

OMGT222

PRODUCTIVITY: STANDARDS AND MEASURES

WEEK 8: PREDETERMINED TIME SYSTEMS



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Learning Outcomes

- Describe PTS (Predetermined Time Systems)
- Describe the uses of PTS
- Describe the different forms of PTS
- Explain different MTM-2 categories
- Prepare and conduct a simple MTM-2 study

Predetermined time standards

- A **Predetermined time system (PTS)** is a work measurement technique whereby times established for basic human motions (classified according to the nature of the motion and the conditions under which it is made) are used to build up the time for a job at a defined level of performance
 - By examining a given operation, identifying the basic motions that make it up & referring to PTS tables which indicate standard times for each type of motion performed under given circumstances, you can derive the standard time for the operation a whole

Motion classification

- **PTS systems** provide information about manual work cycles in terms of basic human motions. There are two main sets:
 - The object-related classification is employed in the majority of PTS systems and almost all the data systems relating to main occupational groups or specifically designed for use within a plant, where reference may be made to the characteristics of parts, e.g. grasp a 6X6X6 mm object
 - The behaviour-related systems classify motions according to what they look like to an observer, e.g. a movement of the empty hand for a distance of between 5 and 15 cm followed by a grasping action made by a simple closing of the fingers defines the GET motion in the MTM-2 system

Origins of PTS

- Frank **Gilbreth** was the pioneer of motion classification whose “therblig” subdivisions of hand and hand & eye motions were the key concept in the development of motion study
- A considerable number and variety of PTS systems were produced during and following the Second World War. Among these was a system which has become very widely used throughout the world, Methods – Time Measurement (MTM)
 - **MTM-2** is a simplified form of MTM

Time and Motion Study – Lowry, Maynard, and Stegemerten – system performance rating

Uses of PTS

- Use of each system is unique to that system although the general procedure is similar
- Work elements of a job are analyzed and recorded on a left hand/right hand chart showing all motions
- This allows the analyst to study the method used and may help in method improvement
- Motions required to complete the work are identified and time is allowed for them based on the PTS system used
- PFD allowance is then applied to determine standard time

Advantages of PTS systems

- PTS systems offer a number of advantages over stop-watch time study. With PTS systems one time is indicated for a given motion, irrespective of where such a motion is performed
- A PTS system, which avoids both rating and direct observation, can lead to more reliability in setting standard times and are more acceptable to unions
- PTS systems are not too difficult to apply and can be less time consuming than other methods

Advantages of PTS systems

- Some PTS systems are particularly useful for very short repetitive time cycles such as assembly work in the electronics industry, while others are most suited for long cycle, low repetition jobs
- It is possible to define the standard time even in the design stage thus allowing refinements before production starts on the operation
- PTS systems are useful in providing information on learning time, developing learning curves and in determining cost data

Criticisms of PTS systems

- There are many different kinds of PTS systems in use, over 200 of them, and many are proprietary
- PTS systems are complicated and difficult to learn, especially if you have to learn several of these systems, and should only be used after training
- They cannot cope readily with movements under abnormal conditions, e.g. while wearing protective clothing or movements made in an abnormal position
- You cannot use PTS systems alone, since machine time, waiting time & other occasional elements still need to be measured by other techniques
- They may not be as accurate as time study

Examples of PTS systems

- **MODAPTS** (Modular Arrangement of Predetermined Time Standards) – relatively easy to use, used in industrial, office and material handling tasks
- **Work Factor System** - more commonly used system and is based on the principle that the time required to perform a fundamental motion is consistent. Additional time is needed based on
 - Body member used
 - Distance moved
 - Degree of manual control required
 - Weight or resistance varies with body member used and sex of operator

Examples of PTS systems

- **Methods Time Measurement (MTM)** – most widely used PTS system
- Has several different forms like MTM-1, MTM-2, etc. for various applications
- We will be using MTM-2 for the balance of the course
- The **time unit** for all MTM systems is a **tmu** (time measurement units), which represents one hundred-thousandth of an hour or 0.0006 minutes or 0.036 seconds

