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CPA MAS

MANAGEMENT ADVISORY SERVICES PRACTICE AIDS

TECHNICAL CONSULTING PRACTICE AID 9

Improving Productivity Through Work Measurement: A Cooperative Approach

Robert G. Failing
Jerry L. Janzen
Larry D. Blevins

AICPA American Institute of Certified Public Accountants

NOTICE TO READERS

MAS practice aids are designed as educational and reference material for the members of the Institute and others interested in the subject. They do not establish standards for preferred practices. The standards for MAS practice are set forth in the Statements on Standards for Management Advisory Services (SSMASs) issued by the AICPA. However, since the services described in this series of practice aids are management advisory services, the standards in the SSMASs should be applied to them, as appropriate.

The MAS Division expresses its appreciation to the authors of this practice aid, Robert G. Failing, CMC, LL.B., Jerry L. Janzen, CMC, CME, and Larry D. Blevins. They practice at Arthur Young's Southwest USA General Management Consulting Group in Tulsa, Oklahoma. Mr. Failing is the partner-in-charge of the general management consulting group. He directs the consulting activities of strategic management, operations management, minicomputers, human resources, and automated office systems. Mr. Janzen is a partner in the operations management consulting practice and specializes in inventory control and engineering. Mr. Blevins, manager, specializes in productivity improvement, work measurement, operational analysis, and maintenance management.

During the preparation of this document, various members of the 1986–1987 AICPA MAS Technical and Industry Consulting Practices Subcommittee, functioning in an advisory capacity, provided information, materials, and comments to the authors and the staff. The members of that subcommittee are listed below.

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TECHNICAL CONSULTING PRACTICE AID **9**

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Preface

This MAS practice aid is one in a series intended to assist practitioners in applying their knowledge of organizational functions and technical disciplines in the course of providing management advisory services. Although these practice aids will often deal with aspects of MAS knowledge in the context of an MAS engagement, they are also intended to be useful to practitioners who provide advice on the same subjects in the form of an MAS consultation. MAS engagements and consultations are defined in Statement on Standards for Management Advisory Services (SSMAS) No. 1, issued by the AICPA.

This series of MAS practice aids should be particularly helpful to practitioners who use the technical expertise of others while remaining responsible for the work performed. It may also prove useful to members in industry and government in providing advice and assistance to management.

MAS technical consulting practice aids do not purport to include everything a practitioner needs to know or do to undertake a specific type of service. Furthermore, engagement circumstances differ and, therefore, the practitioner's professional judgment may cause him to conclude that an approach described in a particular practice aid is not appropriate.

Contents

Scope of This Practice Aid

Work measurement is one way to improve productivity. It provides a quantitative system for evaluating existing productivity levels and for setting and achieving realistic new goals. This practice aid presents a general overview of how work measurement is used in setting productivity standards.[1] It focuses on how practitioners and CPAs in industry, often with appropriate outside technical assistance, can help management improve productivity by establishing and monitoring productivity standards. Work measurement specialists often combine other productivity improvement techniques, such as establishing more effective systems and procedures, work flows, and organizational units, with work measurement techniques in productivity programs or engagements.

The information in this practice aid will assist practitioners in evaluating client needs, identifying areas with great potential for improvement, and recommending the best methods for achieving maximum results. At times a client may request assistance in improving productivity. At other times a practitioner may, based on his existing knowledge of the business's operations, bring productivity problems to the attention of client management and suggest a means of correcting them.

This practice aid will also be useful for the practitioner whose client has already set productivity standards but requires assistance in evaluating results and determining corrective actions, as well as for CPAs in industry whose organizations have, or are considering, a productivity improvement program.

Some of the highlights of this practice aid are as follows:

- The engagement approach section discusses a cooperative engagement between a practitioner or CPA in industry and a work measurement specialist. This section will interest practitioners who plan to use the services of an outside technical work measurement specialist,[2] rather than perform the engagements themselves.
- Appendix A includes a summary of work measurement techniques, focusing on how practitioners can assist clients in improving productivity by establishing and monitoring performance and effectiveness standards. The procedures described are based on work measurement techniques originally applied to manufacturing production personnel. Some of these techniques can be used to set performance

1. *Productivity standards* are benchmarks to which individual performance can be compared. *Work measurement* is the process of quantifying individual performance by establishing standard times for the completion of specific tasks.

2. For additional information on cooperative MAS engagements, see MAS Practice Administration Aid No. 2, *Cooperative Engagements and Referrals* (New York: AICPA, 1986).

standards for both direct and indirect labor functions, whereas others are designed for white-collar personnel.

The techniques have been successfully applied to develop performance standards in the following industries: manufacturing and assembly, government, process manufacturing, service industries, maintenance, warehousing, and retailing. The application of performance standards based on work measurement can improve production, clerical, and support personnel productivity for these and similar activities.

- Appendix B provides samples of the kinds of forms to use in an engagement to improve productivity.
- The Bibliography lists technical publications, including how-to references. Practitioners can also refer to other sources for different techniques that are applicable to specific client situations.

Typical Engagements

Accurately assessing a client's need for improved productivity can be a key to providing important management advisory services. Frequently, a client recognizes when improvement is desirable but needs help in defining specific requirements to achieve it. While every situation is unique, certain conditions, such as the following, can indicate the appropriateness of applying work measurement to improve productivity.

