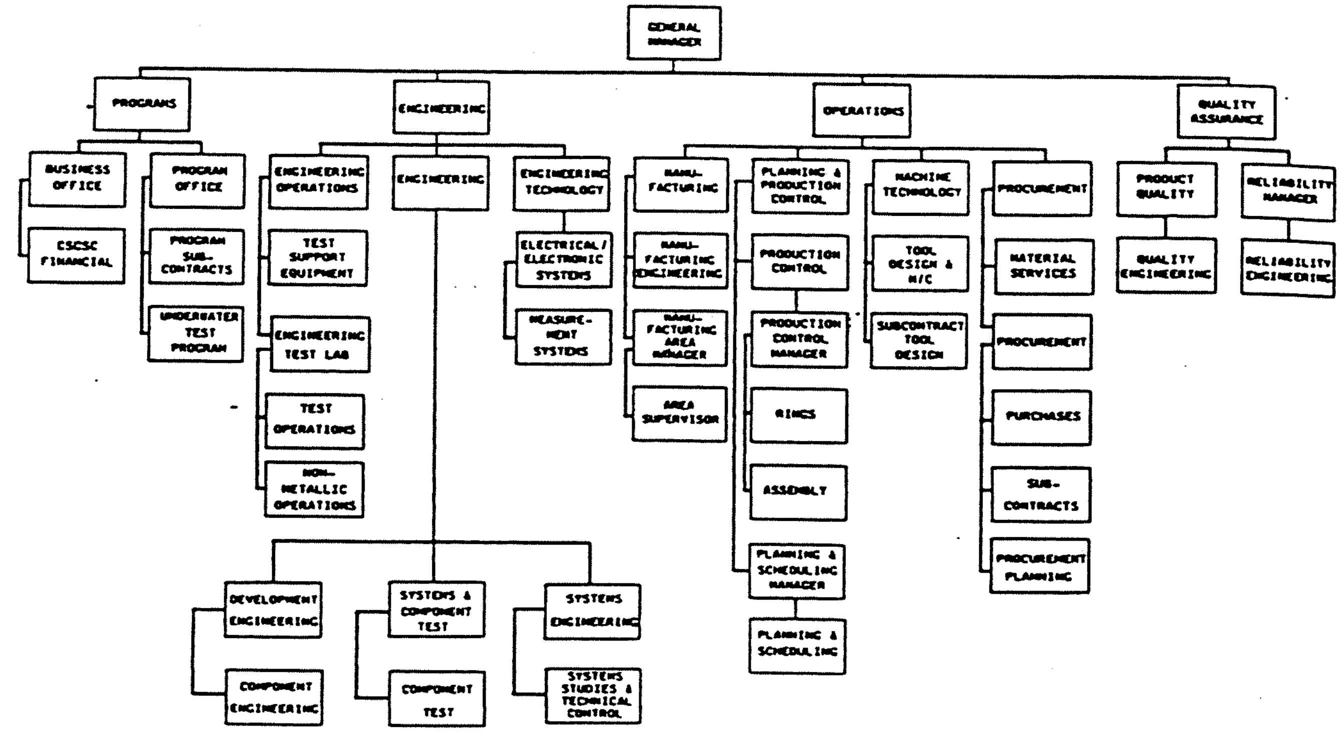

FIGURE 2 GENERALIZED MATRIX ORGANIZATION

point then, the project manager has available a definition of where the component or subsystem is currently positioned in the project manager's triangle. The technical variance may be defined as:

Technical Variance = Attained or Predicted Performance – Performance Needed for Maximum Incentive

Since the customer has predefined the precise utility or value of each component or subsystem in dollar magnitudes in the contract, the project manager and executive department managers can periodically review, on an overview basis, the status of all major items from a simultaneous cost, schedule, and technical basis. Any large variances out of preset thresholds can then be highlighted for detailed management action and corrective action.

The process is attractive in that it necessitates the development of certain project management items (which are generally advisable anyway). The items include:

- detailed planning in the beginning of the project to define components and subsystems
- quantification of the customer's requirements and goals in very clear (dollar) terms (The customer defines utility and value of each of these components and subsystems deemed especially important to the success of the project.)
- these technical performance parameters communicated in a very direct manner to the engineering manager personally responsible for the design and development of that product component or subsystem
- technical status, which is at times very difficult to communicate across the multitude of technology found in any large sophisticated project, readily collected in terms understood by all, regardless of technical background.