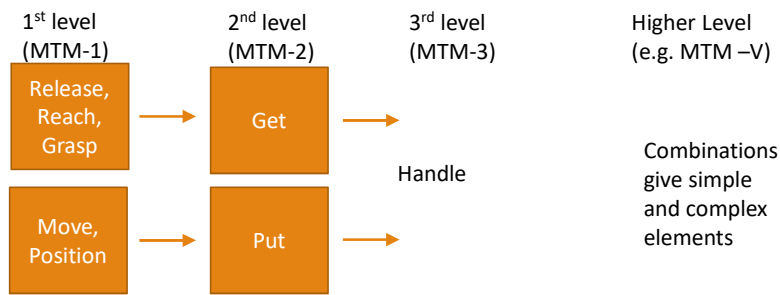
Scope of application of data

Table 21. Scope of application data

Degree	PTS system	Scope of application
1- Universal	MTM-1, 2, 3; Work Factor	Transferable throughout the world and applicable in all manual work areas
2- General	Master Clerical Data (office) MTM-V (machine shops)	Transferable but within a work area
3- Specific	Standard data for particular departments in a plant	Not transferrable without validation studies

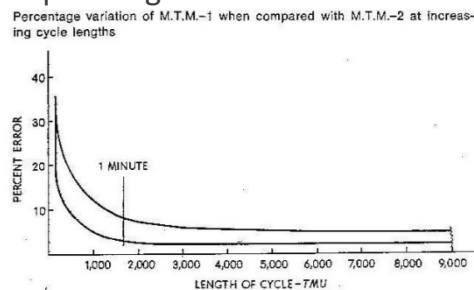
Different forms of PTS systems

Figure 130. PTS data levels: Basic Motions



When can MTM-2 be used

- MTM-2 can be used if:
 - Cycle time > 1600 TMU (1 min, with $\pm 5\%$ accuracy)
 - Cycle is not highly repetitive
 - No complex finger motions are involved



MTM-2 system

The system most likely to be used by the work study person is MTM-2. The following categories constitute the MTM-2 system:

Category	Code
GET	GA, GB, GC
PUT	PA, PB, PC
REGRASP	R
APPLY PRESSURE	A
EYE ACTION	E
FOOT MOTION	F
STEP	S
BEND AND ARISE	B
WEIGHT FACTORS	GW, PW
CRANK	C

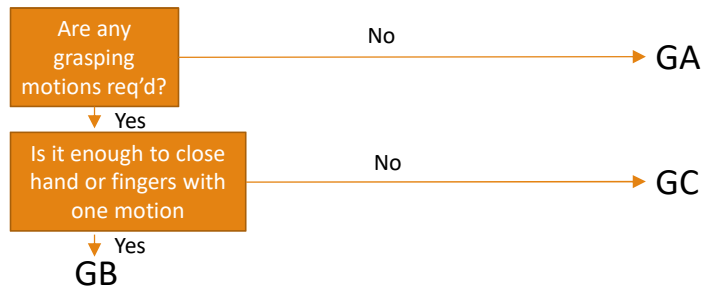
“MTM and BSI rating scale”, in Work Study Management Services (London), Feb. 1969, p97

GET (GA, GB or GC)

- **GET (G)** is an action with the predominant purpose of reaching out with the hand or fingers to an object, grasping the object and then releasing it
 - Scope of GET
 - **Starts:** with reaching out to object
 - **Includes:** gaining control & subsequently releasing control of the object
 - **Ends:** when object is released
 - Need to consider 3 variables in selection of GET:
 1. Case of GET, distinguished by grasping action
 2. Distance reached
 3. Weight of object or its resistance to motion

GET (GA, GB or GC) – cont'd

- Cases of GET are judged by the following:



Examples:

GA, putting palm of hand to side of box to push it across a table

GB, getting an easy to handle object like an 1" cube which is lying by itself

GC, getting the corner of a page of a book to turn it over

GET (GA, GB or GC) – cont'd

- Distance Variable

cm Over	cm Not over	Code
0.0	5.0	-- 5
5.0	15.0	--15
15.0	30.0	--30
30.0	45.0	--45
45.0	-	--80

