Time Study and Work Measurement

Part III

Chapters:

12. Introduction to Work Measurement
13. Direct Time Study
14. Predetermined Motion Time Systems
15. Standard Data Systems
16. Work Sampling
17. Computerized Work Measurement and Standard Maintenance
18. Economic Justification and Applications of Time Standards
19. Learning Curves

Work Systems and the Methods, Measurement, and Management of Work
by Mikell P. Groover, ISBN 0-13-140650-7.

Introduction to Work Measurement

Chapter 12

Sections:

1. Time Standards and How They Are Determined
2. Prerequisites for Valid Time Standards
3. Allowances in Time Standards
4. Accuracy, Precision, and Speed of Application in Work Measurement

Work Systems and the Methods, Measurement, and Management of Work
by Mikell P. Groover, ISBN 0-13-140650-7.

Time Is Important

- Most workers are paid for their time on the job
- The labor content (cost of labor time) is often a major factor in the total cost of a product or service
- For any organization, it is important to know how much time will be required to accomplish a given amount of work

introduction

- Time is important in work measurements according to its economics significations
- For an organizational to operate effectively and efficiently its important to know how much time should be required to accomplish a given amount of work.
- Time study and work measurement are both concern with how much time it should take to complete a unit of work.

Introduction

- Work measurement refers to a set of four techniques concerned with the evaluation of a task in terms of the time that should be allowed for an average human worker to perform that task:
  - Direct time study
  - Predetermined motion and time system
  - Standard data system
  - Work sampling

Introduction

- The objective of work measurement techniques is to determine ***standard time*** for the task.
- ***Work measurement*** focuses on human work effort
- ***Time study*** refers to all of the ways in which time is investigated and analyzed in work situations.(worker or automated system), it include the learning curve phenomenon

Some Definitions

- Work measurement – evaluation of a task in terms of the time that should be allowed by an average worker to perform the task
- Standard time – amount of time that should be allowed for an average worker to process one work unit using the standard method and working at normal pace
- Time study – all the ways in which time is analyzed in work situations

Determining standard time:

- Standard time for a given task is the amount of time that should be allowed for an average worker(100% performance) to process one work unit using the standard method and working at normal pace (not slow or fast).
- Standard time referred to the **allowed time** also.
- **Allowance time**: an additional time to the standard time provides the workers personal needs, fatigue, and unavoidable delays during shifts.

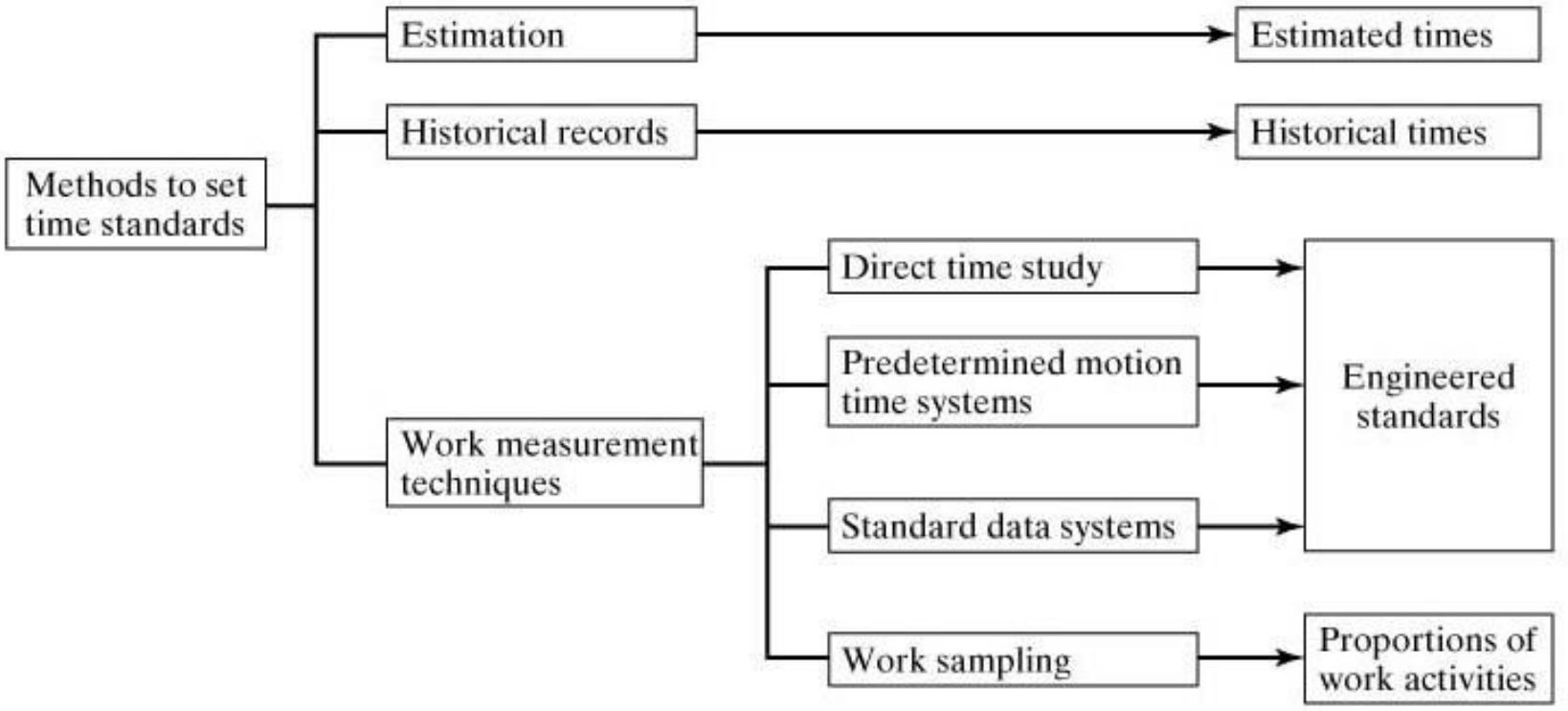
When Are Time Standards Beneficial?

