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Uses of Work Management

Harvey E. Schatz

Meaningful work measurement is more than a single technique, this author believes. Rather it is a complex, involving operations analysis, manpower planning, and one of the work measurement tools—

THE USES OF WORK MANAGEMENT

by Harvey E. Schatz

Touche, Ross & Co.

WORK measurement programs have for some time been a sort of stepchild in systems work. They are tedious to carry out; workers often resent them; they lack the glamor of computer feasibility studies or creating a management information system.

They have only one great advantage: if done well, they can produce significant savings.

And that is no small advantage in this era of rising costs, a diminishing labor market, and lower profit margins.

Work measurement plans are no panacea.

But taken in the proper context —viewed as a plan rather than a single technique — they almost always produce increased efficiency.

It should be noted that the applicability of work measurement is not limited to organizations with massive clerical staffs or that, because of its quantitative nature and the dollar savings objective, its use must preclude recognition of human relationships. Work measurement can be quite effective in small and medium-sized companies and can be instituted without morale-shattering effects if a properly structured program is developed.

By a complete work measurement plan we do not mean any single work measurement technique that establishes a standard time for performing a given task. An effective work measurement program integrates this component, of course, but to be effective it must incorporate additional managerial control tools as well:

1. Operations Analysis
2. Manpower Assignment
3. Variable Budgeting.

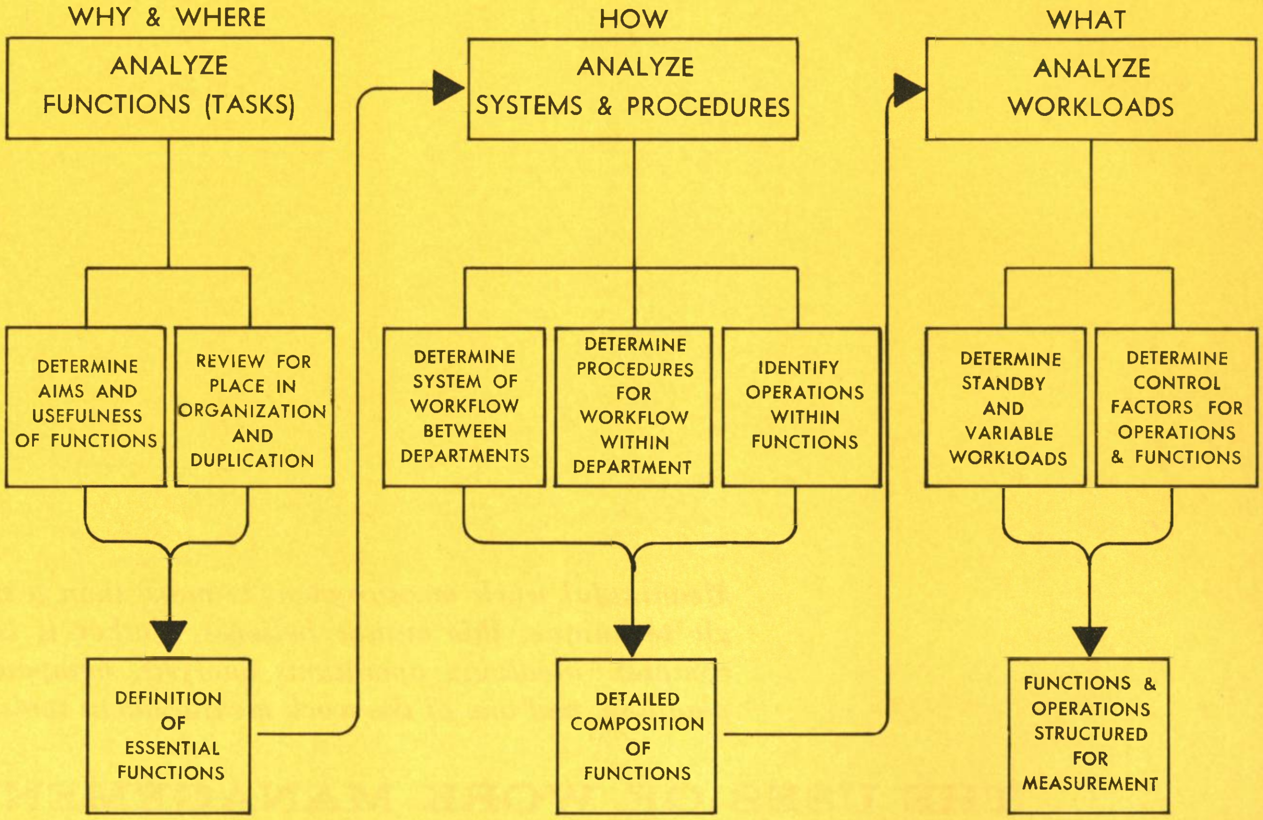
The following discussions and examples illustrate how these can work with the others to create a meaningful and integrated savings program.

A principal reason that work measurement is so often successful in effecting a reduction in the work force is the fact that employees who are not working against a standard or established goal will generally work at a 60 per cent to

EXHIBIT 1

OPERATIONS ANALYSIS

determines and defines essential functions



70 per cent effort level or pace. Simply improving the effort levels, however, is but one way of reducing the time required to perform a task. Even a well engineered standard for an inefficient task will contain built-in inefficiency. Before performing work measurement, therefore, a methods study, or operations analysis, should be performed. (See Exhibit 1, above.)