- *Variable workload.* A client with seasonal fluctuations in product demand (for example, a retail distributor) may wish to maintain a constant work force. By developing labor standards through work measurement, management can establish a production schedule for nonpeak periods that will meet its product demand.
- *High indirect labor cost.* In client organizations with voluminous paperwork or a decentralized organizational structure (for example, insurance claims processing or accounting departments), setting productivity standards through work measurement can help management assess opportunities for indirect labor cost reduction.
- *Limited performance measurement.* In many nonmanufacturing client businesses (for example, a graphic arts department or engineering department), the desired work output is neither well defined nor easy to measure. Individual or group performance is not linked to the production of the work unit. Work measurement can set standards for tasks performed instead of counting units produced.

- *Unregulated staffing changes.* In high-growth or highly profitable large corporations (for example, high technology businesses or defense contractors), staffing is based on a desire for organizational growth. Controls on hiring or funding limitations are not sufficient to regulate hiring, so people are employed on an "as needed" basis. Work measurement can establish when the volume of work requires additional personnel.
- *Unknown standard costs.* Entrepreneurial clients are often faced with setting prices and determining potential profits prior to production. This condition is common when a client is offering, or plans to offer, a new product or service in an untested market. It also exists in many small companies with limited or no standard costing. In such cases, labor productivity standards can help determine standard costs of producing new items or services.
- *Perceived organizational/operational problems.* Cost overruns, excessive backlogs of work, and problems in meeting production goals or schedules may cause client management to be dissatisfied with the operation of a given department. Productivity standards help identify where an imbalance in personnel exists.

There are many situations in which clients or practitioners will suspect that profitability or effectiveness problems may be caused by poor productivity levels. Establishing productivity standards using work measurement may be an appropriate solution to a specific problem or an integral part of a wide-ranging program to improve overall operations. The practitioner may wish to contact an outside technical expert to confirm such a perception and to help identify specific work measurement techniques or other productivity improvement techniques that will best meet client needs.

Engagement Objectives

The overall objectives of a productivity improvement engagement, as discussed in this practice aid, are to (1) upgrade operating systems, procedures, and methods; (2) develop and implement a systematic approach for managing resources; and (3) provide the capability to maintain and operate the production system efficiently. A work measurement system developed as part of a productivity improvement engagement gives managers and supervisors objective techniques and information to accomplish these goals. Such a system can help determine if a client's operating methods are effective, as well as what resources are required

to achieve improved productivity and how, when, and where to allocate them. Systematic work measurement also helps identify a baseline performance. Management can use this baseline to determine current productivity levels and then establish individual, group, or organizational productivity goals. Improved productivity can reduce the unit cost of products or services.

To help accomplish the overall objectives of a productivity improvement engagement, a practitioner might do the following:

- Determine if a work measurement program leading to productivity standards would be appropriate for a client.
- Develop recommendations to improve operating systems, procedures, and methods.
- Assist in implementing the recommendations, including a work measurement program, if appropriate.
- Develop the client's awareness and understanding of work measurement techniques through classroom training, on-the-job training, direct supervision, and technical assistance.
- With the assistance of technical experts, establish performance standards based on work measurement.
- Develop workload and staffing plans, based on performance standards.
- Develop and implement an ongoing management system for—
  - Planning and budgeting.
  - Work assignments and scheduling.
  - Performance monitoring and evaluation.
- Train client management in using performance standards information and techniques to achieve improved results.

Engagement Approach

Understanding With the Client

In order to have a successful productivity improvement engagement, both the practitioner and client need to clearly understand each other's expectations. Before the engagement begins, both parties need to define, agree on, and document these expectations. One important consideration will be agreeing on whether the services of a technical specialist are

required. If so, this person's credentials need to be verified and the terms of his employment established.[3]

Other topics for consideration are as follows:

- Perceived problems
- Engagement objectives
- Engagement work plan
- Engagement scope
- Participation and responsibilities of the client, practitioner, and technical expert (if one is employed)
- Benefits
- Timing and fees
- Progress reporting
- Final reporting

These issues are usually stated in an engagement letter to the client. Exhibit B-1, an illustrative engagement letter, includes a discussion on the use of a specialist and a work plan.

Evaluating the Client's Situation

A practitioner often uses a survey of client productivity, typically a one- to two-day high-level review, as a benchmark for assessing a client's need for improved productivity. The survey, which is essential for scoping the engagement, provides insight into the client's motivation for the program and its intended use. Exhibit B-3 is a sample checklist for collecting initial information on the client.

After briefly reviewing the initial data, the practitioner can interview the client to determine the client's level of support, understanding of the work measurement concepts, expectations, commitment of personnel participating in program development, and what the client believes are significant operational problems.

Next, the practitioner visits the departments or units that he or the client believes will be good areas for initial observation and study. The practitioner may talk to the workers to hear their opinions on existing technical difficulties and to discuss the nature of their work. The practitioner may wish to chart the work flow. The practitioner will find that learning the business's jargon and organizational and operational ter-

3. For additional information on the use of specialists in MAS engagements, see MAS Practice Administration Aid No. 2, *Cooperative Engagements and Referrals* (New York: AICPA, 1986).

minology will promote client confidence and lend credibility to the engagement proposal and project initiation.

The practitioner also needs to review any existing labor contracts the client has. If there are any changes to them, in areas such as work rules or procedures, they may require contacting labor unions.

Determining Management Information Requirements

Evaluating the management information requirements for an engagement involving work measurement usually begins with a review of the current information flow. This activity identifies changes that may be needed to provide new information or reduce extraneous information. The practitioner initiates this review by studying the preliminary survey data and then expands on it by developing a greater understanding of client operations.

A diagram of the current information flow can document the movement of information and the interfaces between the client organization units involved in the process. In addition to highlighting *essential* information flows in the organization, a graphic representation can usually be easily understood and allows for recognition of any *extraneous* information. The diagram may then be used to define the most effective level of management information detail required for operations and to establish an appropriate level of operations on which the work measurement system will focus.