- Characteristics of industrial situations in which time standards would be beneficial
  - Low productivity
  - Repeat orders
  - Long production runs
  - Repetitive work cycles
  - Short cycle times

Functions of Time Standards

- They define a “fair day’s work”
- They provide a means to convert workload into staffing and equipment needs
- They allow alternative methods to be compared objectively
- They provide a basis for wage incentives and evaluation of worker performance
- They provide time data for:
  - Production planning and scheduling
  - Cost estimating
  - Material requirements planning

Methods to Determine Time Standards



Methods to determine time standards.

- Estimation: asking the person familiar with the job about the time that should be allowed to perform the work (estimator judgment),least accurate technique.

- Historical records: of previous production runs. the time standard is determined from the actual time of previous identical or similar job orders. Limitation :no indication of the efficiency of the work accomplished.

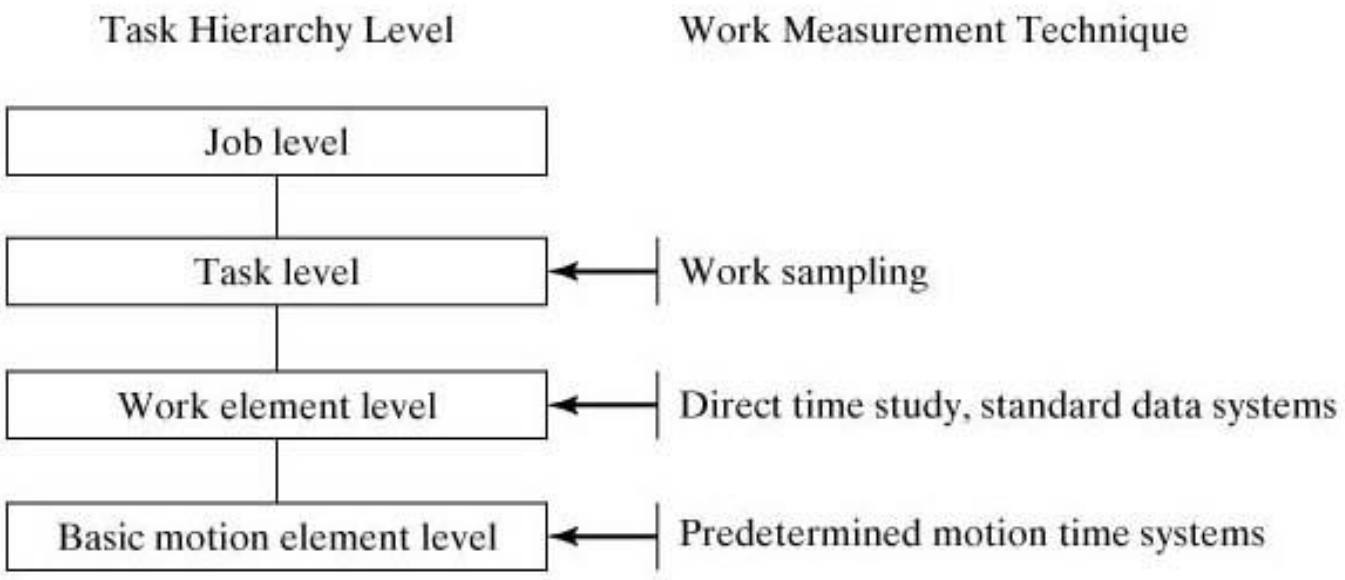
Methods to determine time standards.