Operations Analysis consists of an intensive review of the manner in which tasks are currently being performed. First, functions of each department are studied to ascertain the purpose and usefulness of each function, to detect overlapping or duplication, and to determine where the function can best be performed.

In the past decade, the rapid rate of corporate growth, the advent of the computer, and the frequent movement of managerial personnel have produced significant changes in organizations. These changes often are not reflected in the functions being performed. Frequently, functions are made unnecessary because they have been superseded or are being performed in another department. For example, in the Operations Analysis of a manufacturing plant, it was determined that certain functions performed by the Timekeeping Department were performed the next day, in an almost identical manner, by the Payroll Department. In addition, computation of piecework earnings, performed manually in the Timekeeping Department, was also performed as part of the computerized payroll program.

The second step in Operations Analysis is to review the work flow and the detailed systems and pro-

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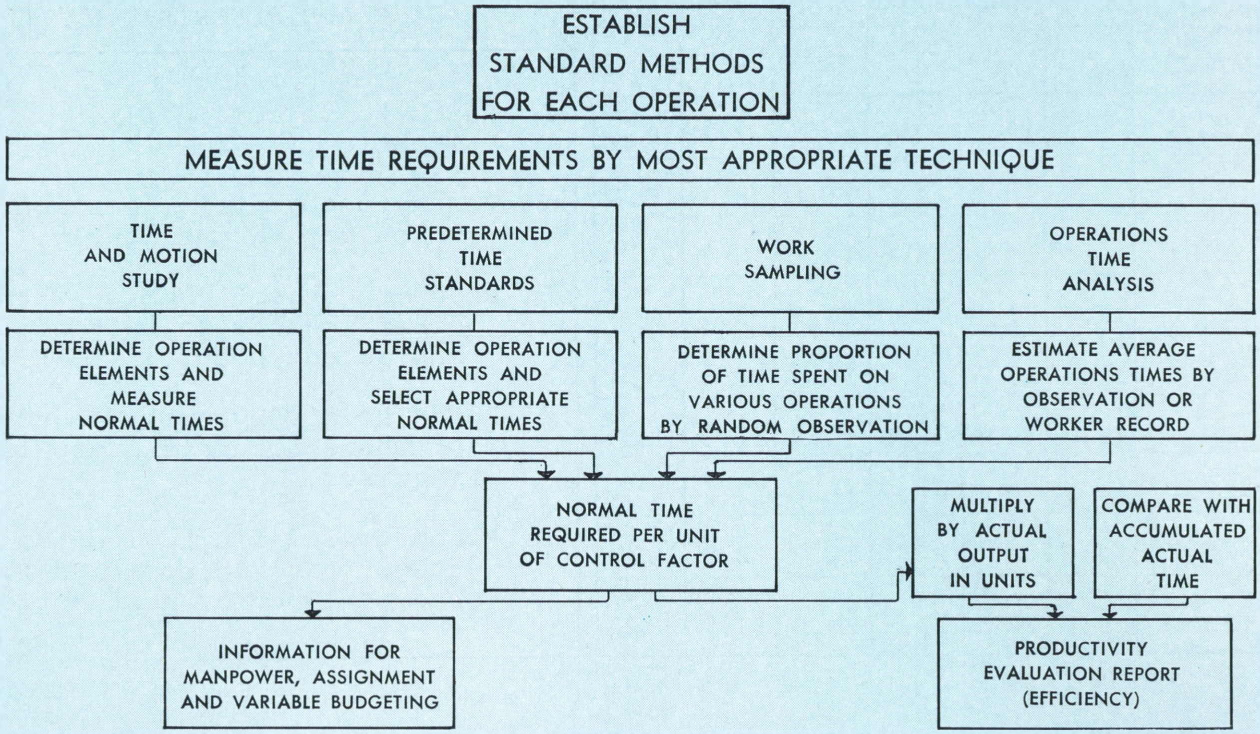
EXHIBIT 2

WORK MEASUREMENT

establishes the time requirements of workloads



cedures used in performing each function within departments and between departments. Each function is broken down into the operations of which it is composed. These operations are studied using work simplification techniques.

For example, in analyzing the material handling function of a multistory manufacturing plant, flow process charts were prepared for each of the principal products, indicating operations, transport, storage, and inspection performed. Distances moved were noted. Evaluation of the feasibility of additional monorail conveyors for transporting and storing several million parts per year was greatly facilitated by use of the flow charts. Determination of material handling manning requirements was deferred until this evaluation was completed.

The third step in Operations Analysis is the analysis of work loads. In the case of office clerical jobs, particularly in smaller companies, there is a lack of repetitiveness in the work and many tasks are difficult to measure (for example, look-ups in an accounts receivable department). However, on the basis of information gathered to this point, it is usually possible to break each job down into the factors which are the determinants of the work load. In the Purchasing Department case which is discussed later as a case study, a number of factors, such as issue of purchase orders, issue of change notices, and salesmen's interviews, determined the work load of the buyers. The relative importance of these factors, which we will call control factors, is determined from an analysis of time spent on each factor during a four- or five-day trial period.

Another product of this analysis is the determination of fixed and variable work loads. That is, how much of the work load would continue to exist under a 60- to 90-day plant shutdown condition and what index or indices of activity would cause the remaining work load to vary.

As a result of the operations analysis, the areas which are most amenable to work measurement are determined and a sequence established for the additional studies to be performed.