Selecting the Engagement Staff

Client-Practitioner-Specialist Relationships

The requirements of the engagement and the expertise of the practitioner will determine whether a technical work measurement specialist is needed. Assuming that the practitioner has no direct expertise in performing work measurement or productivity improvement studies, the primary day-to-day interface during the engagement is likely to occur between the specialist and client personnel.

Most likely the practitioner will assist the client in selecting the work measurement specialist. Choosing a specialist is extremely important, since the practitioner is ultimately responsible for the quality of the engagement unless the client independently engages the specialist.[4] A

4. See MAS Practice Administration Aid No. 2, *Cooperative Engagements and Referrals* (New York: AICPA, 1986). A practitioner may be the prime contractor for the engagement or one of several contractors who cooperate on the engagement but are responsible to the client.

useful source for locating specialists is the *Directory of Management Consultants* published by Consultants News in Fitzwilliam, New Hampshire (03447). Following this selection, the practitioner and client establish the exact working relationships among the client, the technical specialist, and the practitioner.

The data collection roles of the client, practitioner, and specialist vary, depending on the engagement structure. Typically, client personnel collect the raw data, while the practitioner or specialist summarizes that information and divides it into meaningful formats for the work measurement process. However, if the engagement involves direct work measurement, the specialist may collect the data. The roles of the practitioner and specialist in the final project review are essentially equal. The specialist prepares in-progress and final reports, while the practitioner is responsible for interpreting the results for the client.

There are several important considerations in deciding whether the client or specialist should perform the primary tasks in developing performance standards. A major concern is the practitioner's assessment of the client's ability to perform these tasks. Clients lacking personnel skilled in work measurement or other analytical methods are usually better suited to using outside assistance. However, clients with industrial engineering, management analyst, or internal consulting personnel may find it appropriate to develop performance standards internally. The practitioner may also be able to assist the client in developing performance standards by supplying either an expert in work measurement (if there is one on staff) or staff personnel to function as work measurement analysts.

A second consideration is the client's internal political situation. Client management may not be receptive to, or may perceive potential bias in, involving internal personnel in work measurement. Such clients might prefer using external consultants. During interviews with client management, the practitioner may inquire about internal political considerations and evaluate them in relation to the engagement.

A third consideration is the cost of using an outside specialist. The practitioner evaluates the client's current financial position and relates it to the estimated cost of external assistance. If the client has financial concerns, the practitioner may suggest that the client look at a checklist (see exhibit B-4 for an example) and select only the key points that require examination. A comprehensive work measurement program may be too costly, whereas a study of certain specific areas will be more economical.

The Client's Role

Few things are as critical to the project's success as the client's involvement and cooperation in the work measurement study. During a work measurement study, it is desirable for the client to provide—

- Decisions on issues that may arise.
- Historical data.
- Access to all facilities and operations.
- Standard office support (work space, telephone, minor supplies).
- Availability of desired client personnel to serve full-time as study analysts for the engagement, if appropriate. (The availability of client personnel serving as study analysts will reduce engagement costs and develop a staff that can provide ongoing support following engagement completion.)
- Reviews of current standards and recommended changes in methods and procedures.

The Practitioner's Role

Under most circumstances during an engagement, the practitioner interfaces between the client and the work measurement specialist. He also performs a nontechnical quality review of the engagement outputs (for example, standards, reports, instructions) to assure that engagement requirements have been met.

The relationship between the practitioner and specialist varies, depending on the engagement. When acting as a representative of the client, the practitioner may be the technical interface between the client and specialist or assume responsibility for project coordination and project control for the client. As technical interface, the practitioner reviews and interprets the specialist's results for reasonableness and, in some cases, applies those results to the client's business situation. When providing project coordination or project control, the practitioner observes the specialist's progress through interim reviews, ascertains that the project is progressing on schedule and on budget, and assists in the information exchange between client personnel and the specialist.

The practitioner often assists in training client personnel to develop performance standards. Outside assistance may be used to educate the staff, especially if the staff will perform work measurement analysis involving various time study and methods improvement techniques. The training specialists must be experts in the particular work measurement system to be used, and they must also have experience in applying it to the type of work being measured.

The practitioner may also recommend operational training, which focuses on continually educating client managers and supervisors in interpreting and applying the performance standards. This operational training is often critical for the long-term success of the productivity improvement program. People with this training can apply the standards on an ongoing basis long after the practitioner and specialist have left.

The Specialist's Role

The technical specialist retains responsibility for developing a detailed work plan, selecting appropriate work measurement techniques, analyzing technical data, and preparing supporting documents. Since the type of assistance varies according to each technical specialist's areas of expertise, the client and practitioner need to carefully evaluate the experience and qualifications of outside specialists before hiring any. The client's needs and the type of work to be measured influence the selection of each specialist.

One type of assistance, turnkey development and implementation, usually involves the proposed plan of the specialist. Proposals drawn up by specialists need to be evaluated with care because they are expensive to carry out and usually give the specialist tight control over standards development and program implementation.

The second type of assistance involves a joint effort between the client or practitioner and the specialist. Client or practitioner personnel assume the role and function of analysts after some training, while the specialist oversees the results. When offering this type of assistance, outside specialists need to be knowledgeable about the type of work involved and the nature of the business.

In the third type of assistance, the specialists train client or practitioner personnel in how to perform all the work measurement tasks. The specialists need to be available to assist client analysts and program supervisory personnel following the training. This availability is an evaluation criterion for selecting specialists.

Engagement Outputs

Specific outputs, such as training manuals, performance standards, staffing guidelines, and productivity reports, will depend on the engagement objectives, methodology applied, and client needs.