- Work measurement technique: The most accurate techniques but more time to implement.
- these are the four techniques of evaluation of tasks in terms of time allowed for the worker to perform a task.(direct time study, predetermined motion time system, standard data system, work sampling.

Work Measurement Techniques

- Direct time study (DTS)
- Predetermined motion time system (PMTS)
  - Performance rating is not required
  - Can be applied to determine the time standard for a task before production
- Standard data systems (SDS)
- Work sampling

Task Hierarchy & Work Measurement

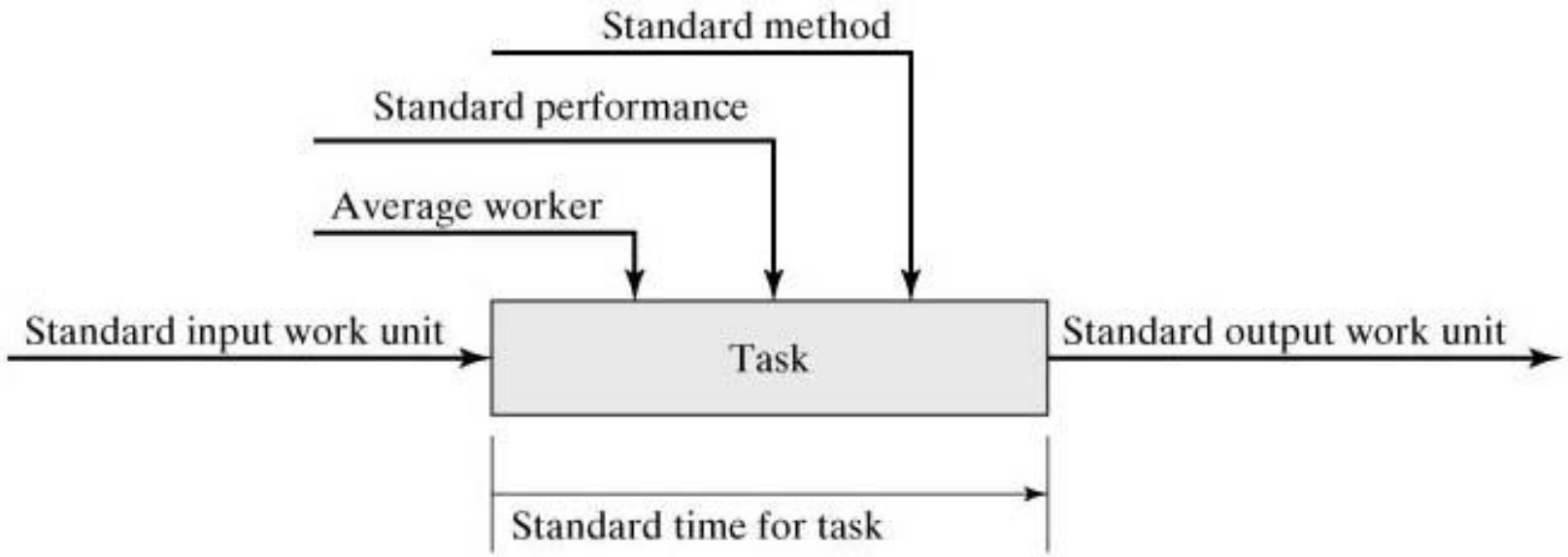


Computerized Work Measurement

- Facilitates collection of data
- Performs routine computations
- Organizes time standards files and databases
- Retrieves data in predetermined motion time systems and standard data systems
- Assists in the preparation of the documentation
  - Methods descriptions
  - Reports