There are four methods of work measurement commonly used to establish standards of performance:

1. Time Study
2. Operations Time Analysis
3. Predetermined Time Standards
4. Work Sampling

Exhibit 2 above illustrates the interrelationship of the four. Each method has certain advantages and disadvantages; the selection of a particular method will depend upon the nature of the operation to be measured, skills available, cost, company policy, etc.

EXHIBIT 3

METHODS-TIME MEASUREMENT
APPLICATION DATA IN TMU

REACH - R

DISTANCE MOVED INCHES	TIME TMU				HAND IN MOTION		CASE AND DESCRIPTION
	A	B	C or D	E	A	B	
10	8.7	11.5	12.9	10.5	7.3	8.6	A. Reach to object in fixed location.
12	9.6	12.9	14.2	11.8	8.1	10.1	B. Reach to object in location which may vary slightly.
14	10.5	14.4	15.6	13.0	8.9	11.5	
16	11.4	15.8	17.0	14.2	9.7	12.9	C. Reach to object jumbled with other objects so that search and select occur.
18	12.3	17.2	18.4	15.5	10.5	14.4	
20	13.1	18.6	19.8	16.7	11.3	15.8	D. Reach to a very small object or where accurate grasp is required.
22	14.0	20.1	21.2	18.0	12.1	17.3	
24	14.9	21.5	22.5	19.2	12.9	18.8	E. Reach to indefinite location to get hand in position for body balance or next motion.
26	15.8	22.9	23.9	20.4	13.7	20.2	

GRASP - G

CASE	TIME TMU	DESCRIPTION
1A	2.0	PICK UP GRASP - Small, medium or large object easily grasped.
1B	3.5	Very small object or object lying close against a flat surface.
1C1	7.3	Interference with grasp of cylindrical object. Diameter over 1/2".
1C2	8.7	Interference with grasp of cylindrical object. Diameter 1/4" - 1/2".
1C3	10.8	Interference with grasp of cylindrical object. Diameter under 1/4".
2	5.6	REGRASP
3	5.6	TRANSFER GRASP
4A	7.3	Object jumbled with other objects. Larger than 1"x1"x1".
4B	9.1	Object jumbled with other objects. 1/4"x1/4"x1/8" to 1"x1"x1".
4C	12.9	Object jumbled with other objects. Under 1/4"x1/4"x1/8".
5	0	Contact, sliding or hook grasp.

EXHIBIT 4

METHODS-TIME MEASUREMENT
GENERAL PURPOSE DATA

BGT - BASIC GET		Distance	f"	1 - 3"	3 - 9"	9 - 15"	15 - 21"	21 - 27"
		Code	01	02	06	12	18	24
CO - Contact Object			2	4	9	13	17	22
E - Easily Grasped	F - Fixed Location		6	8	11	14	16	19
	V - Variable Location		6	8	13	17	21	26
	A - Additional Object		17	19				
J - Jumbled	O - One Hand		13	17	21	25	30	34
	S - Simo		24	28	32	36	41	45
	H - Handful		33	35	39	44	48	52
	A - Additional Object		24	28				

Time study and operations time analysis will be discussed very briefly; the use of predetermined time standards and work sampling will be illustrated by means of case studies.

During the period 1910–1920, stopwatch time studies became an accepted method for setting standards for factory direct labor operations. Even today such studies are accepted by organized labor. Time study is used to determine standard times for short-cycle, highly repetitive operations. Operations are broken down into regular and noncyclical elements for which average times are determined as a result of timing many cycles of the operation. (Elements as small as .03-.04 minutes can be timed with good accuracy.) The observed average cycle time is the sum of the average times for the regular elements, plus provision for the noncyclical elements. This *observed time* is adjusted, based upon the time study observer's rating or leveling of the effort observed, to arrive at the *normal time* for the operation. This is the time required by an average, trained employee working at a normal pace. Allowances for personal time, unavoidable delays, and fatigue are added to the normal time to determine the *standard time* for the operation.

Operations time analysis is simply the development of standards based upon historical averages, estimates of supervisors, or batch scheduling. Batch scheduling refers to the use of a schedule desk which dispatches uniform batches of work to each work center about every hour or half hour. After some trial and error, the actual time required to complete each batch is averaged to arrive at a standard. An article in the NAA *Management Accounting* magazine cited Southern Bell's use of a three-month historical average to set standard times for processing toll tickets and other media. Using methods such as these, standards can be developed at a low cost since no specialized technical skills are required. Although the standards can be used to analyze subsequent trends, they do not possess the normal amount of precision and, therefore, build in existing inefficiencies.

Predetermined time data exist in various forms. Initially, companies developed averages of elements common to several time studies and used these to set times for those elements when they occurred in subsequent operations, in lieu of performing another time study. Gradually, a company could develop sufficient time study data to synthesize standards for most of its operations.

Subsequently, as a result of industrial engineering studies of thousands of frames of slow motion film, predetermined time data were developed and published for minute elements of motion. These data exist in various sizes of building blocks. Methods-Time Measurement (MTM) data (Exhibit 3, page 18), the lowest common denominator, have been combined to produce Methods-Time Measurement General Purpose Data (Exhibit 4 above). An even larger building block has been developed in the form of Clerical Standard Data (Exhibit 5, page 20).