Training Manuals

Training manuals provide client analysts with instruction in the selection, performance, and interpretation of ongoing work measurement.

Productivity Reports

The reports described in this section are intended to be an ongoing part of the organization's management process, reflecting accomplishments,

problem areas requiring management action, and the effectiveness of the program in helping management to implement improvements. In interpreting these reports, management needs to be aware that accomplishing certain objectives is not wholly within the direct control of a particular group or even the overall organization. The actions of external organizations can influence the degree of effectiveness achieved.

Performance reports are prepared for each group that is observed. The data for each group is progressively summarized for successively higher levels of management. Essentially, such reports describe the performance or efficiency of the measured employees in the group; compare budgeted personnel and actual personnel counts with their costs; and indicate productivity improvements that have been realized since the reference period.

Output/backlog reports present workload and backlog data for each group studied. Clients refer to these reports to compare actual workload to forecasted workload and to monitor any backlogs. They also provide concise, historical records of monthly workload volume and are valuable in developing subsequent forecasts to use in determining required staffing levels.

Effectiveness measures reports show the degree to which a group's objectives are being accomplished. The information is expressed in terms of effectiveness measures established for each group and overall measures established for the total organization.

Effectiveness measures reports simply show results. They are not intended to become effectiveness standards (for example, 70 percent effectiveness is a current result, but 100 percent is possible). Once management has sufficient experience in interpreting and analyzing individual performance results, it can establish overall organization effectiveness standards, such as cost or man-hours per unit. Such standards reflect management's judgment about the levels of effectiveness considered most appropriate for the organization.

Revised Procedures

The practitioner and specialist usually suggest revised procedures based on their analysis of current client procedures. Improving productivity through developing and implementing new procedures is a significant benefit of a work measurement program. If the specialist simply sets standards for obviously poor procedures, the procedures will become established and more difficult to change. Later changes will require developing new standards.

Engagement Implementation

Implementation begins after the client accepts the productivity improvement recommendation. This is the first point in the engagement at which the client begins to realize the benefits of work measurement. For example, to determine a staffing level to match the estimated workload, the workload can be multiplied by the standard time to complete the unit and divided by the available productive time per worker. This result, which is the number of man-hours required to complete the workload based on the standard time, is compared to the existing staff level. The current staff level can then be adjusted to the standard-based staff level.

Work measurement also benefits production scheduling. Using accurate labor standards, the client can regulate flow rates and labor assignments based on the known time it takes to complete operations at given work centers. The resulting improved work flow reduces bottlenecks, improves throughput (the number of units completed in a given time), and allows for accurate estimation of completion dates.

Every client has areas in its organization that can be improved by performance standards, and it is up to the practitioner to assist in identifying them. Capacity planning, product quality, customer service (timeliness and quality), and compensation problems can be addressed more successfully following the development of standards.

Client Benefits

Benefits from productivity improvement engagements can include the following:

Reduced labor costs. The client can achieve optimum staffing levels by comparing existing work performance standards to known or forecasted workloads and then eliminating or reassigning unnecessary staff. This benefit is usually obvious shortly after program implementation.

Reduced unit costs. A critical analysis of operations often indicates the need for improvements in procedures and activities, which will reduce unit costs by increasing output with existing resources or producing the same output with fewer resources.

Improved business and operations management. The standards developed by work measurement provide management information that a client needs to accurately control and regulate the labor force, forecast pro-

duction material requirements, and schedule delivery dates. These standards aid in identifying product and service costs, which simplifies pricing and profitability analysis. Thus, a client can better develop and justify budget requirements, as well as evaluate operating results and organizational effectiveness.

Improved employee relations. Typically, employee morale rises because workers can evaluate their own productivity against known management expectations in the form of productivity standards.

Potential Problems

Implementing a productivity improvement program using work measurement can have some drawbacks. Work measurement sometimes has a negative impact on employee morale because workers may think that management is interested only in speeding up production. To avoid this, management needs a well-structured program to gain employee acceptance of the work measurement methods and standards.

Another pitfall is that some workers may not be able to meet performance standards, even though the standards are accurate. The solution may involve upgrading the quality and training of the work force or creating an incentive program to encourage workers to perform at top efficiency. Both the practitioner and client need to recognize that reducing or modifying the work force through employee termination is a sensitive issue.

A third common problem following the implementation of a productivity improvement program may be a reduction in product quality. This sometimes results when workers believe management's primary concern is rapid production and product quality is secondary. This problem can resolve itself, however, as workers begin focusing attention on job requirements; soon product quality will increase.

An additional potential pitfall may be a lack of follow-through by the client after the standards have been presented. To avoid this problem, line personnel and supervisors need to be involved in the standard-setting process so that they will likely support and encourage follow-through. Client staff may also believe that, once developed, the standards will automatically create smooth operations. They may not recognize the need to renew or update existing standards as methods or procedures change and products or services are added or deleted. Therefore, the practitioner may have to monitor the progress of initial client implementation and ongoing application of standards and methods developed in the productivity improvement program.

A final problem may be a difference between client expectations and program results. The practitioner can cushion client disappointment by not forecasting exact savings or improvements and keeping the client abreast of progress in meeting initial estimates during the productivity study.

Engagement Monitoring and Follow-up

Interpreting Key Performance Indicators

Evaluating the success of a productivity improvement program requires monitoring performance indicators following implementation. Monitoring accomplishes the purpose of the engagement, which is to assist the client in establishing measures against which past, current, and *future* production performance can be compared.