Even though the responsible technical manager integrates all current test and/or analytical data and arrives at a judgment on attained incentive, the process of coordinating these technical inputs still requires reasonable technical understanding and is best performed in a systems engineering functional group. That group coordinates with the project office by using the project WBS as a common database. The project office already has the organization, the procedures, and forms in place to take cost and schedule data. It is a natural evolution to modify these incentivized technical milestones.

The cost and schedule status culminates in a cost performance report (CPR). The report typically includes the dollar values for current, cumulative to date, and at-completion values by WBS element and functional element; a near-term forecast; and a narrative including an executive summary and a detailed discussion of variances exceeding a predetermined threshold.

The technical incentive status can now be included in the CPR. A financial format is included in the financial section and a narrative included in the executive summary and detailed section discussing reasons for variances to attainment of maximum technical performance. This technical variance discussion, combined with cost and schedule variance discussions, serves to highlight the interaction between cost, schedule, and technical parameters never visible before in a two-dimensional reporting system. An example of a summary sheet is shown in Figure 3.

The summary variance report indicates the monthly change in cost schedule and technical status, the cumulative change, and estimate of status expected at completion for all three parameters of interest.

For example, the assumption made in Figure 3 is a hypothetical program called the "diving system." One of the incentivized portions of the diving system is the diving chamber. The diving chamber is expected to be a spherical metal chamber capable of containing several oceanographic scientists and associated equipment. Eventually a quantity of twenty will be produced. It is expected to reach a depth of at least 3,000 feet, but never more than 10,000 feet. The weight of the chamber is limited by the strength of the umbilical and the design of the transporting surface craft. The lighter the structural skin, the larger the volume may be without exceeding maximum weight limits. Conversely, the thicker (stronger) the skin, the deeper the vessel can go within weight limits of the specification. Clearly, a balanced design is needed. Figure 4 illustrates the tradeoff ranges for this component.

In this example, the chamber is assumed to be contractually incentivized as follows:

- Each 1,000 feet depth below 3,000 feet earns the contractor $100,000 to a maximum of $700,000.
- Each 100 cubic feet of volume above 1,000 cubic feet earns the contractor $10,000 to a maximum of $400,000.
- The contract is firm fixed priced, at a value of $10 million, with an estimated profit of 10 percent.
- The project schedule is one year. Early delivery earns the contractor $1,000/day to a maximum of $30,000; late delivery penalty is $10,000/day to a limit of $300,000.

Among the options available to the contractor are:

- Design to minimum requirements; this is the easiest option to meet cost and schedule, but earning only the $1 million profit of the fixed price contract and possibly the $30,000 positive schedule incentive.

COST/SCHEDULE/TECHNICAL VARIANCE REPORT

WBS No.	1.6.9.5	Project Cognizance	A.B. Smith
System	Diving System	Technical Cognizance	J.R. Jones
Component	Divers Chamber	Report as of	30 June 1986

	Current Month			Cumulative			At Completion		
Cost	BCWP	ACWP	CVAR	BCWP	ACWP	CVAR	BUD	EAC	CVAR
Schedule	BCWS	BCWP	SVAR	BCWS	BCWP	SVAR	BUD	EAC	SVAR
Technical	Maximum Incentive	Forecast Incentive	TVAR	Maximum Incentive	Forecast Incentive	TVAR	TOT	EAC	TVAR
	1000	800	(300)	1100	550	(550)	1100	1000	(100)

FIGURE 3 COST, SCHEDULE, AND TECHNICAL SUMMARY VARIANCE REPORT

- Using exotic material, design to the maximum depth and volume, earning additional $1.1 million incentive, but risking profit on cost of $1 million and possible negative schedule incentive of $300,000.
- Some interim position, earning some incentive and profit.

Obviously, the goal of the project manager is to maximize profit at acceptable risk as well as provide the customer with a good product delivered on time. Because of the significant schedule penalties, technical status of the design must be assessed as the projects in progress.

It is assumed, in this hypothetical case, that the project has four phases: development, evaluation, qualification, and production. One unit is built for each of the first three phases, and twenty are built in production. This phasing is typical of most large-scale research, development, and production projects.

The cost, schedule, and technical summary variance report (Figure 3) may now be prepared on a periodic basis to permit the project manager to guide and direct the project.