Prerequisites for Valid Time Standards

Factors that must be standardized before a time standard can be set



Average Worker

A worker who is representative of the persons who usually perform tasks similar to the task being measured

- If the work is performed mostly by men, then the average worker is male
- If the work is performed mostly by women, then the average worker is female

Standard Performance

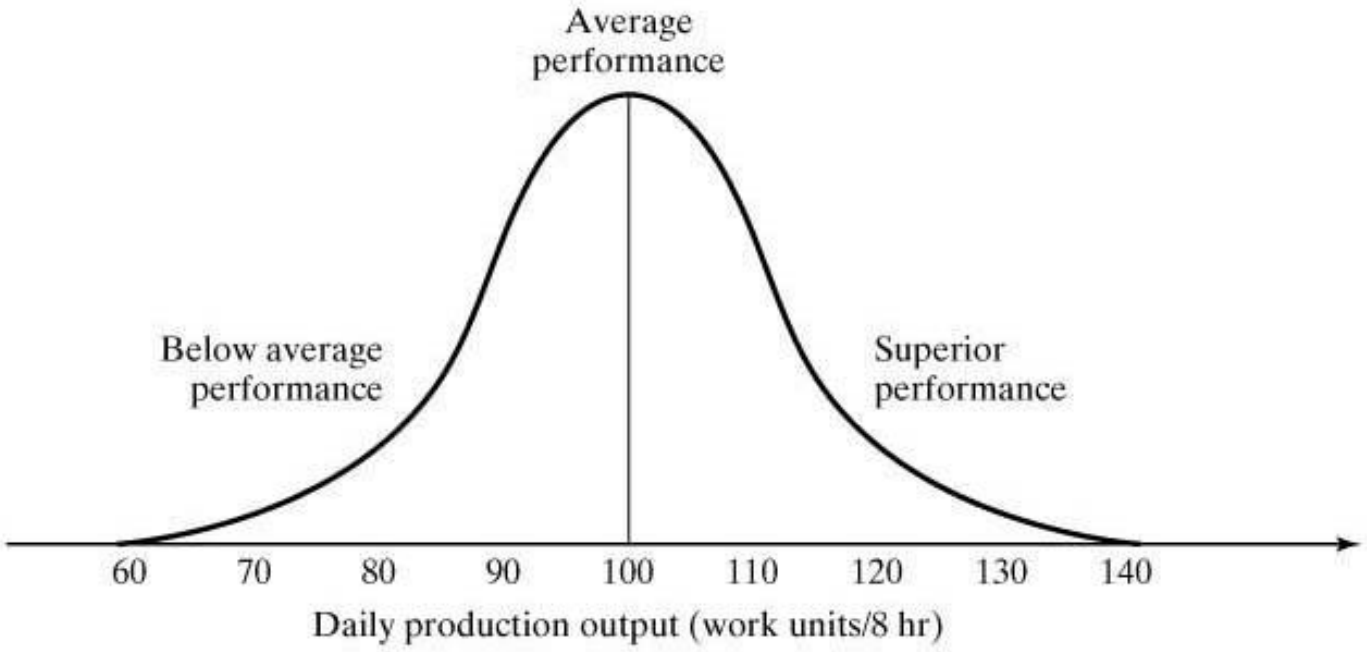
A pace of working that can be maintained by an average worker throughout an entire work shift without harmful effects on the worker's health or physical well-being

- The work shift includes periodic rest breaks and occasional interruptions are experienced by the worker
- Benchmarks of standard performance:
  - Walking at 3 miles/hr on level flat ground
  - Dealing four hands of cards from a 52 card deck in exactly 30 sec

Work Systems and the Methods, Measurement, and Management of Work
by Mikell P. Groover, ISBN 0-13-140650-7.