One method of monitoring results is to use a productivity index to compare actual performance to the benchmark(s) established through the standard-setting process. Often expressed as a percentage, a productivity index can indicate the level of success the program is achieving during any period following implementation. A second method involves comparing total production before and after implementation of the productivity improvement program. A third method focuses on evaluating standard costs derived from client accounting information. When compared to preimplementation costs, standard costs per production unit for direct labor and material (especially scrap costs) can generally indicate whether the program is having the desired effect on costs.

Evaluating the Overall Program

A practitioner can evaluate a productivity improvement program by using measures similar to those used to capture information on client accounting systems. These indicators may include changes in total operating costs, total production, or total profits. Using these measures requires the practitioner to verify whether savings resulted directly from the productivity improvement program.

Updating Performance Standards

Using outdated performance standards may be harmful to client operations. At a minimum, performance standards need to be updated annually, at which time the practitioner determines if the methods and

products are substantially the same as when the performance standards were developed. If the client introduces new production methods or new products, such changes may require reevaluation of existing standards or development of new standards.

Conclusion

Practitioners and CPAs in industry need to be aware of the potential benefits of productivity improvement through work measurement. A work measurement study can be a very useful tool for the MAS practitioner because it not only establishes performance standards, but it can also provide a systematic analysis of existing client methods, procedures, work flows, and information flows. In addition, clients who are approached directly by work measurement specialists or who read about the subject may ask practitioners for advice on whether work measurement would be useful in their organizations.

Practitioners who do not use work measurement techniques on a regular basis can provide assistance by—

- Making clients aware of the potentials, pitfalls, and client responsibilities related to work measurement.
- Coordinating and controlling the job of a work measurement specialist who may be employed in a cooperative engagement or engaged separately by the client.
- Monitoring the results of a work measurement program by analyzing and evaluating the reports and their impact on the client's financial results and recommending actions based on the findings.

Practitioners with large numbers of clients who might benefit from work measurement programs may wish to establish an internal technical capability consistent with the requirements of their practice.

CPAs in industry may assist management in implementing work measurement programs in their organizations or in analyzing such programs' effects on costs. A controller or internal auditor who is familiar with setting performance standards is a valuable resource should management become interested in a work measurement program.

APPENDIX A

Work Measurement Techniques

Work measurement techniques were originally designed as manual systems and have a proven record of success in a wide variety of applications. However, computer technology has improved upon these systems by increasing information processing speed, reducing overall costs (through the use of microcomputers), and expanding the possibilities for "sensitivity (what-if) analysis."

Establishing a client's current level of productivity is the first step in developing an overall program to improve productivity. Current productivity may be assessed by analysts who apply work measurement techniques. The practitioner may also be able to detect low productivity through a financial analysis revealing labor costs that appear excessive for the industry or for the number of units produced. Regardless of the method used, a benchmark level of current productivity provides a basis of comparison when determining whether changes in staffing levels resulting from work measurement are effective in reducing costs and improving productivity.

A broad spectrum of work measurement techniques exists. At one end of this spectrum are techniques for the well-defined, highly repetitive kind of job, such as data entry. At the other end are methods for the vaguely defined, long-cycle job often involving less motion and more mental effort, such as computer programming, budget analysis, or engineering. Clerical operations often fall into the broad middle area. An individual who has applied various work measurement techniques is the most qualified to select those appropriate for a specific situation or environment. The technique or techniques selected depend on functions being studied, number of people, time constraints, budget constraints, and objectives of study. Exhibit A-1 relates the suitability of various work measurement techniques to the jobs being studied. Following are several work measurement techniques and the advantages and disadvantages of each.

Micromotion Study

The micromotion study technique uses a movie or video camera to record, in great detail, the motions of a highly repetitive job performed at a fixed location. By using a timing device in conjunction with the film, the analyst has a permanent record of what the job entails and how long it takes. The micromotion study has some drawbacks, however, including its high cost and, at times, adverse effect on employee morale. In addition, the study is normally reserved for high-volume or production situations, such as an assembly line station.

Predetermined Time Systems

Four widely used predetermined time systems are the Maynard Operation Sequence Technique (MOST)®, Methods-Time Measurement (MTM)®, Master Clerical Data (MCD)®, and Basic Motion Time study (BMT)®.

This method uses tables containing standard times for performing specific manual motions. The work measurement analyst uses the times either directly or

in the form of a sum of time values for larger groups of motions. In the past, predetermined time systems have been widely applied to factory production in which operations are both repetitive and physical. However, they are now being used to measure short-cycle, repetitive office and clerical operations that do not involve a great deal of machine time.

Although this technique can be time-consuming and costly, it has many advantages, including accurate and detailed results, minimal interruption of an employee's work routine, and consistency in application.

Time Study

In a time study, the work measurement analyst continuously observes a worker or workers and records, in detail—

- A description of each step of the job.
- The time it takes to perform each step.
- The work pace.

A timing device determines elapsed time (that is, the time from start to finish). Once the information is documented, the analyst develops a time standard for each activity based on how long it takes to complete all the steps in the process.

Time study is particularly applicable to relatively short-cycle, moderate-volume activities in which there are few employees per activity. The advantages of this technique are as follows:

- Supervisors tend to place confidence in programs that are established for their own employees performing in their usual work areas.
- Time standards are based on the operating conditions actually in effect. The analyst observes complete, continuous cycles of production.
- Method improvement ideas usually result since the analyst has specific, first-hand knowledge of how each job is performed.
- Because of clearly defined details of the steps performed, standards can be more easily adjusted as methods or procedures change in the future.

The major disadvantage of time study is its costliness, because it is a slower process than any of the other techniques discussed in the paragraphs that follow.