Standards for nonrepetitive tasks or for estimates for bidding purposes can be developed by breaking the tasks down into appropriately sized elements, depending on the predetermined data to be used, and assigning the published times to these elements. Predetermined time data are widely used in the office areas, where the use of a stopwatch is frequently considered objectionable. A high degree of consistency of standards is obtained because a common element has a uniformly assigned time and no effort rating is required. However, in order to develop qualified analysts, considerable training is required.

The fourth method of work measurement, work sampling, got its name in 1952 although the technique was conceived 40 years ago. An Englishman named Tippett was making time studies in a textile mill to determine lost time for various causes. Time study was tedious and he was looking for a less detailed and easier approach when a weaving manager remarked:

> "I can tell at a glance whether the weaving in the shed is good. If most of the weavers are bent over their looms mending warp breaks, weaving is bad; if the weavers are mostly watching running looms, weaving is good."

Tippett realized that this instantaneous reading gave an indication of production conditions in the brief interval surrounding the reading.

EXHIBIT 5

CLERICAL STANDARD DATA

CODE: SCDD-XX

OPERATION: OPEN AND/OR CLOSE DESK DRAWER

DRAWER	DISTANCE OPENED OR CLOSED	OPEN DRAWER		CLOSE DRAWER – HAND LOCATION – IN OR AT DRAWER		CLOSE DRAWER – HAND LOCATION – OVER DESK		OPEN AND CLOSE	
			TMU		TMU		TMU		TMU
Center	Part 6"	10	26	12	18	14	22	16	44
	Full 12"	11	55	13	51	15	55	17	106
Side Top	Part 12"	20	34	22	22	24	35	26	56
	Full 18"	21	38	23	34	25	39	27	72
Side Lower	Part 12"	30	39	32	22	34	35	36	61
	Full 18"	31	43	33	34	35	39	37	77
File Drawer	Part 12"	40	48	42	31	44	44	46	79
	Full 18"	41	52	43	43	45	48	47	95

DATA CODES

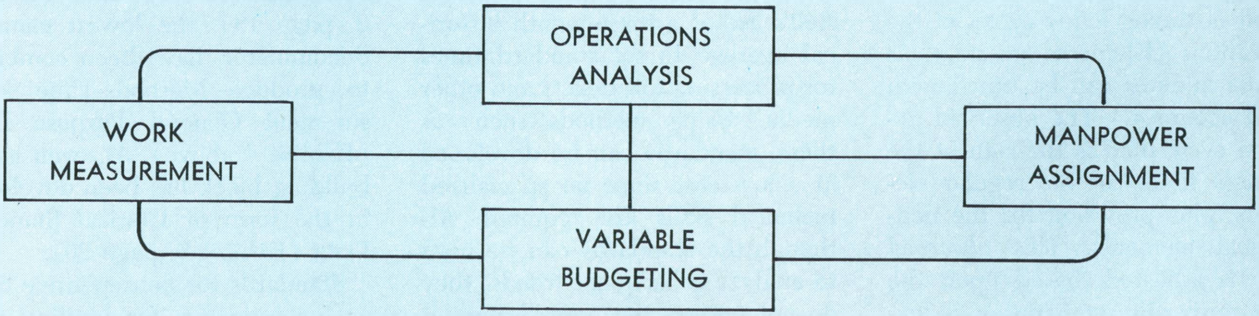
START: Hand over desk

END: Hand on drawer

Table from *Universal Office Controls*, copyright, H. B. Maynard & Co., Pittsburgh, Pa.

EXHIBIT 6

ALTHOUGH each of the activities can be USEFUL SEPARATELY



They are MOST USEFUL when properly COMBINED

EXHIBIT 7

VB1

VARIABLE BUDGETS

ANALYSIS OF DEPARTMENTAL FUNCTIONS

DEPT. NO. 16 NAME PURCHASING DATE

Description of Departmental Functions

PURCHASE ALL PRODUCTIVE MATERIALS, TOOLS, SUPPLIES AND EQUIPMENT, PROCESS PURCHASE REQUISITIONS, DETERMINE ECONOMIC PURCHASE QUANTITIES AND SOURCES WHICH WILL SUPPLY BEST QUALITY AT LOWEST PRICE.

ISSUE PURCHASE ORDER CHANGE NOTICES.

INTERVIEW SALESMEN.

Remarks

H. F. SNYDER
ANALYST

J. P. ENGLE
Supervisor

EXHIBIT 8

VB2 — VARIABLE BUDGETS — 1 OF 2

CURRENT INDIRECT WORKING FORCE ANALYSIS

DEPT. NO. 16 NAME PURCHASING

NO. OF SHIFTS ______ SHIFT NO. ______ DATE ______

PERSONNEL STATUS

No. As Of Sal.	Hr.	Job Classification No.	Description	Functions Performed	Ref. No.
1			GENERAL PURCHASING AGENT	SUPERVISE PURCHASING DEPT. WHICH INCLUDES	
				SEVEN BUYERS AND FOUR GIRLS.	
				CHECK VENDORS FACILITIES, CAPABILITY AND	
				RELIABILITY.	
				ASSISTS BUYERS WITH THEIR PROBLEMS. COORDINATE	
				WITH QUALITY CONTROL AND ENGINEERING DEPTS.	
				HANDLES PURCHASING ON SPECIAL PROJECTS.	
6			BUYERS	PURCHASES ALL PRODUCTIVE MATERIALS, TOOLS,	
				SUPPLIES AND EQUIPMENT. PROCESSES	
				PURCHASE REQUISITIONS, FOLLOWS UP ON	
				DELIVERY AND INTERVIEWS SALESMEN.	
1			SECRETARY	SECRETARY TO THE GENERAL PURCHASING AGENT.	
				TYPES LETTERS, SORTS MAIL AND DELIVERS IT	
				TO BUYERS, DOES GENERAL FILING, AND	
				ASSISTS WITH TYPING OF PURCHASE ORDERS.	
			TOTAL		