Little explanation is needed for the cost and schedule sections of Figure 3, as they follow standard definitions:

- current month: measurement in dollars of reporting period performance
- cumulative: sum of all periods' performance from beginning of project to date
- at completion: estimated value expected at project completion
- BCWS: budgeted cost of work scheduled
- BCWP: budgeted cost of work performed
- ACWP: actual cost of work performed
- CVAR: cost variance = BCWP – BCWS
- SVAR: schedule variance = BCWP – BCWS
- BUD: budget at completion
- EAC: current estimate cost at completion
- TVAR: technical variance.

The technical portion of the variance report (Figure 3), although measured in dollars, does differ from the conventional cost and schedule parameters. As noted above, the hypothetical project has four phases. Contract incentives are assumed to be proven and earned on the qualification phase unit,

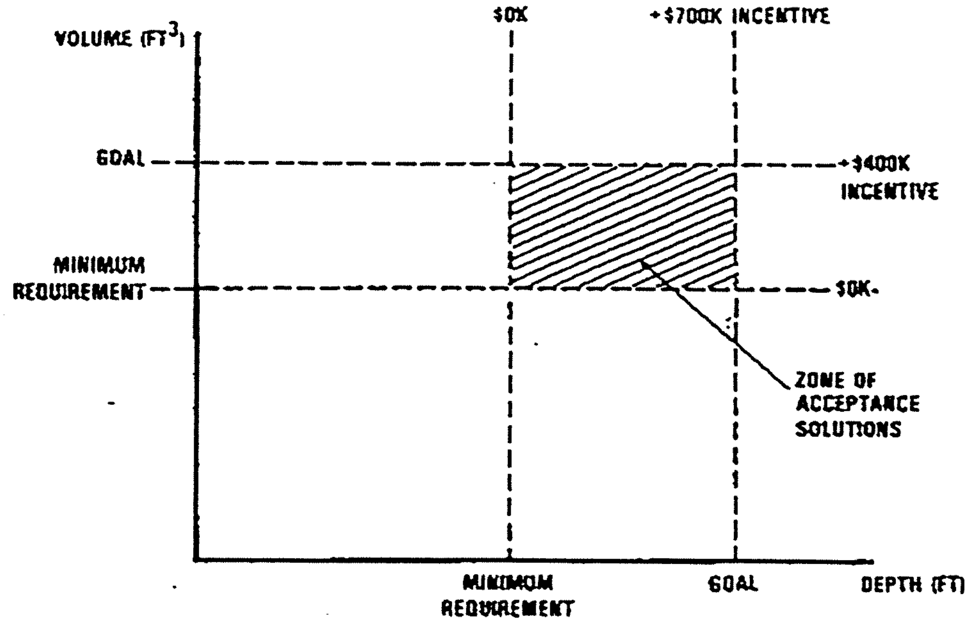

FIGURE 4 TRADEOFF CHART FOR TECHNICAL INCENTIVES

immediately preceding production. Therefore, the "At Completion" sections on the variance report would represent the incentive that the technical manager anticipates earning at the end of the project. The "TOT" column represents the total possible design incentive from technical sources on the diving chamber ($1.1 million in this example). The "EAC" column is the expected incentive on the qualification phase unit ($1 million in this example). This estimate is updated every reporting period as the design progresses. The "TVAR" is the quantification in dollars of the technical variance.

The "Cumulative" section contains the results of any phase that has actually been completed. The "Maximum Incentive" column shows what could possibly be earned through maximum technical performance. The "Forecast Incentive" column shows the amount that would have been earned had the completed unit been the final product.

The "Current Month" section data is based on that unit in progress at the time of the report. The project manager would require explanations of deviations from maximum technical incentives, TVAR, just as in the cases of cost and schedule variances.

The reasonableness of the "At Completion" estimates are assessed based on the trend of the design incentive to date, as the product goes through the various phases. For example, the report could show if the cost variances were showing $1 million negative variance at completion because exotic materials, with costs $1 million more than budget, were being used for the purpose of earning the $1.1 million performance incentive. This information would be clearly visible, comparable, and challengeable. The project manager may not want to risk the unknowns in use of the exotic material for essentially a break-even on total project profits.

Additionally, the project manager may very well question the credibility of the technical forecast of 91 percent incentive achievement in the "At Completion" unit with only 50 percent success achieved on the first unit and 73 percent success forecast on the current unit. The collected information gives some indication of technical progress along the development timeline to aid in those judgments. The variance discussion in this case may point to the fact that cost is being sacrificed in order to achieve the maximum technical incentive performance and that projected performance is still in question. Armed with that information, the project manager may need to evaluate that trade-off to assure a balance between cost, schedule, and "technical excellence."