Work Sampling

In work sampling, the analyst makes a large number of instantaneous, random observations to record the activity of a person or a machine. This technique is commonly used to determine busy or idle times, allowances for such things as telephone interruptions for groups of people, and the frequency of each step in a procedure.

In certain applications, work sampling can also be used to *establish* time standards. For example, an analyst can make a large number of instantaneous observations of the work of a person or a group of people. By comparing the percentage of observations of a certain activity to the total observations made, he can determine, with predictable accuracy, the percentage of time actually

spent on that activity. To establish a standard time for each activity, the analyst then relates the output count (units produced) to the time spent on each activity. This establishes a standard time per activity per unit produced.

The following characteristics are common in activities to which work sampling is applicable:

- Large groups of people working in the same general area, so that they may be observed simultaneously
- Long activity cycles[1]
- Work procedures that cannot be specifically defined or that are subject to regular, frequent changes
- Work that involves the combined efforts of a group or team

There are several disadvantages to the work sampling technique. Although it is considerably less expensive to implement than a time study, it sometimes requires long observation, especially when the analyst has to observe many job activities. There is also little opportunity for methods improvements during the actual sampling period. The standards derived are difficult to revise as methods or procedures change; in fact, revising the standards generally requires a complete restudy of the work in question.

Multiminute Measurement

Also known as predetermined interval sampling, multiminute measurement (MMM) is a blend of work sampling and time study. The analyst uses this technique to observe two or more employees during the same time period. As in work sampling, the theory of instantaneous observation is applied, but the observations take place at planned intervals, rather than at random. The observations are more frequent than in work sampling, ranging from one-quarter of a minute to five minutes apart. MMM is similar to continuous time study because it uses long, uninterrupted periods of observation.

The major advantage of MMM in comparison to work sampling is that the analyst can identify and monitor nonproductive time and can adjust productive time more accurately to consider individual variances. Its advantages in comparison to time study are as follows:

- Less analyst time is required to develop standards.
- It is ideal for "crew" work, since several employees performing different but interrelated activities can be studied simultaneously.
- There is usually less adverse employee reaction.
- It becomes more advantageous as the overall cycle time of the activities increases.

On the other hand, MMM does not provide detailed step breakdowns, as a time study does, nor is it as accurate in measuring short-cycle operations.

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1. A *long cycle* is defined as a large block of time required to complete an activity.

Extended Cycle Analysis (ECA)

Extended cycle analysis (ECA) requires professional and technical employees to report the time they actually spend on various activities. Jobs measured by this technique usually have very long cycles and high variability. The analyst defines work activities prior to data collection and breaks down overall projects or functions into limited and more uniform blocks of work. He then collects the reported time data, along with output data about the work accomplished, over a period of time sufficient to obtain a statistically reliable sample of both the work content and the time expended.

The analyst uses work sampling techniques in conjunction with employee time reporting to adjust, or *pace-rate,* reported time and to identify nonproductive time. *Raw,* or actually reported, time is then adjusted by these observations to obtain *true* productive time. The analyst divides total productive time for each activity by the number of output units completed to establish a time per unit.

The activity time standards developed with ECA can provide reasonable estimates of the overall times required to complete projects or functions which, in terms of their typical definitions, may take weeks, months, or even years. However, these standards will not be as detailed or accurate as those determined by time study or MMM.

Engineering Operations Analysis (EOA)

Originally developed to establish standards for engineers, programmers, and technicians in the aerospace industry, engineering operations analysis (EOA) is also used by highway design engineers, architects, and similar professionals. This technique measures activities that typically have long cycles and high variability and that involve considerable mental effort and judgment. The final product of these activities is usually a physical item that can be described by a number of independent forecastable variables, such as project cost, length, weight, and number of major components.

EOA is very similar to ECA. The major exception is that EOA is applied to work activities in which time does not vary in direct relationship to a single output variable (production unit). Instead, the relationship between the time required to complete an activity is most properly expressed as a function of several variables by means of a regression formula—for example, $a + bx + cy + \ldots$.

Rated Actual Time

Relying mainly on individually maintained employee records of how time is spent and work units produced, the rated actual time technique is usually used to measure short-cycle, less variable operations. The analyst collects time and production data over a period of several weeks or months and records it on *time survey* or *time ladder* forms. After completing data collection, the analyst divides the total time by the total units to find an average time per unit and then adjusts actual reported time based on the random pace ratings, or leveling observations, made during the data collection period.

Rated actual time is used when a direct observation technique, such as time study or MMM, would be applicable except that a program constraint exists, for

example, lack of sufficient analyst manpower. However, these standards tend to be less accurate than standards developed through direct observation, contain no step details, and can be revised only by complete restudy of the work in question.

Exhibit A-1

Job Characteristics Spectrum

The closer the technique is to the characteristic, the more appropriate it is.