Distribution of Worker Performance

Worker performance is expressed in terms of daily output

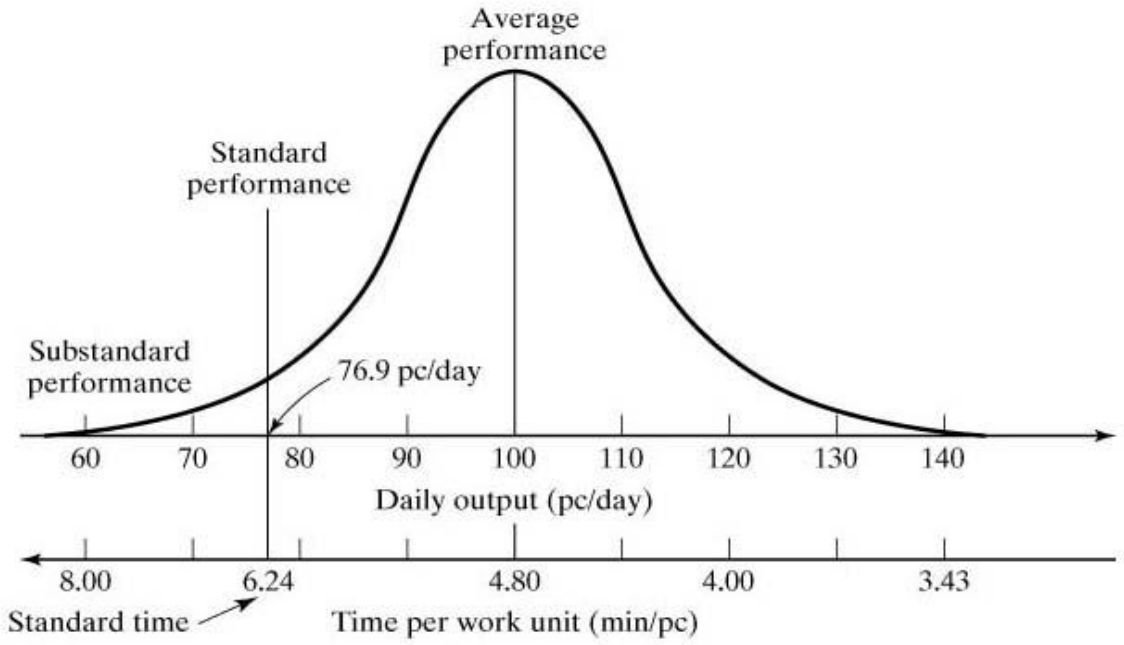


More on Standard Performance

- Standard performance is commonly defined to be a pace that can be readily attained by the majority of workers
  - A typical policy is to define standard performance so that an average worker is able to work at a pace that is 130% of that pace
    - Thus, most workers are able to easily achieve standard performance

How a Standard Time is Defined

Distribution of worker performance, indicating how standard time is defined so that it can be readily achieved by most workers



Work Systems and the Methods, Measurement, and Management of Work
by Mikell P. Groover, ISBN 0-13-140650-7.

Standard Method

- Must include all of the details on how the task is performed, including:
  - Procedure - hand and body motions
  - Tools
  - Equipment
  - Workplace layout
  - Irregular work
  - Working conditions
  - Setup

Standard Work Units

- The time needed to process the work unit depends on its starting condition
  - Therefore this condition must be specified
  - If the actual condition deviates from the specification, then extra time may be required to accomplish the task
- Exactly what changes are made in the work unit by the task?
- What is the final state of the completed work unit?

Allowances in Time Standards

- Normal time is adjusted by an allowance factor A_{pfd} to obtain the standard time
- Purpose of allowance factor is to compensate for lost time due to work interruptions and other reasons
- Standard time:

$$T_{std} = T_n(1 + A_{pfd})$$

where pfd = personal time, fatigue, and delays

Reasons for Lost Time at Work

Work-related interruptions

- Machine breakdowns
- Waiting for materials or parts
- Receiving instructions from foreman
- Talking to co-workers about work-related matters
- Rest breaks for fatigue
- Cleaning up at end of shift

Non-work-related interruptions

- Personal needs (e.g., restroom breaks)
- Talking to co-workers about matters unrelated to work
- Lunch break
- Smoke break
- Beverage break
- Personal telephone call

Work Systems and the Methods, Measurement, and Management of Work
by Mikell P. Groover, ISBN 0-13-140650-7.