Naturally, this reporting process is meant to be a supplementary overview of the day-to-day interactions and other formats for communications which include: engineering weekly meetings to review periodically all component and subsystem technical status; weekly and monthly status reports; and periodic project review meetings with the customer. The cost/schedule/technical variance report does, however, provide a formalized overview on a controlled, periodic basis to provide upper management with the assurance that the project is proceeding on a correctly balanced path, and that any technical variances are identified early for subsequent management action.

The examples used in this paper describe a method of measuring technical performance using technical incentives, resulting in contract-defined rewards—the "cost plus incentive" contract environment. In the fixed-price world, the measurement of technical performance, using incentives, is still possible. The process is more subtle and more powerful.

In a fixed-price contract, the customer is buying a product for a specified price that meets minimum specifications. When not incentivized by the customer, any performance in excess of the specification of the contract is, in essence, an investment paid for by the contractor. This product with enhanced capability may be or become of greater value to the contractor. It may make him more competitive in the future. It may broaden his market. In other words, it may result in making him more money. If that is the case, it would, of course, be worth it for him to invest something to exceed the original specification. On the other hand, it may be worth nothing to the contractor to exceed the contract specification, if he will realize no advantage. After all, he is being paid to just meet a specification and nothing more. The market may not be willing to pay any more in the future even for a superior product.

It is important to consider, at this point, the personality of the engineer. The realities of the world are that the bent of the engineer is to improve her design, to exceed the specification. Left unchecked, the engineer will tend to tinker with her design until it is "perfect."

It, therefore, behooves the owner/project manager, the engineering manager, and the marketing manager to decide early in the project what exceeding the minimum contract specification is worth to the company; what the added cost (or investment) of exceeding specifications is worth to the company; and then, set an incentive commensurate with that worth to measure technical performance. (Incentive money does not necessarily mean paid to performers" any more than they are paid on a cost-type contract.) If it is decided that no investment should be made to exceed the specification, then a negative incentive would be set. This means that if the design exceeds the contract specification, the designer has spent unnecessary money to achieve that result, and has unnecessarily cost the company profits on this fixed price job.

Figure 5 represents the concept of incentive award dollars from the customer versus incentive investment dollars from the company. To the performer—designers or manufacturers—the incentive dollars look the same. The measurement of performance, therefore, would be the same in either case (as described earlier in this paper).

