



Predetermined Motion Time Systems

Sections:

1. Overview of Predetermined Motion Time Systems – **part 1**
2. Methods-Time Measurement – **part 2**
3. Maynard Operation Sequence Technique



PMTS Defined

- Problem with DTS:
 - involves performance rating
 - this's based on judgment by time study analyst
 - disagreement can occur between worker doing task and analyst
- Alternative to DTS is predetermined motion time systems (PMTS)
 - doesn't involve PR step



PMTS Defined

- **General:** A *database* of basic motion elements and their associated *normal time values*, together with *procedures* for applying the data to *analyze manual tasks* and establish *standard times* for the tasks
- **ANSI definition:** organized body of *information, procedures, techniques, and motion times* employed in the study and evaluation of *manual work elements*. The system is expressed in terms of the *motions used*, their general and specific *nature*, the *conditions* under which they occur, and their previously determined *performance times*



PMTS Defined

- PMTS database involves:
 - set of tables listing time values
 - values correspond to basic motions elements
 - determined based on extensive research of manual work activity
 - based on frame-by-frame analysis of motion pictures of activity
- BME's include:
 - Reach
 - Grasp
 - Move
 - Release (and others)



PMTS Defined

- Time required to perform BME depends on certain work variables
 - e.g. time to reach object increases with the distance of reach
 - e.g. time to move object depends on its weight and distance moved
- Contents of chapter:
 - General discussion of PMTS [1]
 - Two important examples of PMTS:
 - Methods-time measurement (MTM) [2]
 - Maynard Operation Sequence Technique (MOST) [3]*



Predetermined Motion Time Systems

1. Overview of Predetermined Motion Time Systems



1.1 PMTS Procedure

- Overview of PMTS
 - applying PMTS procedure to a task
 - use to determine T_{std} for a task:
 - before task is in production, or
 - for an existing task
 - PMT systems
 - differences among them
 - how they can be classified



PMTS Procedure

- All PMT systems use same procedure (4 steps)
 - differences are in details
- 1. **Synthesize method** used to perform the task
 - method is described i.t.o. BME's,
 - based on workplace layout and set of tools*
- 2. Retrieve **T_n values** for each BME
 - This is based on:
 - work variables, and
 - conditions under which BME is performed
 - \sum element times for all BME's to find task T_n



PMTS Procedure

3. Evaluate method to make improvements

- Result: reducing T_n
- Achieved by:
 - Eliminating motions,
 - Reducing distances,
 - introducing special tools,
 - using simultaneous right/left hand motions,
 - etc.
- This requires:
 - detailed listing of BME's
 - corresponding time values



PMTS Procedure

4. Apply allowances to **determine** T_{std}
- Note, may be omitted if emphasizing methods improvement only
 - Also, basic time values in PMT systems do not include any allowances
 - \Rightarrow organization must add P , F , D allowances (according to its policies)
 - Usual equation is used to find T_{std} :
$$T_{std} = T_n (1 + A_{pfd})$$
 - T_{std} : standard time (T_{std} and T_n in *min*)
 - T_n : normal time (\sum BME time values for task*)
 - A_{pfd} : *PFD* allowance



1.2 PMTS Levels and Generations

Various levels of PMT systems:

- First-level PMT Systems: use BME's
 - e.g. reach, grasp, and move used separately to define the task
- Higher-level systems: combine several motion elements into ***motion aggregates***
 - motion aggregates: combined “motion sequences” commonly used in work situations
 - e.g. ***reach*** and ***grasp*** combined into one element called ***get*** (used assembly work)



PMTS Levels and Generations

- Times in PMTS Levels:
 - First-level PMTS's:
 - very detailed
 - body motions differentiated very precisely
 - e.g. *reach* and *grasp* distinguished as 2 separate motion elements
 - \Rightarrow times for BME's: v. short (may be $< 1s$)
 - Higher-level systems
 - use condensed databases
 - fewer body motions (contained in tables)
 - \Rightarrow longer times for each motion sequence
 - tables: simplified, with fewer work variables