How to Allow for Lost Time

- Two approaches used by companies:
  1. Scheduled rest breaks during the shift
     - Typical - one 15-minute break in mid-morning and another in mid-afternoon
  2. A PFD allowance is added to the normal time
     - This allows the worker to take a break on his/her own time

PFD Allowance

- Personal time
  - Rest room breaks, phone calls, water fountain stops, cigarette breaks (5% typical)
- Fatigue
  - Rest allowance to overcome fatigue due to work-related stresses and conditions (5% or more)
- Delays
  - Machine breakdowns, foreman instructions (5% typical)

Other Types of Allowances

- Contingency Allowance
  - Additional allowance due to a problem with the task (e.g., raw material problem) - not greater than 5%
  - Temporary basis – solve the underlying problem
- Policy allowance
  - Machine allowance (set by company policy)
- Training allowance – for teaching new workers
- Learning allowance – learning a new task

Contingency Allowances

Problem area	Problems and examples
Materials or parts	Starting materials or parts are out of specification, and extra time is needed to correct the nonconformance (e.g., oversized casting that requires an extra machining pass or slower feed rate).
Process	Manufacturing process is not in statistical control (Section 10.2), and additional time is required to inspect every piece rather than inspect on a sampling basis.
Equipment	Equipment is malfunctioning or breaking down more frequently than what is provided by the unavoidable delay factor, and additional time is needed to compensate the worker to make adjustments, lubricate the machine more frequently, or other extra task(s) not included in the standard time.

Measurement

A procedure in which an unknown quantity is compared to a known standard, using an accepted and consistent system of units

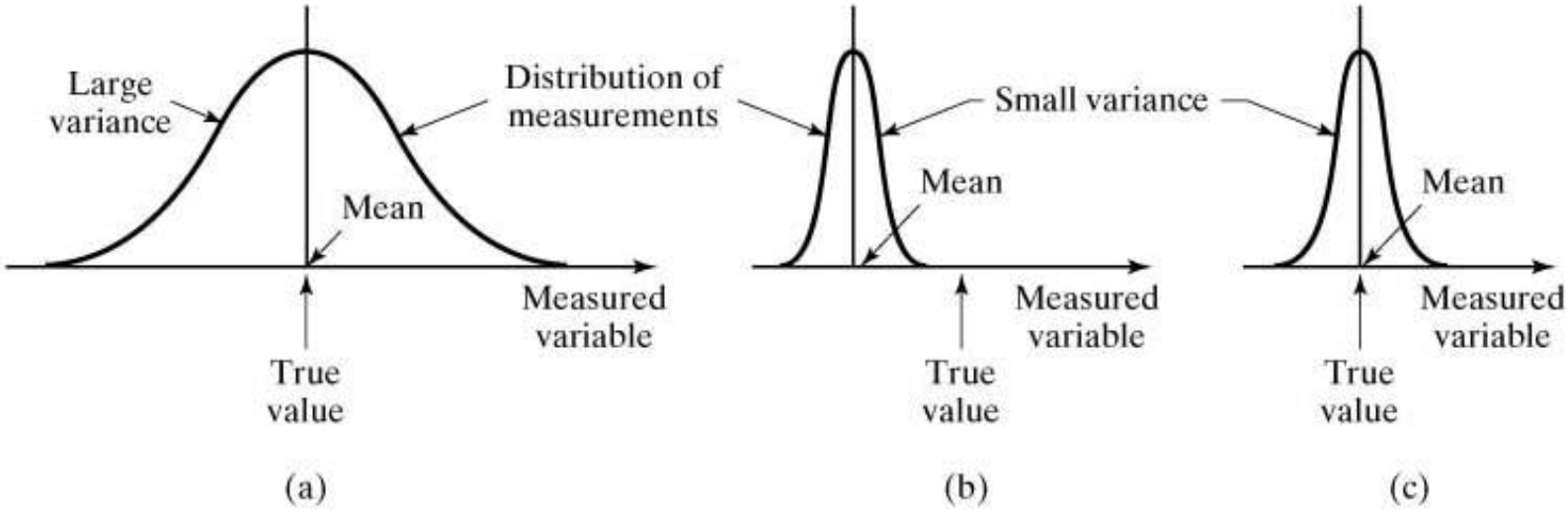
- Important attributes of a measurement system:
  - Accuracy
  - Precision
  - Speed of response
- Work measurement is a measurement process

Work Systems and the Methods, Measurement, and Management of Work
by Mikell P. Groover, ISBN 0-13-140650-7.