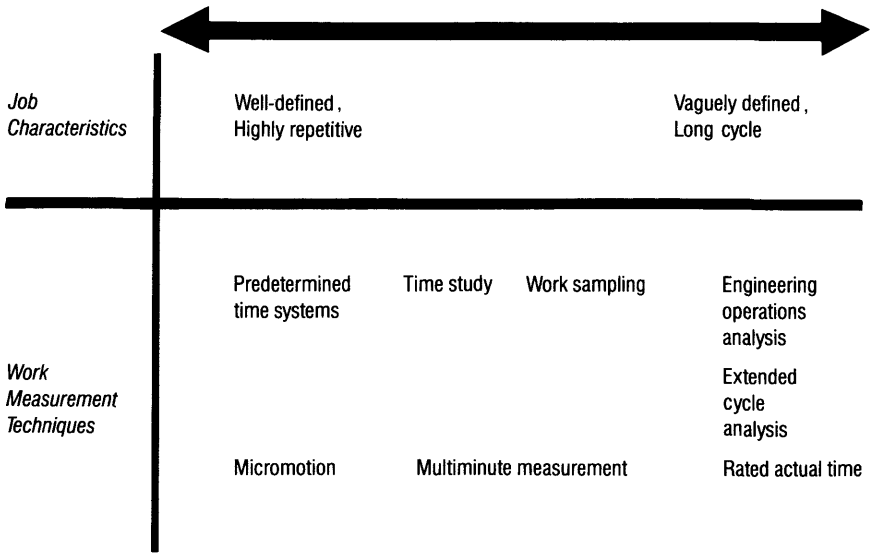

Exhibit A-2

Costs of Techniques

Although it is difficult to make generalizations about internal and external costs, certain trends are typical. These estimates assume the extensive use of client work measurement analysts and will vary by engagement. Factors influencing the cost for a given technique include the size of the organization under study, technical capabilities of client personnel, the desired level of detail or accuracy expected from the study, and the current level of client productivity.

Technique	*External Cost*	*Client Involvement (Internal Cost)*
Micromotion study	High	High
Predetermined time systems	High	Moderate
Time study	High	High
Work sampling	Moderate	Moderate
Multiminute measurement (MMM)	Moderate	Low
Extended cycle analysis (ECA)	Low	High
Engineering operations analysis (EOA)	Low	High
Rated actual time	Low	High

Exhibit A-3

Comparison of Techniques

Comparison Category	*Micromotion*	*Predetermined Time Values*	*Time Study*	*Multiminute Measurement*	*Work Sampling*	*Professional Measurement – Extended Cycle Analysis, Engineering Operations Analysis*
Typical area of application	Highly repetitive, e.g., assembly operations in fixed areas	Highly repetitive, e.g., assembly operations	Clerical and variable factory operations	Clerical pools or operations within limited area	Varied activities within group distinguishable through observation	Long cycle with high degree of mental activity
Generally possible for application to individual employees?	Yes	Yes	Yes	Maybe	No	No
Time required to collect and analyze data	Long	Long	Medium	Short	Long	Long
Interruption of employee's work routine	Close observation under laboratory conditions	Little	Little	None	None	Employee self-reporting
Provides detailed standards?	Yes	Yes	Yes	Some	No	No
Consistency	High	High	Good	Good	Good	Fair
Requires leveling for work pace?	Yes	No	Yes	Yes	Yes	Yes
Requires additions for personal allowances?	Yes	Yes	Yes	Yes	Yes	Yes
Employee reaction	Overcome reaction to camera	Reaction to close observation by analyst	Some fear of stopwatch	Good	Good, except mathematics must be explained	Some concern with reporting requirements

APPENDIX B

Sample Forms

Exhibit B-1

Sample Engagement Letter

CPA & Company
Anytown, USA

May 14, 19XX

Mr. George Jackson
Hickory Manufacturing
Anytown, USA

Dear Mr. Jackson:

This letter confirms our agreement to assist Hickory Manufacturing in improving operating procedures and methods and in determining staffing levels in the production department. Our firm will work with a technical specialist [engaged by you] [engaged by us][2] to provide on-site work measurement. (See the staffing section of this letter.)

Objectives

1. Develop recommendations for improvements in operating systems, procedures, and methods.
2. Train internal analysts at Hickory Manufacturing in work measurement techniques.
3. Train managers and supervisors in the application of work measurement information and techniques.
4. Establish work standards, staffing guidelines, and effectiveness measures.
5. Develop a simple monthly reporting system to track standard versus actual staffing and to record effectiveness measurement statistics.

The objectives outlined above will be accomplished by performing the following tasks:

1. Train the two Hickory Manufacturing analysts selected to assist with the study.
2. Conduct orientation sessions for both management and employees.
3. Review production department methods and procedures with appropriate supervisors and employees. Current documentation will be revised and updated as necessary.
4. Develop and assist with the implementation of methods and procedures improvements. We will give specific attention to improvements that can be implemented immediately at low or no cost prior to work measurement.

---

2. Choose whichever option applies to a particular engagement.

5. Conduct work sampling observations and develop recommended staffing levels.
6. Develop effectiveness measures and supervisory reporting procedures.
7. Train managers in the uses of the staffing and effectiveness measurement data.

Scheduling

We have attached a preliminary work plan outlining the project approach in more detail. We estimate that this project can be completed in approximately eight weeks. This schedule depends on timely Hickory Manufacturing participation, including full-time assistance from two Hickory Manufacturing internal analysts for six weeks. We will also need assistance from the production department management and staff for interviews and review meetings.

Staffing

John Doe will serve as the project director and will have overall responsibility for this project. Bob Jones will be the on-site project manager responsible for day-to-day project operation. Jane Williams and Dan Johnson, consultants from our local office, will assist him. Sam Smith and Tom Clark have overall responsibility for our services to your company. We [you] have retained the services of Joe Black of Work Measurement, Inc., to provide work measurement technical advice and assistance for this engagement.

Reporting

A weekly progress report will be issued to inform you of project progress and status. Furthermore, we intend to review this report with production department managers in a weekly progress meeting.

Fees

We estimate our fees and expenses at $ _____ for this project. We base our fees on the time our consultants actually spend working on an engagement at standard hourly rates according to their experience. We bill expenses at actual cost. Should our participation be less than we have estimated, we will bill you only for the time worked and expenses incurred. Should you desire to expand the scope of our assistance beyond that planned, we will provide you with an estimate of our additional fees and expenses and secure your approval prior to proceeding. We will bill you monthly for actual fees and expenses incurred.