GET WEIGHT (GW)

- **GET WEIGHT (GW)** is the action required for muscles of the hand and arm to take up weight of the object
 - **Scope of GET WEIGHT**
 - **Starts:** with the grasp on the object completed
 - **Includes:** muscular force necessary to gain full control of the weight of the object
 - **Ends:** when object is sufficiently under control to permit movement of the object
 - GET WEIGHT occurs after the fingers have closed on the object in the preceding GET. It must be accomplished before any movement can take place
 - No GW when weight or resistance is < 2Kg/hand, otherwise 1tmu is assigned per Kg (incl. first 2 Kg)

MTM-2 data card

Time in tmu						
Code	GA	GB	GC	PA	PB	PC
-5	3	7	14	3	10	21
-15	6	10	19	6	15	26
-30	9	14	23	11	19	30
-45	13	18	27	15	24	36
-80	17	23	32	20	30	41
GW: 1 per 1 kg				PW: 1 per 5 kg		
A	R	E	C	S	F	B
14	6	7	15	18	9	61

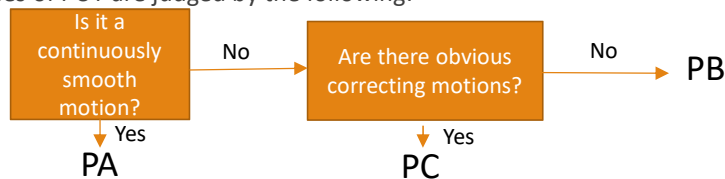
Warning: Do not attempt to use these data unless you have been trained and qualified under a scheme approved by the International MTM Directorate

PUT (PA, PB or PC)

- **PUT (P)** is an action with the main purpose of moving an object to a destination with the hand or fingers
 - **Scope of PUT**
 - **Starts:** with an object grasped & under control at initial place
 - **Includes:** all transporting & correcting motions necessary to place an object
 - **Ends:** with object still under control at destination
 - **Need to consider 3 variables in selection of PUT:**
 1. Case of PUT, distinguished by correcting motions employed
 2. Distance moved
 3. Weight of object or its resistance to motion

PUT (PA, PB or PC) – cont'd

Cases of PUT are judged by the following:



- An example of PA is tossing aside an object
- An example of PB is the action of putting a 12 mm ball in a 15 mm diameter hole
- An example of PC is inserting a Yale or similar key in a lock
- A correction is not likely to be confused with a short PA. A correction is a very short unintentional motion at the terminal point; a PA is purposive, usually of easily discernible length
- The motion distance is handled in a similar manner to GET
- When there is an engagement of parts following a correction, an additional PUT will be allowed when the distance exceeds 2.5 cm.

PUT WEIGHT (PW)

- PUT WEIGHT (PW) is an addition to a PUT motion depending on the weight of the object moved
- Scope of PUT WEIGHT
 - **Starts:** when the move begins
 - **Includes:** the additional time, over & above the move time in PUT, to compensate for additional time required in moving heavy objects over the same distance
 - **Ends:** when the move ends
- PW assigned when resistance to movement >2Kg/hand
- 1 tmu for PW5 for 2-5Kg, 2 tmu for PW10 for 5-10Kg, etc.

REGRASP (R)

- **REGRASP (R)** is a hand action with the purpose of changing the grasp on an object (6 tmu)
 - Scope of REGRASP
 - **Starts:** with the object in the hand
 - **Includes:** digital & hand muscular readjustment on an object
 - **Ends:** with the object in new location in the hand
 - A single REGRASP consists of no more than three fractional movements

REGRASP (R) – cont'd

- Digital & muscular readjustments, while performing an APPLY PRESSURE are included in APPLY PRESSURE & a REGRASP should not be assigned in combination with APPLY PRESSURE
- If the hand relinquishes control & then secures another grasp on the object, the action will be a GET & not a REGRASP
- An example of R is changing the grasp on a pencil in order to get into the position for writing

APPLY PRESSURE (A)