PMTS Levels and Generations

- PMTS Generations:
 - First-level PMTS's:
 - chronologically: 1st to be developed \Rightarrow called 1st gen. PMTS (e.g. MTM-1)
 - *see reading handout*
 - Second- and higher-level systems:
 - constructed based on first-level systems
 - called 2nd and 3rd generation systems
 - e.g. MTM-2 (based on MTM-1) and MTM-3



PMTS Levels and Generations

- Characteristics of PMT system levels (Table 1)
 - First-level PMTS's:
 - long lists of elements
 - long time to set standard for task
 - \Rightarrow high “application speed ratio”
 - e.g. for MTM-1: time to set std $\cong 250 * T_{task}$
 - e.g. for $T_{task} = 1 \text{ min} \Rightarrow T_{set-std} > 4 \text{ hr}$
 - Second- and higher-level systems:
 - require less application time
 - e.g. MTM-2: $T_{set-std} \cong 100 * T_{task}$
 - \Rightarrow more convenience, but less accuracy



Comparisons

First-level PMTS

Most accurate

High application speed
ratio

Most suited to highly
repetitive short cycles

Basic motion elements

Very detailed

Highest flexibility

Higher-level PMTS

Less accurate

Less time to set
standards

Longer cycle times
feasible

Motion aggregates

Less detailed

Less flexible



PMTS Levels and Generations

- PMT Systems:
 - > 50 PMTS's developed over the years
 - Table 2:
 - brief description of major PMT systems
 - focuses on those commercially used today
 - Most systems no longer used
 - Most widely used PMTS: based on MTM
 - Note, MOST*:
 - widely used higher-level PMTS
 - based on MTM



TABLE 2 Summary of Predetermined Motion Time Systems

Motion-Time Analysis (MTA): A first-level system developed by A. B. Segur in the mid- and late 1920s. Its primary importance today stems from the fact that it was the first PMTS to be developed and applied. Today it is seldom used if at all. There are 17 basic motion elements in MTA, involving one or more body movements. The elements are classified as positive (considered useful to the task), negative (motions that should be reduced or eliminated), or either (might be positive or negative).

Work-Factor (WF): A first-level PMTS developed by J. H. Quick, W. J. Shea, and R. E. Koehler in the mid-1930s, with applications starting in 1938. It is still used today and at least one simplified version has been developed to reduce application time. Coverage includes both factory and office work.

Methods-Time Measurement (MTM): Developed by H. B. Maynard, G. J. Stegemerten, and J. L. Schwab in the mid-1940s. The original MTM was a generic, first-level system published as a book in 1948. Today, that original PMTS is known as MTM-1, and several higher-level and specific PMT systems have been developed based on MTM-1. We describe the MTM family in Section 2.

Basic Motion Timestudy (BMT): Developed by R. Presgrave, G. B. Bailey, and J. A. Lowden in the early 1950s. Its initial applications were in 1952, and it was published in book form in 1958. It is considered a first-level system, but some of its motion elements are combinations of therbligs. At least one second-level PMTS has been developed based on BMT.

Master Standard Data (MSD): One of the first second-level systems. It is based on MTM-1 and was developed in Canada by R. M. Crossan and H. W. Nance in the late 1950s (published as a book in 1962) to reduce the analyst's time needed to set a time standard for manual production operations with fewer than 100,000 cycles per year. Its coverage emphasizes reach-grasp-move-release motions that are common in such operations.

Maynard Operation Sequence Technique (MOST): Developed by K. B. Zandin and others at the Swedish Division of H. B. Maynard Company as a higher-level PTMS based on MTM-1 and MTM-2. Its coverage emphasizes production operations and material handling. We describe MOST in Section 3.

Modular Arrangement of Predetermined Time Standards (MODAPTS): A second-level PTMS developed by C. Heyde and others in Australia during the mid-1960s. It is based on MSD, MTM-1, and MTM-2. The basic motion element in MODAPTS is a finger movement, and other body motions are expressed in terms of this element. Coverage includes production operations and material handling, with a special version covering office work.