Chapter 24

Time/Job
Work Measurement

• Goal: determine standard time for a task.

• Techniques
  – Direct Time Study
  – Predetermined Time Systems
  – Standard Data Systems
  – Work Sampling
Determining Time Standards

- Standard Time (also Allowed Time): time that should be allowed for worker to process one work unit, assuming
  - Standard (average) worker
  - Standard method
  - Normal pace
Situations For Applying Standards

- Low productivity
- Repeat orders
- Long production runs
- Repetitive work cycles
- Short cycle times
Functions and Applications In Organization

- Define a “fair day’s work”
- Determine staffing and equipment resource needs
- Compare alternative methods
- Basis for wage incentives
- Basis for evaluating worker performance
- Time data for production planning, scheduling, etc.
Methods To Set Time Standards

- Estimation
  - Historical records
- Work measurement techniques
- Direct time studies
  - Pre-determined time systems
  - Standard data systems
- Work sampling

Estimated times
Historical times
Engineered standards
Proportions of work activities
Estimation

- Expert (e.g., foreman) judges time requirements
- Least accurate technique
- Better than nothing
Historical Records

- Data from previous production runs
- Similar job orders
- Time cards
Work Measurement Techniques

- Techniques
  - Direct Time Study
  - Predetermined Time Systems
  - Standard Data Systems
  - Work Sampling
- Work Analysis Approach
  - Job (processes)
  - Task WS
  - Work element DTS, SDS
  - Basic motion element PTS
Direct Time Study

- Divide task into work elements (task analysis)
- Observe worker
- Time elements with stopwatch
- Rate performance
- Yields Normal Time
  - Normal Time = (Observed Time) x (Rating)
- and Standard Time
  - Standard Time = (Normal Time) x (1 + Allowances)
Predetermined Time Systems

- Database of motion elements (e.g., therbligs)
- Task consists of motion elements
- Task time is sum of motion element times
- Yields predicted Normal Time
- Standard Time must be calculated
  - Standard Time = (Normal Time) \times (1 + \text{Allowances})
Standard Data System

- Work element normal times
- Compiled for given facility from
  - previous direct time studies
  - predetermined time system
  - work sampling
  - historical records
Work (Occurrence) Sampling

- Work sampled at random intervals, noting activity in progress
- Yields proportion of time spent on each activity
Computerized Work Measurement

- Facilitates data collection
- Facilitates routine computation
- Organizes data
- Provides database access
- Assists document preparation
Prerequisites For Valid Time Standards

Task

Standard method
Standard performance
Standard (average) worker
Standard input work unit

Standard Time

Standard output work unit
Standard (Average) Worker

- Representative of those who perform task
- Assumed to be practiced and proficient
- Well into the learning curve
Standard Performance

- Pace that can be maintained by average worker throughout entire shift
- Benchmarks
  - Walk 3 mi/hr on level, flat ground with 27-in steps
  - Deal four hands from 52-card deck in 30 sec
- 100% performance → Normal Time (no allowances)
- Physically demanding work means greater allowances
- Common practice: standard performance is pace readily attainable by majority of workers
Standard Method

- Standard procedure
- Standard tools
- Standard equipment
- Irregular work elements included appropriately
- Standard working conditions
- Standard setup
Standard Input and Output

Work Units

• Input consistent with engineering documents
• Output consistent with engineering documents
Interruptions In the Workplace → Allowances

- **Work-Related**
  - Machine breakdown, malfunction
  - Waiting for parts, tools, etc.
  - Receiving instructions
  - Work-related talk
  - Rest breaks to overcome fatigue
  - End-of-shift cleanup

- **Non-Work-Related**
  - Restroom
  - Non-work-related talk
  - Lunch break
  - Coffee break
  - Smoking
  - Personal telephony
Allowances

- Account for periods when worker is not working
- Types
  - Scheduled breaks
  - Personal, Fatigue, and Delay (PFD) allowances
  - Contingency allowances
  - Other
    - Policy allowances
    - Training allowances
    - Learning allowances
Scheduled Breaks

- Lunch breaks
- Rest breaks
- Typical shift: 8 hr paid time
  - 8:00 AM start
  - Mid-morning break (15 min)
  - 12:00 – 12:30 lunch
  - Mid-afternoon break (15 min)
  - 4:30 PM end
PFD Allowance

- **Personal time**
  - Restroom, phone calls, etc.
  - Typically 5%

- **Fatigue (rest) time**
  - To overcome fatigue
  - Determined by
    - Rest formulas
    - Negotiation
  - 5% - 20%

- **Delays (unavoidable)**
  - Usually work-related
  - Responsibility of management
  - Usually random
Contingency Allowances

- Represent unusual problems
- Examples
  - Materials/parts out of spec
  - Process out of statistical control
  - Equipment breaking down or malfunctioning more often than usual
Policy Allowances

- Cover special work situations
- Example: Machine allowance
  - Added to machine-paced portion of work cycle
  - Worker has no control
Other Allowances

- Training
  - Time to train other employees

- Learning
  - Time depends on practice
  - Individual learning
  - Organization learning
  - Important (omission is primary cause of bad standards)
Accuracy, Precision, Speed

- High accuracy, low precision
- Low accuracy, high precision
- High accuracy, high precision
Work Measurement Methods: Relative Accuracy

- Estimation
- Historical records
- Work sampling
- Pre-determined time systems
- Direct time studies
- Standard data systems

Relative Accuracy:
- Poor
- Fair
- Good
- Very good
Work Measurement Methods: Relative Speed

- Standard data systems
- Direct time studies
- Pre-determined time systems
- Historical records

Slow | Medium | Fast
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Estimation
Learning

- Amount of time to perform a task depends on how much practice the person has.
- Learning occurs in both the individual and the organization.
- The primary cause for incorrect standard times is failure to adjust for learning.
Individual Learning

- Improvement in time/unit even though the product, tools, and equipment don’t change.
- Components
  - Cognitive learning (faster, greater improvement)
    - Reduced decision time
    - Fewer mistakes
  - Motor learning (slower)
    - Better eye–hand coordination
    - Fewer slips
Organizational Learning

- Improvement in time/unit due to changing product design, changing tools and equipment, or changing work methods.
- Organizational learning includes individual learning.
- Organization improvements come from:
  - Operator learning
  - New technology
  - Substitution of capital for labor
Quantifying Improvement

- Manufacturing progress curves are placed on a log–log scale.
- On a log scale the physical distance between doubled quantities is a constant.
- The progress curve becomes straight.
Practice Makes Perfect

Direct man hours/lb of airplane vs. Cumulative number of planes
Practice Makes Perfect on a Log–Log Scale

$20 / 24 \approx 83\%$ curve
Typical Values for Organization Progress

• Rate of improvement depends on amount that can be learned.

• Amount that can be learned depends on:
  – Amount of previous experience with product
  – Extent of mechanization
Example Values for Organization Progress

Rate (%) and example

60  Production work hours/cumulative units of steel produced since 1867
72  Price/unit of integrated circuits (1963–72)
86  Cost/unit for Ford Model T
95  Lbs of raw material/airplane (Wright, 1936)
Applications of Learning

- Cost allocation
- Scheduling
- Evaluation of alternatives
- Acceptable day’s work