Accuracy and Precision

- *Accuracy*
  - Freedom from systematic errors, which are positive or negative deviations from the true value that are consistent from measurement to measurement
- *Precision*
  - Repeatability of the measurement system
  - Plus or minus three standard deviations often used as a benchmark

Measurement Accuracy vs. Precision



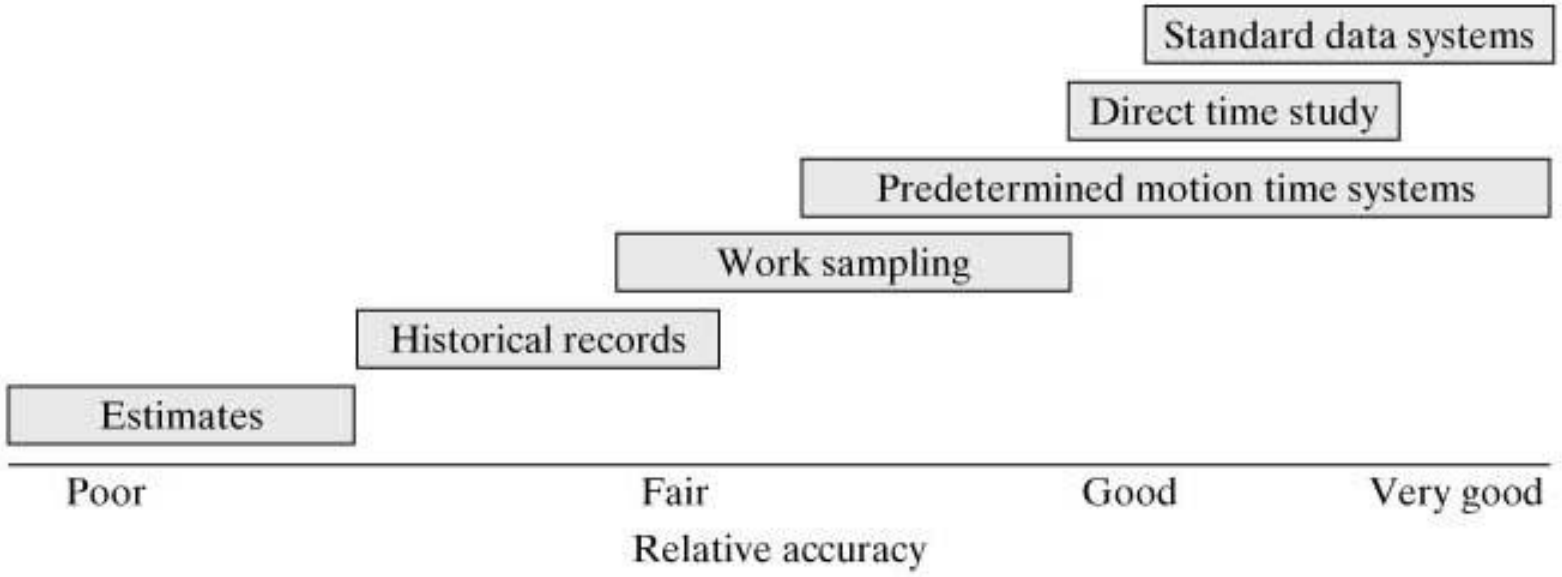
Accuracy in Work Measurement

- Accuracy is concerned with closeness to the true value
  - But what is the true value of a task time?
- Measurement is a procedure in which an unknown quantity is compared with a known standard
  - But the known standard in work measurement is the definition of standard performance used by the company
  - The standard is not based on time

Precision in Work Measurement

- Precision is concerned with the expected variability within a single time study
- Precision of a time standard is determined at a certain reliability or confidence level
  - For example, the standard time for a task is 4.00 min, and we are 95% confident that the actual time is within 5% of that time
- Related term: *Consistency* – concerned with variations in standard time values among different time study analysts

Relative Accuracy of Time Standards



Engineered Standards

- Time standards that are based on measured time values that have been adjusted for worker performance
- Some effort has been made to determine best method to accomplish the task

Application Speed Ratio

- Speed of application – how much time is required to determine the time standard for a given task
  - Varies for different work measurement techniques
- Application speed ratio = ratio of the time required to set the standard divided by the value of the time standard itself
  - Typical values = 100 to 250

Relative Application Speed