If you have any questions now or during the course of this project, please call John Doe or Sam Smith at 555-1212.

Sincerely,

_____

Joe Barnes, CPA

Exhibit B-2

Work Plan

Client _____ Engagement Supervisor _____
Location _____ Personnel _____
Nature of Work _____
Client Personnel _____

	Assigned to	Week 1					Week 2					Week 3					Week 4					Week 5					Week 6					Comments
Task1 – Project Initiation		M	T	W	Th	F	M	T	W	Th	F	M	T	W	Th	F	M	T	W	Th	F	M	T	W	Th	F	M	T	W	Th	F	
1.1 Review work plan and revise if necessary																															
1.2 Select client analysts																															
1.3 Prepare analyst training course																															
1.4 Conduct analyst training																															
1.5 Conduct management orientation session																															
1.6 Conduct employee orientation sessions																															
Task 2 – Operations Review																															
2.1 Gather basic organization and legal information																															
2.2 Conduct interviews with supervisors and selected employees																															
2.3 Develop description of operations and work distribution																															
2.4 Review existing flowcharts and update as necessary																															
2.5 Develop activity lists																															
2.6 Identify workload indicators																															
2.7 Obtain concurrence and approval																															
Task 3 – Methods Improvement																															
3.1 Analyze the activities																															
• Work elements																															
• Method and flow of work																															
• Distribution of work																															
• Skill utilization																															
• Quality requirements																															
• Forms																															
• Layout																															
• Files and records																															
3.2 Develop improved methods																															
3.3 Obtain concurrence and approval																															

Exhibit B-2
(continued)

Work Plan

	Assigned to	Week 1					Week 2					Week 3					Week 4					Week 5					Week 6					Comments
		M	T	W	Th	F	M	T	W	Th	F	M	T	W	Th	F	M	T	W	Th	F	M	T	W	Th	F	M	T	W	Th	F	
Task 4 – Work Sampling																															
4.1 Identify and define sampling categories																															
4.2 Establish a production unit count system																															
4.3 Determine required number of work sampling observations																															
4.4 Establish sampling schedule																															
4.5 Prepare observation and summary forms																															
4.6 Conduct analyst briefing																															
4.7 Perform work sampling observations																															
4.8 Validate accuracy of sample																															
4.9 Summarize results																															
Task 5 – Staffing Guidelines																															
5.1 Calculate earned hours per production unit																															
5.2 Develop staffing allowances:																															
• Defined station employees																															
• Vacation, sick leave, holidays																															
• Nonmeasured time																															
5.3 Determine standard hours for each work center																															
5.4 Develop recommended staffing levels																															
5.5 Obtain concurrence and approval																															
5.6 Implement recommended staffing levels																															

Exhibit B-2
(continued)

Work Plan

	Assigned to	Week 1					Week 2					Week 3					Week 4					Week 5					Week 6					Comments
		M	T	W	Th	F	M	T	W	Th	F	M	T	W	Th	F	M	T	W	Th	F	M	T	W	Th	F	M	T	W	Th	F	
Task 6 – Reporting System																																
6.1 Identify effectiveness measures																																
6.2 Develop simple monthly report for output,																																
earned vs. actual staffing, and effectiveness																																
measures																																
6.3 Obtain concurrence and approval																																
6.4 Implement reporting system																																
Task 7 – Project Reporting																																
7.1 Prepare interim status reports																																
7.2 Prepare final report																																
7.3 Review final report with client management:																																
• Flowcharts																																
• Methods improvements																																
• Staffing levels																																
• Reporting system																																

Exhibit B-3

Client Condition Data Collection Checklist

Organization		Analyst(s)	
Group			
Item	Responsibility	Date Planned	Date Completed
Organization charter (functions and responsibilities)			
Organization charts			
Pertinent laws, rules, and regulations			
Organization policies and procedures			
Personnel name and classification list			
Area layouts			
Interviews/Questionnaires – supervisors			
Interviews/Questionnaires – employees			
Samples of forms used			
Equipment used			
Filing systems			
Existing data reporting			
Job logs			
Workload volume indicators			
Work backlog			
Previous system studies			
Existing work standards			
Work assignment systems			
Cost and management reports			
Review of data with group supervisor			

Exhibit B-4

External Specialist Proposal Evaluation Checklist

Understanding of the Problem/Need

- Demonstrates understanding of client business _____
- Discusses cause(s)/effect(s) _____
- Has included background information _____
- Has clearly described the nature and severity of the situation _____

Project Objectives/Benefits

- States long-range objective/impact on client business _____
- Explicitly describes anticipated results _____
- Relates to specialist's understanding of the problem _____
- Cites expected tangible outputs _____
- States benefits, including expected intangible benefits _____

Technical Approach

- Details task plan _____
- Details task descriptions _____
- Describes key factors influencing tasks in the introduction _____
- Describes task interrelationships/dependencies _____
- Discusses skill requirements _____
- Defines progress reporting _____

Project Scope

- Clearly states limitations _____
- Discusses related impact on approach _____
- Gives alternatives for client evaluation _____

Project Personnel

- Sets project organization and responsibilities _____
- Describes client personnel/skills anticipated _____
- Sets consultant/client participation by task _____
- Discusses impact of personnel changes _____
- Establishes availability/commitment of personnel _____

(continued)

Firm Qualifications

- States related firm experience _____
- Gives previous client references _____
- Includes résumés of specialists _____
- Includes descriptive previous engagement summaries _____

Timing and Fees

- States professional fees _____
- States estimated expenses _____
- States assumptions impacting fee estimates _____
- States alternative fees for varying assistance _____
- States project duration _____

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