H. F. SNYDER — Analyst

J. P. ENGLE — Supervisor

EXHIBIT 9

VB 4/

WORKLOAD ANALYSIS

DATE ______

DEPT. NO. 16 DEPT. NAME PURCHASING SHEET NO. 43 OF _

TIME				CODE NO. 1			CODE NO. 2			CODE NO. 3			CODE NO. 4			CODE NO. 5			CODE NO. 6			CODE NO.	
START	STOP	NO. UNITS	CODE NO.	MIN E.T.	NO. UNITS	MIN A.T.	MIN E.T.	NO. UNITS	MIN A.T.	MIN E.T.	NO. UNITS	MIN A.T.	MIN E.T.	NO. UNITS	MIN A.T.	MIN E.T.	NO. UNITS	MIN A.T.	MIN E.T.	NO. UNITS	MIN A.T.	MIN E.T.	NO UNIT
8:00	8:15		8D																				
8:15	9:02	5	1	47	5	9.4																	
9:02	9:11		2A																				
9:11	9:41	2	2				30	2	15.0														
9:41	9:50		8D																				
9:50	10:00		8A																				
10:00	10:15		7																			15	
10:15	10:19		8A																				
10:19	11:05	4	1	46	4	10.5																	
11:05	11:09		1A																				
11:09	12:00	6	1	51	6	8.50																	
1:00	1:20	1	4										20	1	20.0								
1:20	1:25		5C																				
1:25	1:40	1	5													15	1	15.0					
1:40	2:30	5.	1	50	5	10.0																	
2:30	2:45		7																			15	
2:45	3:11	1	4										26	1	26.0								
3:11	3:31	1	2				20	1	20.0														
3:31	3:42	1	5													11	1	11.0					
3:42	3:55	4	3							13	4	3.3											
3:55	4:20		8A																				
4:20	5:00	2	1	40	4	10.0																	
TOTALS		TODAY		234	24	9.75	50	3	16.7	13	4	3.3	46	2	23.0	26	2	13.0				30	
		ACCUM.		4930	486	10.1	918	60	15.3	75	27	2.8	843	55	15.33	677	67	10.1				560	

Work sampling is based upon the laws of probability. A sample number of chance occurrences tends to follow the same distribution as the large group from which the sample was drawn. Work sampling is an extremely useful technique for determining the time distribution for activities being performed by direct and indirect factory labor and by office employees; it can be used to establish standards. It is widely used to determine allowances for delays which occur at irregular intervals; this application has been named ratio delay. Another common application is the use of work sampling to determine utilization of facilities, such as machines, material handling equipment, or truck loading docks.

This method is less expensive than time study or the use of predetermined time data and does not require observers with specialized engineering skills. It is more acceptable to factory and office employees than are continuous time studies. Its broad range of applicability facilitates obtaining facts which otherwise might not be obtained. Work sampling has the disadvantage of being somewhat difficult to comprehend and does not provide as much detailed information as time study or the use of predetermined time data.

In both of the case studies presented further on, manning is ultimately related to an index of activity. By projecting the level of activity, manpower requirements can be determined in advance and varied as required with the work load. This does not necessarily mean short-term hiring and firing. In the office, for example, peak loads will not occur simultaneously in all departments. Utility personnel and overtime can be used to handle peaks when a department is manned at a level less than that required for the peak.

A vice president of a major company was quoted as saying:

"I'd hate to think how I'd have been able to run the office without work measurement. The greatest value comes in knowing the work loads are reasonably equitable."

By tieing the results of work measurement to flexible budgets, the savings effected can be perpetuated. In many cases where the work measurement technique was used as a one-time cost cutter, personnel who were eliminated ultimately reappeared on the scene. The use of flexible budgets allows for an increase in manning when justified by an increase in the work load. Meaningful budget reports highlight deviations from standard manning.

Operations Analysis, Work Measurement, Manpower Assignment, and Variable Budgeting have all been discussed. (See Exhibit 6,