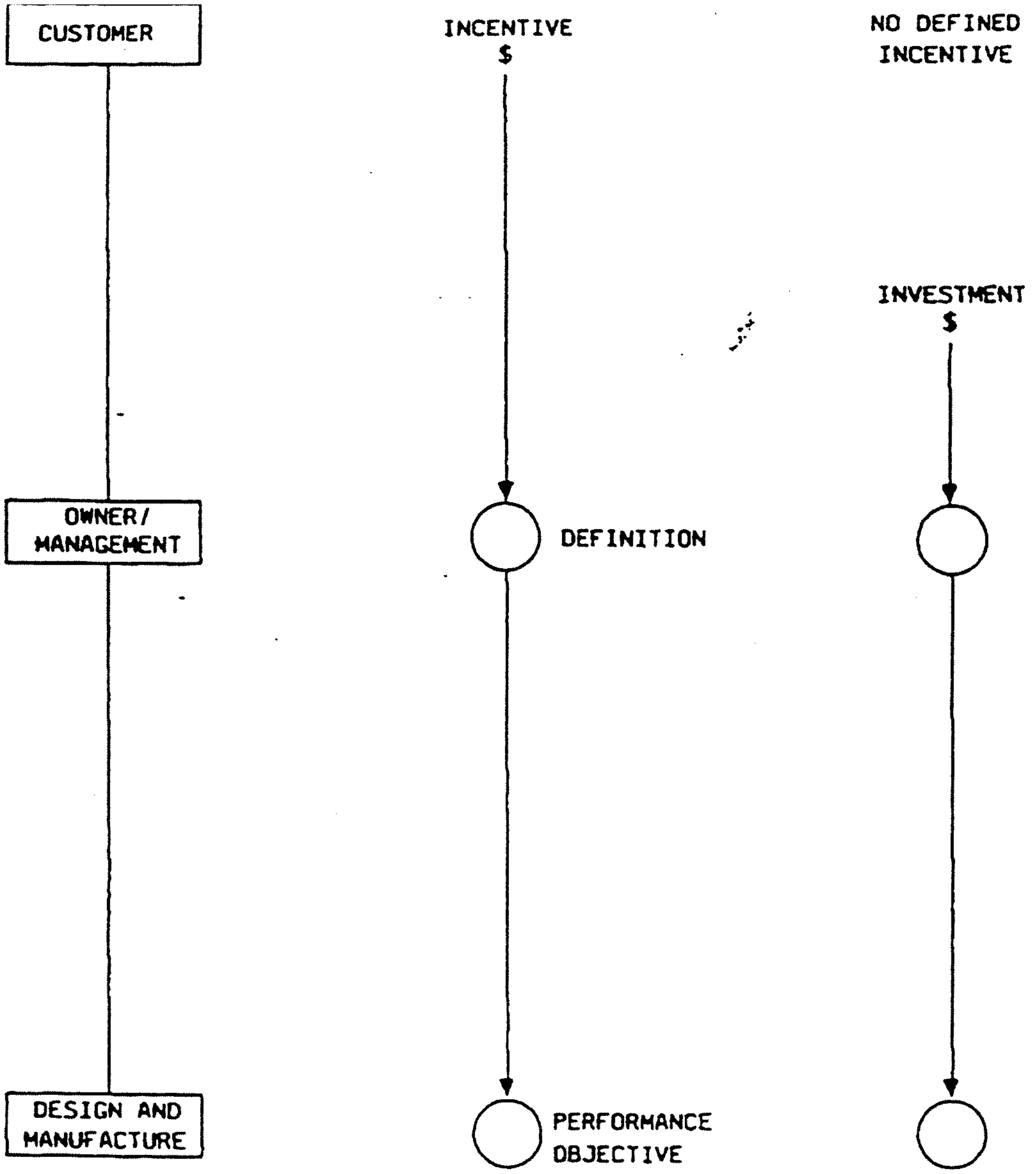

FIGURE 5 APPLICATION OF INCENTIVE MEASUREMENT TO GENERAL CASE

The absence of such an incentive determination by the owner/program manager at the outset of a fixed price venture merely means that the determination of the investment of the company's funds is left solely to the discretion of the engineering manager at best, or the individual engineer at worst.

CONCLUSIONS

Cost and schedule measurements are well-established inputs to the project manager. Technical measurements, however, have historically been a more elusive subject. Very little formalization of this third part of the project manager's triangle of concerns has taken place.

Those few systems that have been developed typically require considerable manpower to implement and maintain; complexities of the system and the inability to tie to a common denominator have left many doubts about the benefits of technical performance measurement systems.

For the particular case of a fully incentivized contract, an inherent, readily implemented process of quantification has been realized. Technical managers report on their current technical progress towards a contractual goal. This goal is fully understood by the technical manager because it is the product of extensive communications and negotiations with the customer early in the project.

It would appear that the concept of an incentive environment for a project, with incentives placed on cost, schedule, and technical performance, provides a unique opportunity for a balanced project management approach to measure success on a rational, relatively simple basis. In other commercial applications it may be possible, for example, for a company to set up internal bonus awards for personnel instead of customer-supplied incentives. The process of implementation should remain the same. The challenge for the future is to apply this observed phenomena creatively to other industries with differing customer and marketplace situations, and yet retain the structure and motivational forces which permit the measurement of cost, schedule, and technical performance in a constructive and efficient manner on a common denominator basis.

Past experience shows that the formal, existing two-dimensional cost and schedule systems, with all their benefits, do not quite tell the total story. The one element missing (and the fundamental element of any project) is the technical performance. The project manager most often has no formalized process to balance the decisions, tradeoffs, and product decisions that must continually be made in any project. Personal judgment and experience will always be primary in all these decisions, but a formalized quantification of the impact of those decisions on the cost/schedule/technical balance within the project should add substantially to the success of the project.

Most project managers measure and predict the cost and schedule elements of a project. It is time to now quantitatively add the third element of technical performance to assure action when problems do arise and to promote a truly balanced end-product and successful project.

Study Questions

Measuring Successful Technical Performance: A Cost/Schedule/Technical Control System

1. Demonstrate your understanding of the project manager's triangle as presented in the case.

2. How can cost and schedule variances be measured? Discuss the difficulties in defining technical variance.

3. A successful project is one that not only fulfills the constraints of time, cost, and technical performance, but fulfills other requirements such as minimal scope change and customer acceptance. Discuss some of these other requirements.

4. The case emphasizes the importance of measuring technical performance. What are the elements to consider in performance reporting in cost, schedule, or technical performance?