- APPLY PRESSURE (A) is an action with the purpose of exerting muscular force on an object (14 tmu)
 - Scope of APPLY PRESSURE
 - **Starts:** with the body member in contact with the object
 - **Includes:** the application of controlled increasing muscular force, a minimum reaction time to permit the reversal of force and the subsequent releasing of muscular force
 - **Ends:** with the body member in contact with the object, but with the muscular force released

APPLY PRESSURE (A) – cont'd

- APPLY PRESSURE is the action of exerting muscular force on an object
 - To achieve control, to restrain or overcome resistance to motion
 - The object is not displaced more than 6 mm during this action
 - Over a short time period but longer than a GET or PUT
 - Can be performed by any body member & is recognized by a noticeable hesitation when force is applied
 - An example is pushing a button or a final tightening action with a screwdriver or wrench

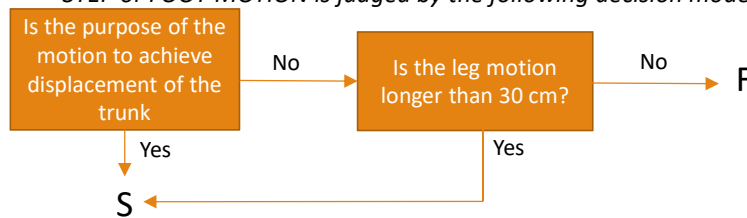
EYE ACTION (E)

- EYE ACTION (E) is an action with the purpose of either: recognizing a promptly distinguishable characteristic of an object or shifting the aim of the axis of vision to a new viewing area (7 tmu)
 - To recognize an object, no mental time other than simple perception
 - Shift line of vision to new area, normal area of vision is 10 cm circle at 40 cm
 - Do not overdo, GETs and PUTs have E already included
 - Example of E is determining if a coin is showing head or tail

FOOT MOTION (F)

- FOOT MOTION (F) is a short foot or leg motion when the purpose is not to move the body (9 tmu)
 - Short foot or leg motion, less than 30 cm, where the purpose is not to move the body
 - e.g., move the foot to activate a pedal

STEP or FOOT MOTION is judged by the following decision model:



STEP (S)

- STEP is either a leg motion with the purpose of moving the body or a leg motion longer than 30 cm (18 tmu per step)
 - Scope of STEP
 - Starts: with the leg at rest
 - Ends: with the leg at the new location
 - e.g., making a single step to the side to enable the arm to reach further
 - To evaluate walking, count the number of times the foot hits the floor

BEND AND ARISE (B)

- BEND AND ARISE is a lowering of the trunk followed by a rise (61 tmu)
 - Vertical displacement of the body
 - Bend, stoop, kneel on one knee
 - The criterion is that, with this motion, you are able to reach below the knee even if you do not actually do so
 - Kneeling on both knees = 2B

CRANK (C)

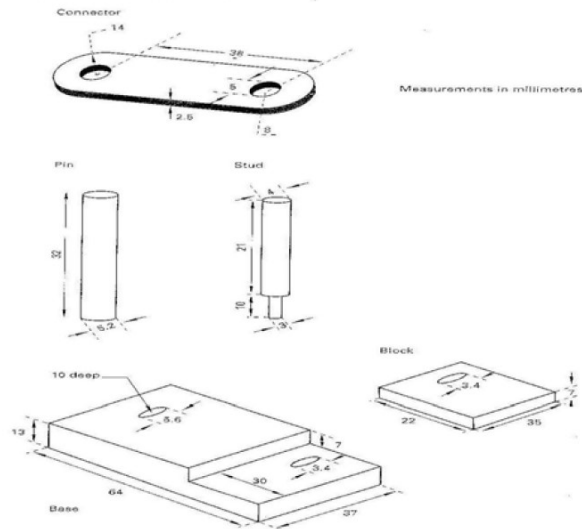
- CRANK is a motion with the purpose of moving an object in a circular path of more than half a revolution with the hand or finger (15 tmu per revolution)
 - Hand/fingers move object in circular path $> \frac{1}{2}$ revolution
 - If $< \frac{1}{2}$ revolution, use G and P
 - May also need GW, to overcome initial friction, one value of GW for a continuous set of revolutions or one value for each intermittent revolution
 - May also need a PW for sticky crank, one value of PW per revolution
 - Weight or resistance affects the value of GW & PW
 - Example of C is turning a hand wheel through one revolution

- Use MTM Methods Analysis Chart

- Summarize motions
- Consider special cases:
 - Principle of simultaneous motion – simultaneous difficult [C] motions can not be done as quickly as with one hand only, add a penalty
 - Principle of limiting motion - for two different times for each hand, use longer one
 - Principle of combined motion - for two combined motions in one hand, use longer time
 - R as part of GC or PC is not counted
- Add TMUs (ratings are included) & convert to minutes
- Add allowances as in Time Study to get standard time

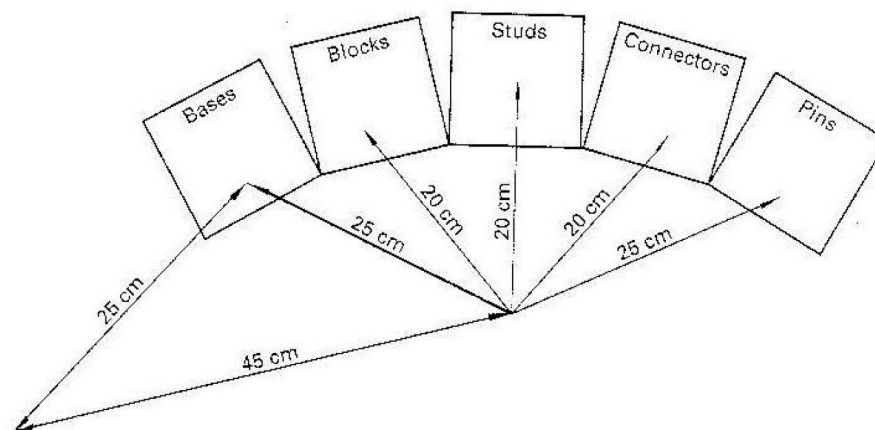
Example: Base assembly

Figure 131. Base assembly



Base assembly workplace layout

Figure 132. Base assembly workplace layout



Base assembly instructions

- Assemble Base assembly as follows:
 - Use LH to get Base from the box & place it on the bench and use RH to get Pin from its box & place it on the Base
 - Get a Block from the box with LH while getting a Stud from its box with RH & locate the stud through the Block
 - Fit the Block-Stud assembly to the Base with the RH with the LH assisting
 - Get a Connector from its box with RH & locate to Stud with LH assisting & then locate it to Pin with LH
 - Pick up finished base assembly with LH and place it on the conveyor

Base assembly MTM-2 analysis sheet

Time in tmu				MTM-2 data card		
Code	GA	GB	GC	PA	PB	PC
-5	3	7	14	3	10	21
-15	6	10	19	6	15	26
-30	9	14	23	11	19	30
-45	13	18	27	15	24	36
-80	17	23	32	20	30	41
GW: 1 per 1 kg				PW: 1 per 5 kg		
A	R	E	C	S	F	B
14	6	7	15	18	9	61

MTM-2 analysis sheet, base assembly

MTM Methods Analysis

Page: 1 of 1

Operation: Assemble Base		Remarks: See sketches of parts and layout				
Study No.:						
Date: 20 / 02 / 2020						
Analyst:						
Description	No.	LH	TMU	RH	No.	Description
Get base from box		GC30	23	G-		Get pin from box
			14	GC5		
Put base on bench		PA30	30	PC30		Locate pin to base
Get block from box		GC30	23	G-		Get stud from box
			14	GC5		
Move block stud		P-	30	PC30		Locate stud through block
Assist location		P-	26	PC15		Fit assembly to base
			23	GC30		Get connector from box
Assist location		GB-	30	PC30		Locate to stud
Locate to pin		PC5	21			
Pick up assembly		GC15	10			
Place on conveyor		PA80	20			
			264			

Bolt-Washer-Nut Assembly



That's it for today!

If you have not read the Chapter 7 please do it soon.

Next week: Chapter 8 – Work Sampling

Questions?
Comments?



By Mauro Spies