EXHIBIT 10

3 40

SUMMARY OF WORKLOAD
ACTUAL TIME ANALYSIS

PERIOD COVERED
FROM ______ TO ______

DEPT. NO. 16 DEPT. NAME PURCHASING – BUYERS

EMPLOYEES NAME $	WORKLOAD CODE NUMBER 1	2	3	4	5	6	7	8	9	10	11	12	13	1
J. P. ENGLE – GENERAL PURCHASING AGENT						9900	660							
S. A. FOSTER – BUYER	4816	821	202	1022	719		650	1558	141	306	98	117		
B. F. GOULD "	4701	997	165	946	612		660	1830	61	358	44	185		
R. I. HARRISON "	5177	705	59	1116	538		660	1863	101	146	61	134		
L. B. MAUER "	4664	802	28	1216	444		748	1949	162	402	39	106		
K. V. STRONG "	4930	918	75	843	677		660	1836	83	278	46	214		
H. C. WOODS "	5222	906	221	734	798		660	1259	155	384	60	161		
TOTAL TIME (MINUTES)	29,510	5149	750	5877	3788	9900	4708	10,395	703	1874	348	918		
TOTAL UNITS OF CONTROL FACTOR	3,049	329	270	278	255	–	–							
UNASSIGNED TIME DISTRIBUTED TO CONTROL FACTORS														
CODE NO. 8 (3378 UNITS AT 3.077 EACH)	9382	1013						(10,395)						
	703								(703)					
		1874								(1874)				
			348								(348)			
					918							(918)		
TOTAL REASSIGNED TIME	10,085	[illegible]	348		918			(10,395)	(703)	(1874)	(348)	(918)		
REASSIGNED TIME % TO C.F. TO...	34.17	50.07	46.40		24.23									

page 20). Each is a powerful managerial control tool. They are most powerful, however, when integrated to create an effective Work Measurement Program.

This effectiveness has been proved dramatically by applications ranging from small individual departments to large organizations with massive clerical staffs—annual dollar savings in the millions have been reported.

Work measurement is mundane, and it is time consuming. But at a time when labor is becoming a larger and larger item in a firm's expenses—in many cases the largest item—the effectiveness of Work Measurement cannot be ignored.

Case study 1:

The following Purchasing Department case study illustrates an application of work measurement using predetermined time data.

Brief descriptions of departmental and personnel functions were prepared on preprinted forms (Exhibits 7 and 8, pages 21 and 22). In the case of the buyers, the control factors or determinants of work load were listed and assigned code numbers. Provision was made for a breakdown of miscellaneous time to include accumulation of time spent on telephone calls, personal time, dictation, etc. These code numbers were noted on work load analysis or logging sheets (Exhibit 9, page 23), which were used by the employees to record their time for several days.

Based upon the summary of actual time spent working on each control factor (Exhibit 10, above), the most significant control factors for which standards would be developed were identified. In addition, time spent on other control factors was allocated to the appropriate standard control factors and expressed as a percentage of the actual recorded time.

At this point, each selected function was broken down into its required operations and times were determined, using MTM—General Purpose Data (Exhibit 11, page 25). Note that since all functions are not to be timed, provision has been made for unmeasured functions by adding an allowance to the MTM times. The allowance is based upon the percentage of allocated unmeasured time to time recorded for the selected control factors.

Two other allowances are included: a safety factor of 10 per cent to allow for elements too small to identify in the operation breakdown and a personal time allowance of 6.7 per cent, or 30 minutes of an eight-hour day. The

EXHIBIT II

VB4

CONTROL FACTOR
DETAILED OPERATION
UNIT TIME REQUIREMENT

DEPARTMENT NO. 16 DEPARTMENT NAME: Purchasing - Buyers DATE:

OPERATION DESCRIPTION	CONTROL FACTOR AND OPERATION TIME (MINUTES)				
	PURCHASE ORDERS (REGULAR) AVERAGE 2 LINE ITEMS	PURCHASE ORDERS (SPECIAL) AVERAGE 1 LINE ITEM	CHANGE NOTICES AVERAGE 1 LINE ITEM	SALESMEN INTER-VIEWS	LETTERS
1. Receive and review purchase					
requisition	1.75	2.00			
2. Determine possible sources	3.67	6.30			
3. Check quantity requested with					
economic purchase quantity	1.25				
4. Enter quantity	.14	.07			
5. Determine delivery date	.15	3.00			
6. Write delivery date	.07	.07			
7. Write unit price	.16	.08			
8. Initial requisition	.05	.05			
9. Drop in box for typing	.03	.03			
10. Review change request			1.42		
11. Check with purchase order:					
(a) Select order			.25		
(b) Check item description			.08		
(c) Write unit price			.08		
(d) Post quantity change			.15		
(e) Initial			.05		
Sign	.05	.05	.05		
Salesmen interviews				15.00	
Dictate review and sign					11.00
Total measured time allowance	7.32	11.65	2.08	15.00	11.00
Unmeasured time (Pct. VB 4 c)	2.50	5.36	.97		2.67
Safety factor 10% of measured time	.73	1.17	.21	1.50	1.10
Total	10.55	18.18	3.26	16.50	14.77
Personal time allowance 6.7%	.71	1.22	.22	1.11	.99
Total time allowance	11.26	19.40	3.48	17.61	15.76

EXHIBIT 12

VB5 PERSONNEL REQUIREMENTS ANALYSIS

DEPT. NO. 16 DEPT. NAME: Purchasing - Buyers DATE:

CURRENT WORKING FORCE PRODUCTIVITY EVALUATION

VARIABLE CONTROL FACTORS EARNED FROM TO

NO.	NAME	ACTUAL UNITS	WEIGHTS APPLIED	WEIGHTED VALUE	ORGANIZATION WORK LOAD CAPABILITIES	ADDITIONAL WORK LOAD CAPABILITIES DURING PERIOD EQUIV. PEOPLE
1	Purchase orders - regular	4,125	1.00	4,125	22 days x 480 min. per day = 10,560	7,502 minus 5,648 = 1,854
2	Purchase orders - special	385	1.69	651	10,560 ÷ 11.26 min. for base unit = 937.83	1,854 ÷ 938 = additional work load capabilities equivalent to -
3	Change notices	270	.31	84	W. L. cap. of one person	
4	Salesmen's interviews	276	1.56	431	8 people x 937.83 = organization's work load capabilities totaling -	
5	Letters dictated	255	1.40	357		
Total weighted units of control factor				5,648	7,502	1.98 persons

H. F. SNYDER
ANALYST

J. P. ENGLE
SUPERVISOR

total of measured time and allowances is the standard time for each control factor. These standard times are then summarized. Each control factor is given a weighted unit value by assigning a value of 1.0 to any factor identified as the base unit and relating each factor's time to the base unit time.

The Personnel Requirements Analysis (Exhibit 12, above) is used to determine the excess number of buyers in the current organization based on standard units. The standard is developed by using the actual units for each control factor, converted to weighted values. The total weighted units of control factor are compared to the number of units the existing organization can produce at standard. This comparison indicates the additional work load capability, or the excess number of persons, based upon the existing staff.

An example of the integration of work measurement with variable budgeting and performance reporting for an order and billing department is shown by a chart comparing actual to standard performance. Between mid-April and the end of May, there was a steady improvement in performance as indicated by the convergence of the actual and standard lines. The falloff of output concurrent with the increase in staffing beginning in June is highlighted by this graphic type of reporting and indicates that corrective action is required.

Let us look at an actual application of work sampling on a pilot basis in a manufacturing department. It was mentioned earlier that work measurement can be instituted without harmful effects on employee morale. In this example, some of the steps taken to maintain good personnel relations will be discussed.

Case study 2:

As in the case of any work measurement study, the objectives of this study were clearly defined. In this case the objectives were:

1. To train company management personnel in the use of work measurement techniques
2. To acquaint factory indirect and office employees with work measurement (Time study was currently being used for the direct labor force.)
3. To develop a program for work measurement of indirect factory and office areas to be implemented by company personnel with the objective of cost reduction.

The above objectives were to be accomplished by two consultants working with selected company personnel for a two-week period. Two pilot studies were to be conducted, one in an office department and one in a factory department.

The factory departments were selected by preparing a matrix which listed the number of indirect labor employees by classification, by department. From this matrix an assembly department with seventeen direct and five regular indirect employees was selected because of the relatively high indirect to direct employee ratio. The primary interest was to determine how indirect labor personnel spent their time. It was decided to include direct labor personnel in the observations, however, since little additional effort would be required.

An index of the activity level must be selected so that the time distribution observed during the study can be related. Since indirect labor employees were a supporting function to direct labor, it was decided to use standard direct labor hours as the index.

The next requirement in preparing for the study was the selection and training of observers. The fact that observers were selected from departments, such as cost accounting, production control, and plant engineering, is an indication of the ease with which people can be trained in the use of work sampling. This type of selection also established a nucleus of trained personnel in the various departments. The plant time study man was selected to be in charge of the study. Training sessions were held with this group and with the plant foremen to familiarize them with the practical aspects, but not the detailed theoretical concepts, of work sampling.

It is essential that the employees being studied be informed of what is taking place. The initial reaction to work measurement, in one instance, has been described as running "from tears to fears." This can be overcome by careful and tactful communication—before the fact. The following excerpts are from the letter issued to the employees by the plant manager concerning the "Labor Utilization Survey."

"The plan is to study one department in the office and one department in the plant during this two-week period. In addition to a careful examination of the selected departments, this will be a training program for the supervision assigned so that they can in turn complete the study of all departments on an extended-schedule basis. The studies in both the plant and office will be performed using a work sampling procedure which is an accepted industrial engineering technique. Random observations of job performance will be recorded and the results evaluated statistically.

"There is no need for any personnel to be disturbed because they are being observed during the course of these studies. Please do not attempt to put on any special performance or show. Be natural, do your work normally, and try to ignore the fact that you are participating in a special program."

It is essential that the employees being studied be informed of what is taking place. The initial reaction to work measurement, in one instance, has been described as running "from tears to fears." This can be overcome by careful and tactful communication before the fact.

The objective of matching manning to work loads was emphasized to supervision and to the employees. In addition, the company policy of depending on attrition alone for reductions highlighted by work measurement was reiterated.

Randomness and instantaneous observations are essential to a proper study. Consequently, the study must be organized in such a manner that:

1. Each observer is consistent in his classification of an activity
2. Tour times are random
3. Tour routes are random
4. The activity first observed is noted without anticipation of an activity about to happen.

In order to ensure that these conditions are met, detailed instruction sheets are prepared which include definitions of each of the

EXHIBIT 13

Random Tour Times & Routes
For Work Sampling of Department 14

Wednesday, September 18, 1963

Gladstone			Baranowski			Buckley			Tabacsko			Lemon			Latovick		
Tour No.	Rt.	Time	Tour No.	Rt.	Time	Tour No.	Rt.	Time	Tour No.	Rt.	Time	Tour No.	Rt.	Time	Tour No.	Rt.	Time
241	2	7:18	251	1	11:12	261	2	7:17	271	1	12:34	281	2	7:10	291	1	12:07
242	1	7:39	252	1	11:26	262	2	7:31	272	2	12:48	282	1	7:28	292	1	12:23
243	1	7:53	253	2	11:47	263	1	8:06	273	2	12:58	283	1	8:06	293	2	12:35
244	2	8:03	254	2	11:57	264	1	8:31	274	1	1:15	284	1	8:32	294	1	12:46
245	1	8:44	255	1	12:40	265	2	8:50	275	1	1:31	285	2	8:52	295	1	1:02
246	1	8:55	256	1	1:15	266	2	10:07	276	2	1:59	286	2	9:51	296	2	1:32
247	1	9:18	257	2	1:25	267	2	10:22	277	2	2:09	237	1	10:05	297	1	2:04
248	2	9:30	258	2	2:54	268	2	11:23	278	2	2:28	288	2	11:13	298	2	2:21
249	2	9:49	259	1	3:06	269	2	12:00	279	1	2:58	289	2	11:33	299	2	2:49
250	2	10:25	260	1	3:21	270	2	12:21	280	2	3:08	290	2	11:44	300	2	3:19

