Chapter 12

Standard Data Systems

12 Introduction

A ***standard data system*** is a structured method of collecting, analyzing, and using data related to work processes and operations to create a database of normal time values. The Standard Data System database is typically organized by work elements that can be used to establish time standards for tasks comprised of work elements that are like those in the database. It is designed to ensure consistency, accuracy, and reliability in measuring and improving productivity and efficiency. The system typically includes predefined times and methods for tasks using direct time study and predetermined motion time systems, which serve as benchmarks for evaluating performance, setting labor standards, and determining costs. Common database formats used to create standard data systems include charts, tables, mathematical formulas, worksheets, and computerized databases and retrieval systems.

Standard data systems are applicable to the following work situations:

1. Similarity in tasks
2. Batch production
3. Large volume of standards that must be set
4. A desire to set standards before production begins

12.1 How to Create a Standard Data System

1. Identify the Scope and Objectives:
    - Determine the specific processes or tasks to be included.
    - Define the objectives, such as improving productivity, reducing cycle time, or establishing performance benchmarks.
2. Conduct Work Studies:
    - Perform time and motion studies to analyze current work processes.
    - Break down tasks into elemental motions and measure the time taken for each element.
3. Establish Standard Time:
    - Use the data from work studies to calculate the standard time for each task.
    - Adjust for allowances such as rest breaks, fatigue, and delays.
4. Develop Standard Operating Procedures (SOPs):
    - Document the best practices and methods identified during work studies.
    - Create detailed SOPs for each task, outlining the steps and methods to be used.
5. Implement Data Collection Systems:

   - Set up systems to regularly collect data on task performance, such as electronic time-tracking tools or manual logs.
   - Ensure that data collection is consistent and accurate.
6. Analyze and Update Data:
   - Regularly review the collected data to identify trends, bottlenecks, and areas for improvement.
   - Update the standard times and SOPs as necessary to reflect changes in processes or technology.
7. Train Employees:
   - Train workers on the new standards and procedures.
   - Ensure that they understand the importance of adhering to the standard methods.
8. Monitor and Enforce Standards:
   - Continuously monitor performance to ensure compliance with the standards.
   - Provide feedback and corrective actions if deviations are observed.

12.2 How to Use a Standard Data System

Four steps are commonly employed when using a standard data system, as follows:

1. Analyze the task at hand and divide it into distinct work elements.
2. Refer to the database for normal time values for the work elements.
3. