FURTHER INVESTIGATION OF BODY ASSISTED REACHES AND MOVES

Body Assisted Reaches and Moves--Supply Level Below Normal Height

BY

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Introduction

Competition, coupled with high labor costs, has forced manufacturers more and more to examine their methods of production in an effort to increase the operating efficiency of their machines, workers, and managerial systems. The control and detail planning for manual operations is by far the most difficult task that faces management in this examination. The usual procedure is through the methods of Motion and Time Study.

Motion and Time Study is a procedure which studies, simplifies, and standardizes the methods, materials, and work-place layout, and by use of stop watch studies, establishes standard time values for the individual jobs. The resulting standards are used for the establishment of wage incentives, and for the planning and control of production. All attempts to reduce stop watch studies to a science are doomed to failure, apriori, as the resulting times on each operator must be corrected by the use of a leveling factor; that is, a factor which corrects the pace worked by the operator studied to a pace considered normal. This factor is a judgement factor made by the time study man in the course of the stop watch study. It has been established that a variation of more than 10 per cent may exist between leveling factors estimated by experienced time study men. (6)* This large variation has the effect of nullifying any precise measurements made with the stop watch, and it leaves the entire system open to criticism.

It has been argued that a better system for establishing time standards might be by the use of classified elemental time values in which the job studied could be broken down into these elements, and a standard time value for the job synthesized from these elements. Many different Standard Time systems have been devised, mostly by individual companies to cover the operations within their scope.

One such system recently presented is the procedure called Methods-Time Measurement, originated by Methods Engineering Council, Consulting Engineers, of Pittsburg, Pennsylvania. This system has several advantages over other Standard Time Systems, in that:

(a) It is easy to apply,
(b) It is applicable to a large variety of jobs, and
(c) It forces a methods-study prior to the establishment of the Time Standards.

The success that Methods-Time Measurement has enjoyed in industry since its introduction in 1942 is indicative of the superiority of this system. However, several deficiencies in the system have been noted, and research is being carried on to investigate these deficiencies.

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* Numbers refer to references in the Bibliography.

The Research Group of the Industrial Engineering Department at this Institute has been engaged in the investigation of hand motions involving the use of the body, in an attempt to determine the adequacy of the present Methods-Time Measurement classification, and to determine better classifications if the present ones are found to be inadequate. These hand motions are classified as Reach and Move. Reach is that motion which has as the main purpose, the transporting of the hand to gain control of an object. Move is the motion of the hand which has as the main purpose, the transportation of an object from one location to another. This particular investigation is concerned with Reaches and Moves involving body rotation about the hips and ankles, and body bends. An investigation by Mr. Alfred Shih-Ou York of the above mentioned Research Group has shown that the present method of classification of the body assisted reaches and moves in the Methods-Time Measurement system results in discrepancies between the calculated times and the observed times for this type Reach and Move. Thus, it is the object of this investigation to attempt to analyze the effects of the various factors which would influence the classifications of these body assisted reaches and moves.

It is hoped that this investigation may be of aid in finding a more adequate classification.

II

REVIEW OF LITERATURE

A review of the literature concerning motion and time study shows that, although much has been published, little of it applies to the problem investigated in this study.

The main text consulted was Methods-Time Measurement (1) by Maynard, Stegemerten and Schwab. This publication is the main source of information on the Methods-Time Measurement system of elemental time standards. The definition of the elements and the procedure of analysis of films as given in Chapters 3, 4, and 5, were followed in this investigation.

An investigation of the book shows that the authors considered that body rotation about the hips and ankles was not a major element, and a technique was given for finding the times required for reaches and moves involving body rotation by means of a correction factor method.

In Time and Motion Study and Formula for Wage Incentives (2) by H. B. Maynard, G. J. Stegemerten, and S. M. Lowry, the problem of separating body rotation as a basic element is discussed. No suggestions as to the possible solution of the problem were given.

W. G. Holmes, in Applied Time and Motion Study (3), advanced a system of elemental time standards which included the body rotation about the hips and ankles as a basic element. Times required for different angles of body rotation were given.

A. S. York, in Investigation of Body Assisted Reaches and Moves, (4) concludes on page 54 that the Method-Time Measurement technique for finding the time and length of a reach or move motion accompanied by body rotation is inconsistent and unsatisfactory.

In a thesis to be presented in 1952, at Virginia Polytechnic Institute, F. Umibe deals with a problem similar to the one investigated herein.

III THE INVESTIGATION

A Object

In the performance of certain long Reaches and Moves, the action of the body aiding these motions introduces new variables which affect the time required for the motions. The object of this investigation is to find which variables are inherent in the motions and analyze them to discover the relative importance among the variables.

The scope of the investigation is limited to the performance of the following, using one hand:

1. Reaching for an object from a normal working level of forty inches above the floor to supply height at or near the floor.
2. Moving an object from a supply height on or near the floor to a normal working level of forty inches.

The body motions involved are Body Rotation and Bend, defined as (a) "Body Rotation"--The rotation of the trunk of the body about the hips and ankles, with no movement of the feet. (b) "Bend"--The bowing of the body at the waist with the upper portion of the torso being lowered to bring the hands within reach of an object that cannot be obtained when the body is held erect.

B Apparatus and Material

The overall plan consisted of photographing with a moving picture camera various subjects performing the motions to be studied, and analyzing the resulting films to obtain time required.

1. Setup

The work place layout is illustrated in Figure 1. One table, set at a height of forty inches is used as the dispose table, and the material to be moved is placed on the floor as shown.

2. Materials

The materials used are illustrated in Figure 2. The number of units in the supply stack varied with the different materials, which varied the total height. The physical properties are given in Table I, Appendix.

3. Operators

The operators selected as subjects are all instructors in the laboratories of the Industrial Engineering Department at Virginia Polytechnic Institute.

The data for these operators is given in Table II, Appendix.

4. Cameras

The moving picture cameras used in the investigation were Bedeaux Measurement Cameras, manufactured by Eastman Kodak Company. They are constant speed 8mm cameras, and operate at 1000 frames per minute, or 4000 frames per minute.

5. Analysis Projectors

The projectors used in analyzing the film were Model K-68 Keystone projectors fitted with a Porter Micromotion Conversion. This conversion, a Veeder-Root Counter, and electric control box, allowed the pictures to be projected consecutively at varying rates of speed, stopped, and reversed where desired. The Veeder-Root Counter is so geared as to count the number of individual pictures which are projected.

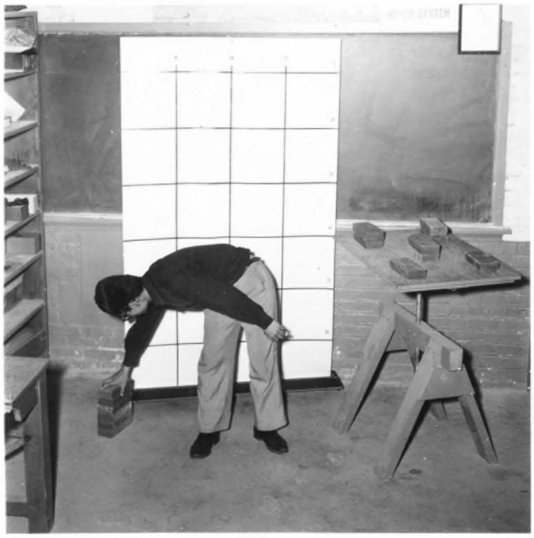


FIGURE 1. WORK PLACE LAYOUT
Operator is shown reaching for material on floor.

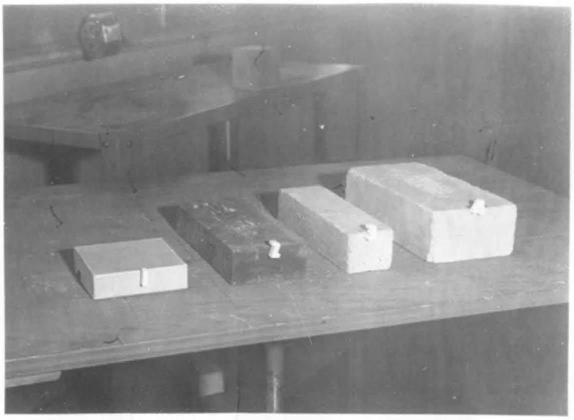


FIGURE 2. MATERIALS MOVED

C Method of Investigation

1. Preliminary Method

Motion pictures were made of five operators performing the Reaches and Moves. Four different sets of blocks, all of the same shape, with weights ranging from one ounce to 120 ounces were used. The blocks of the weight to be studied were set on the floor in stacks, and the blocks were moved consecutively to different points on the supply table, as shown in Figure 2.

A run is considered to be the reaching for and moving of a stack of blocks of one weight from the floor to the dispose table, by one operator. Operators 1, 2, and 3, made runs with each weight, and operators 4 and 5 made runs with weights numbers 2 and 4.

The laboratory conditions imposed were:

(1) The operators were to work at their normal pace.

(2) Operators were to work with the preferred hand only.

(3) The grasp of the block was to be as simple as possible.

(4) Positioning of the objects was to be kept at a minimum.

2. Analysis of the Films

The resulting films were analyzed by the use of the motion picture projector and were projected into a desk projection booth.

The analysis of the pictures was made according to standard micromotion techniques on the basis of motions as defined by the Methods-Time Measurement system. At the end of each motion, the counter readings and the type motion studied were recorded onto Loop Data Sheets. By subtraction of the counter reading of the end point of the motion studied from the end point of the preceding motion, the number of elapsed pictures was found. On the basis of the 1000 frames per minute camera speed, the actual time of the motion studied was found.

3. Collection of Other Data

The various distances for each reach and move were calculated from the plan of the setup, and checked by actual measurement, where possible.

4. Tabulation of Data and Results

The Data was collected, and recorded on a summary data sheet, as shown in Table III, Appendix.

5. Analysis of the Data

The object of this thesis is to examine the variables which affect the motions studied, and to find the relative importance among these variables. After much deliberation and consideration, it was decided that the following variables could possibly affect the time for each motion:

(a) Weight of object moved

(b) Amount of bend necessary to reach or move an object on or near the floor.

(c) The angle through which an operator would have to turn to reach for or place the object considered.

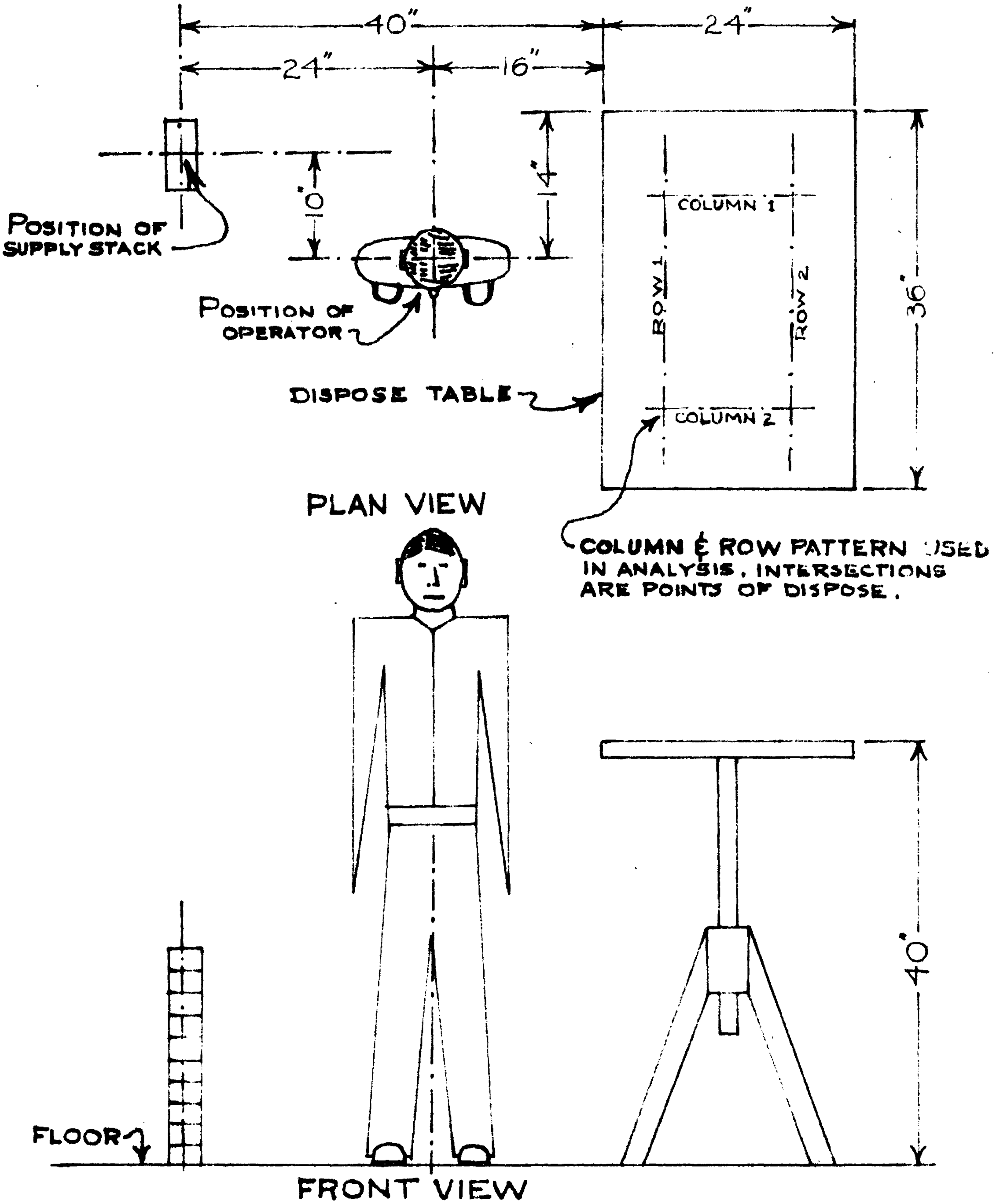
(d) The distance the operator would have to reach in placing the object, past the normal working distance.

(e) The height to which the object would have to be moved.

(f) The total distance required to move the object.

This investigation deals with only one dispose height; thus, we can consider number "d" above as a constant in our analysis. The experimental design did not include a variation of distance of stack to table, only a variation of distance due to the manner in which the blocks were placed on the table; thus, this factor was not included in the analysis.

The manner in which the experiment was set up did not lead to ease in analysis. Due to the fact that there was unbalance in number of operators per weight, number of cycles per run, and changes of pattern within one weight class, it was necessary to eliminate some of the data in the analysis. These difficulties were partially overcome by the use of a type of statistical treatment known as an analysis of a Factorial design.



WORK PLACE LAYOUT
SHOWING PATTERN AS USED IN ANALYSIS
FIGURE 3
SCALE: 1" = 1'4"

6. <u>Statistical Analysis</u>

To obtain a balanced design; that is, a design such that there is a one-to-one correspondence between operators in each weight class, and between all weight classes, it was necessary to limit the analysis to the blocks on the corners of the pattern. Thus, for one operator moving one weight, the corner blocks were selected for each layer. In all, a total of eight blocks for each run were analyzed. Figure 3 shows the layout, as used in analysis, and may be helpful in understanding the factors involved. In line with the variables theoretically considered, the following factors were analyzed:

(a) Weight of the object moved. Four levels of weight were considered in the analysis as given in section II-2.

(b) Operators. The operators were considered as variables in order to measure the different time levels associated with individual operators among the group. The five operators studied comprised the five levels under <u>Operators</u>.

(c) Bend. The amount that the operator had to bend to reach each block was not directly measurable. Therefore, to investigate Bend as a variable, it was necessary to select two levels in the stack of supply blocks. Thus, we are investigating the effect of different heights of supply stacks, or the cause for the variation in bends, and not the bends themselves.

(d) Row effect. The rows are defined by the position of the blocks on the dispose table. Row 1. is that row closest to the supply stack, and Row 2. is the row nearer the back edge of the table. The row effect is considered to be a measure of the amount of bend or reach that an operator has to perform in the placing of the block on the dispose table, and the analysis only covers the two levels as defined above.

(e) Column effect. The columns, like the rows, are defined by the position of the blocks on the table. Those blocks nearest the operator are defined as Column 1., and those farthest away are Column 2. Thus, it is seen that the column effect, or the effect on the time required for the motion due to placing blocks in column 1. over the effect of placing them in column 2, can be considered as some measure of the angle through which the operator has to turn to place the blocks.

The analysis was made by the standard method. (7)

Due to the inter-relationship between the factors, the main factors may combine to form variables. Thus, one operator may be suitably adapted to one weight, and another operator may be adapted to a different weight. It is this inter-relationship of main factors which we call interaction. Since there is a possibility that, even though the main factors considered do not vary significally within themselves, they may combine to form interactions which would vary significantly, it was decided to study both the second and third order interactions. As any interpretation of fourth or fifth order interactions is impossible, these were put into the error term. (8)

IV

DISCUSSION OF RESULTS

The results of the analysis of the data will be discussed in two parts; first, the results of analysis of the Move element, and secondly, the results of the analysis of the Reach element.

A. Move Accompanied by Body Rotation and Bend

The five main factors considered in the analysis were all statistically highly significant; that is, the chances were less than one in one thousand that the mean differences of time among the levels in each factor could have occurred by chance alone if the levels were the same. Thus, these factors may be considered as true variables.

The factor "Operator"shows this high variability. From this, it is safe to assume that the effects of different operators tested was large enough to demand a measure of the operators to be used for setting standards in order to give accurate time values for all workers. Hence, only the trends which were noted from the analysis will be given.

In the present Methods-Time Measurement system, move times for certain distances and types of moves are given, and these are corrected for the effect of weight of the object moved by a table of weight factors. These factors cover the range from zero to fifty pounds. In our investigation, the maximum weight moved was seven and one half pounds.

An attempt was made to see if the average time required per weight could be related to the weight itself. A regression analysis showed that there is a definite relation between weight and the time required to move the weight. This would seem to indicate that the factor method of correcting for various weights would be applicable in this set of motions also.

The factor with the highest variability among the levels was the Row effect. This effect is believed due to both the distance from the supply stack to the table, and the amount of "stretch" the operator had to exert in placing the blocks in the pattern. Since only one distance of supply stack to table was tested, then one might assume that this effect was due to the fact that the operator had to bend and stretch the upper part of his body in placing the blocks at the back edge of the table, while the placing of the blocks at the front edge of the table took place within a normal working distance.

The effect of layer, while still very highly significant statistically, showed the least amount of variability between the different levels. One possible cause of this might be that, in the investigation, the two levels used were (1) both fairly close to the floor, and (2) varied from weight to weight.

The effect of column, or some indication of the effect of the angle through which the body has to turn was also found to be statistically significant. Due to the square array of blocks in the pattern as analyzed, it is felt that this column effect is not a true angle effect, but a combined angle and row effect. This is due to the fact that the blocks in the outer column do not lie on a radius with the operator as the center, thus, the column effect is some function of both rows and angle. However, it is believed that this is not a serious handicap in the investigation.

Of the twenty interactions tested, five interactions involving OPERATOR as a factor were found to be statistically significant.

It is to be noted that the measure of variability used indicated that the OPERATOR-ROW interaction was zero. No interpretation of this phenomena has been advanced, except that it may be due to random chance variations.

The other interactions which could possibly be considered variables are listed in the Analysis of Variance for Move, Table 1.

B. Reach Accompanied by Body Rotation and Bend

Of the five main factors considered, the effect of COLUMN was the only one which was not found to be significant. These will be discussed in order.

The effect of WEIGHT was found to be highly significant. This effect seems paradoxical, as the operator is merely reaching for the weight, and does not lift it. It is felt that this effect is due to psychological factors such as motivation, attitude toward accuracy, attitude toward effect, etc. The weight effect did not appear to be a linear function, thus, making the application of "factors" impractical in the REACH case.

The COLUMN effect was found to be highly non-significant. This seems to indicate that the angle through which the body turns is not a variable over the range tested.

However, due to the manner in which angles are confounded with rows, this effect should be further investigated.

The effect of OPERATOR was found to be highly significant. This would seem to indicate again the correctness of the assumption that the variability of operators was too large to give concrete data for all operators.

The ROW and LAYER effects were both highly significant. Nine interactions were found to be significant.

The WEIGHT-OPERATOR interaction was found to be highly significant. This seems to indicate that different operators had different psychological attitudes toward the objects to be moved.

The other interactions are shown in the Analysis of Variance for Reach, Table II.

Table 1.

Analysis of Variance--Move Element

Source of Variability	Sum of Squares	Degrees of Freedom	Mean Square	Significance Level*
Weight	291.536	3	97.176	* * *
Operator	109.680	2	54.840	* * *
Layer	22.040	1	22.040	* * *
Row	150.002	1	150.002	* * *
Column	39.529	1	39.529	* * *
Weight-Operator	28.591	6	4.765	*
Weight-Layer	12.393	3	4.131	
Weight-Row	6.833	3	2.277	
Weight-Column	10.630	3	3.543	
Operator-Layer	11.385	2	5.692	*
Operator-Row	0.000	2	0.000	
Operator-Column	8.471	2	4.240	
Layer-Row	2.163	1	2.163	
Layer-Column	1.501	1	1.501	
Row-Column	3.372	1	3.372	
Weight-Operator-Layer	8.103	6	1.350	
Weight-Operator-Row	7.782	6	1.300	
Weight-Operator-Column	12.585	6	2.097	
Weight-Layer-Row	9.851	3	3.283	
Weight-Layer-Column	0.920	3	0.306	
Weight-Row-Column	10.651	3	3.550	
Operator-Layer-Row	2.921	2	1.460	
Operator-Layer-Column	6.763	2	3.381	
Operator-Row-Column	6.810	2	3.405	
Layer-Row-Column	0.141	1	0.141	
ERROR	42.372	29	1.461	
TOTAL	807.000	95		

*Following notation is used:

* * * - Significant, less than 0.1% level.
* * - Significant between 0.1% and 1.0% levels.
* - Significant between 1.0% and 5.0% levels.

Table 2.

Analysis of Variance--Reach Element

Source of Variability	Sum of Squares	Degrees of Freedom	Mean Square	Significance Level *
Weight	28.864	3	9.621	* * *
Operator	41.312	2	20.656	* * *
Layer	8.760	1	8.760	* *
Row	90.093	1	90.093	* * *
Column	0.010	1	0.010	
Weight-Operator	33.605	6	5.601	* * *
Weight-Layer	3.282	3	1.094	
Weight-Row	12.615	3	4.205	*
Weight-Column	1.032	3	0.344	
Operator-Layer	21.021	2	10.510	* * *
Operator-Row	0.063	2	0.031	
Operator-Column	21.021	2	10.510	* * *
Layer-Row	5.511	1	5.511	*
Layer-Column	0.261	1	0.261	
Row-Column	4.594	1	4.594	*
Weight-Operator-Layer	25.962	6	4.327	* *
Weight-Operator-Row	5.354	6	0.892	
Weight-Operator-Column	2.562	6	0.427	
Weight-Layer-Row	5.531	3	1.844	
Weight-Layer-Column	1.782	3	0.594	
Weight-Row-Column	2.765	3	0.922	
Operator-Layer-Row	0.432	2	0.216	
Operator-Layer-Column	3.152	2	1.576	
Operator-Row-Column	0.099	2	0.049	
Layer-Row-Column	0.751	1	0.751	
ERROR	24.722	29	0.853	
TOTAL	345.156	95		

*Following notation is used:

* * * - Significant, less than 0.1% level.

* * - Significant between 0.1% and 1.0% levels.

* - Significant between 1.0% and 5.0% levels.

V
CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

It is felt that the main value of this investigation may lie in its use as a basis for future research. Therefore, the conclusions will be a discussion of the results in connection with recommendation for future research.

There are several approaches one might take in an investigation of this type. The correct approach will depend on the object and the scope of the investigation. To thoroughly investigate the field; that is, to obtain the best standard time system and values, it will be necessary to first establish the best possible classification. Since this classification problem is the next logical step in the ultimate solution of the problem, the recommendations will be limited to that specific problem.

The classification of a time standard system will be based on two factors:

(1) Practicability of the system from a standpoint of consumer use, and

(2) the most accurate system within the above factor.

There are two types of measurements which may be used in the classification:

(1) The measurements made on the operators; that is, actual angle of bend, actual angle of body turn, etc.

(2) The physical measurements made on the setup, without regard to operator.

It is felt that in any classification attempt, both the best "theoretical" classification and the best "practical" classification should be found. Theoretical classification is meant to convey the idea of a classification system, using individual operator measurements. It would seem that between the two types of measurements available, the latter should be the most practical from a standpoint of consumer use. However, it is felt that classifications should be tried using operator measurements for use as a comparison of the accuracy of the system based upon setup measurement.

The micromotion techniques used in this investigation are well adapted to the problem. One of the main difficulties experienced was due to the deficiency of the experimenter in the proper use of the cameras. It is essential that the experimenter be experienced in the proper techniques of photography for maximum precision in the analysis of the films.

The selection of the operators in future research will have to be determined by two factors:

(1) Which operators, and (2) How many operators.

The problem of which operators to use is essentially a problem of definition of the population to which the results of the study will apply. It is anticipated that this definition of population will be one of the important decisions confronting the investigator in future researches along this line. The number of operators tested will, of course, have to be a compromise between the accuracy desired, and cost considerations.

Some of the variables which will have to be included in the classification have been studied herein. The results, in terms of probability levels, are given in Tables 1 and 2. It is sincerely hoped that this thesis will be of benefit to those who will engage in future research in this field.

VI

SUMMARY

The purpose of this study is to investigate the variables which are inherent in those reaches and moves accompanied by body bend and body rotation about hips and ankles. The variables, and the interactions between variables, are investigated and conclusions are given as to which variables would affect a time-standard classification.

VII

ACKNOWLEDGEMENT

The author wishes to express his appreciation to Professor Herbert L. Manning for the advice and guidance given throughout the course of this investigation.

The valuable advice given by Dr. Milton E. Terry, II, of the Statistics Department, aided materially in the analysis of the results and is deeply appreciated.

VIII

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APPENDIX

Appendix Table 1

Physical Properties of Materials

No.	Description of Material	Weight in Ounces	Dimensions in inches (L x W x H)	No. in Stack	Stack Height (inches)
1	Cardboard Box	1.0	4 x 4.00 x 1.11	21	23¼
2	Wood Block	13.0	8 x 3.63 x 1.63	14	23
3	"Soap" Fire Brick	43.2	8 x 2.19 x 1.99	12	23-7/8
4	Fire Brick	120.0	9 x 4.50 x 2.51	9	22-5/8

Note: Material dimensions are averaged over the number of blocks as given in "No. in Stack" column.

Appendix Table 2

Physical Properties of Operators

Description of Dimension	Operator Number				
	1	2	3	4	5
Sex	Male	Male	Male	Male	Male
Age, in years	27	25	39	38	29
Height from floor to top of head, in inches	69	67	70	68	$72\frac{1}{4}$
Height from floor to top of thigh bone at waist, in inches	$43\frac{1}{2}$	$38\frac{1}{2}$	42	$40\frac{1}{2}$	$43\frac{1}{4}$
Height from floor to tip of elbow, forearm at right angle to upper arm	$41\frac{1}{2}$	$39\frac{1}{2}$	$44\frac{1}{4}$	$41\frac{1}{4}$	44
Height from floor to flat surface at end of collar bone, in inches	$57\frac{1}{4}$	54	$57\frac{1}{4}$	56	$60\frac{1}{4}$
Length of arm, measured from knuckles to flat surface at end of collar bone, in inches	28	25	25	26	$27\frac{1}{2}$
Length of forearm, measured from knuckles to tip of elbow, in inches	14	13	14	13	$13\frac{1}{2}$
Shoulder width, measured over the outside ends of the flat surface of the collar bones, in inches	14	13	$14\frac{1}{2}$	13	15
Weight, in pounds	172	120	163	113	205

Appendix Table 3

Raw Time Data

A. Data for Move Element

Material No.	Row No.	Column No.	Layer No.	Raw Times for each Operator in 0.001 minute units				
				1	2	3	4	5
1	1	1	1	17	15	15	-	-
1	1	2	1	14	17	15	-	-
1	2	1	1	19	20	18	-	-
1	2	2	1	18	21	18	-	-
1	1	1	2	17	18	18	-	-
1	1	2	2	17	18	16	-	-
1	2	1	2	20	21	20	-	-
1	2	2	2	18	22	22	-	-
2	1	1	1	18	19	16	19	-
2	1	2	1	16	17	16	18	-
2	2	1	1	24	23	17	15	-
2	2	2	1	18	19	18	19	23
2	1	1	2	18	19	17	20	20
2	1	2	2	15	21	16	17	17
2	2	1	2	20	22	19	20	23
2	2	2	2	19	18	19	20	21
3	1	1	1	22	20	20	-	-
3	1	2	1	16	20	18	-	-
3	2	1	1	21	23	20	-	-
3	2	2	1	20	22	19	-	-
3	1	1	2	20	21	19	-	-
3	1	2	2	16	19	17	-	-
3	2	1	2	20	23	23	-	-
3	2	2	2	21	22	22	-	-
4	1	1	1	23	25	20	23	23
4	1	2	1	20	21	18	20	23
4	2	1	1	22	26	20	21	27
4	2	2	1	22	21	22	20	22
4	1	1	2	21	26	20	21	24
4	1	2	2	20	25	18	22	24
4	2	1	2	25	28	23	21	26
4	2	2	2	23	28	21	22	26

Appendix Table 3 - (Continued)

Raw Time Data

B. Data for Reach Element

Material No.	Row No.	Column No.	Layer No.	Raw Times for each Operator in 0.001 minute units				
				1	2	3	4	5
1	1	1	1	16-	18	15	-	-
1	1	2	1	17	16	16	-	-
1	2	1	1	19	19	16	-	-
1	2	2	1	17	18	18	-	-
1	1	1	2	17	14	16	-	-
1	1	2	2	16	16	17	-	-
1	2	1	2	21	18	20	-	-
1	2	2	2	18	20	22	-	-
2	1	1	1	21	16	14	17	17
2	1	2	1	17	15	15	15	17
2	2	1	1	18	15	15	17	-
2	2	2	1	18	16	17	18	24
2	1	1	2	17	16	16	18	17
2	1	2	2	16	16	15	16	19
2	2	1	2	19	17	17	17	20
2	2	2	2	18	17	17	18	21
3	1	1	1	18	17	14	-	-
3	1	2	1	15	17	16	-	-
3	2	1	1	19	19	16	-	-
3	2	2	1	20	20	17	-	-
3	1	1	2	16	17	16	-	-
3	1	2	2	15	17	16	-	-
3	2	1	2	19	20	17	-	-
3	2	2	2	19	20	18	-	-
4	1	1	1	21	16	15	15	20
4	1	2	1	17	16	15	14	21
4	2	1	1	21	18	16	15	23
4	2	2	1	20	19	17	16	18
4	1	1	2	17	20	17	15	20
4	1	2	2	17	20	16	-	-
4	2	1	2	20	20	17	17	22
4	2	2	2	18	23	19	19	23