activities to be studied. These activities are preprinted on the observation sheet. The vertical column lists badge numbers. These badges were worn by the employees during the study to identify their job classifications and to facilitate accounting for all employees on each tour. IBM cards were used for observations made during a much larger study. It is interesting to observe that at no time during either of these studies was any dissatisfaction expressed by the employees because they were required to wear these badges.

A table of random numbers is used to select random tour times and routes. A schedule of these times and routes (Exhibit 13, above) is prepared for the observers; the routes are shown on a sketch of the department included in the instructions.

An initial trial run is made and a control center established for observers to note for each other any aspects of the operations which had not been anticipated and to re-

EXHIBIT 14

SCHEDULE B

MATERIAL HANDLERS

Time Distribution Based Upon 4-Day Work Sampling (1)
(457 Observations)

		Percent	Hours
A. Average attendance hours per day			16.0
B. Hours during which observations were not made because of breaks and cleanup period			.8
C. Hours available to be observed			15.2
D. Hours not observed—13.9% x C			2.1
E. Hours in observation area			13.1
F. Time distribution per work sampling observations:			
ACTIVITY OBSERVED			
Material Handling		56.7	7.4
Unrack in Dept. 3		5.3	.7
Direct Labor:			
Assembly	2.6		
Obtain Prod. Mat'l.	2.5	5.1	.7
Production Inspection		.2 }	.1
Expedite		.4 }	
Janitorial		1.8	.2
Idle		11.6	1.5
Walking		16.2	2.1
Discussion		2.7	.4
		100.0	13.1

(1) Observations during the first day of the sampling were not classified in a manner consistent with that used during the remainder of the study. The first day's results, therefore, have been excluded.

solve problems which develop. The trial run also provides the first reading of the distribution of time between the activities observed. The percentage of total time occupied by an activity or delay, for example, idle time, is used to make an initial determination of the total number of observations required. This can be determined by formula, chart, or table.

To determine the number of observations required, the desired confidence level and degree of accuracy must be specified. A 95 per cent confidence level simply means that one is confident that 95 per cent of the time the random observations will represent the true condition and 5 per cent of the time they will not. The degree of accuracy required will determine the number of observations, which in turn affects the cost of the study.

Based upon the trial run some redefinition of the study may be made. Observations are then made and the results tabulated daily. The percentage occurrence of an activity can be plotted daily on control charts to detect changed conditions which would affect the validity of the results. A particular advantage of work sampling is that accuracy of the results can be evaluated at any point during the study by use of a table similar to the one previously discussed. In other words, the number of observations may be cut short of the original plan if at some point it is determined that improvement in accuracy would not be warranted by the additional number of observations required.

The pilot work sampling study conducted in the manufacturing department indicated, with varying degrees of accuracy, the amount of time spent in direct and indirect activities by persons working in the department. About 7,000 observations were made of the 17 direct employees, two material handlers, a repairman, an inspector, and an expediter.

The accuracy with which the occurrence of a particular activity can be stated, at a specific level of confidence, is dependent upon the number of observations and the percentage occurrence of the activity. The larger the number of observations and the higher the percentage occurrence, the greater the accuracy with which the results can be stated. Consequently, the percentage indicated for each activity would have to be expressed as a range rather than a single number to say, with 95 per cent certainty, that the result is correct. As a practical matter this was not done in each case. Idle percentages by job classification, however, were determined in this manner.

Direct labor had a very low occurrence of idle time; the repairman had virtually none. A point which should be emphasized with respect to idle time is that in some cases it is difficult to define the nature of an observed activity. Examples of this situation are material handlers or an expediter observed walking or talking to other employees. Each of these activities could be an element of work or of idle time. The approach used was to classify the activity actually observed, that is, walking or discussion, and to use experience and judgment in evaluating the results. As a result of this approach, the idle percentages shown represent time which was definitely identifiable as idle time.

Exhibit 14 on page 28 illustrates the time distribution for the two material handlers, based upon 460 observations. Based upon these data it was determined that 10 hours of material handling were required to support the level of activity which existed during the study. By reassigning two hours to material handlers in an adjacent department, who had available time, one material handler was eliminated.

This may seem to be excessive effort to eliminate one man. The total impact of this program, however, was significant. About 60 per cent of all indirect employees were measured. Of this number about 10 per cent were eliminated by the program, through attrition.

To determine the number of observations required, the desired confidence level and degree of accuracy must be specified. A 95 per cent confidence level simply means that 95 per cent of the time the random observations will represent the true condition and 5 per cent of the time they will not. The degree of accuracy required will determine the number of observations, which in turn affects the cost of the study.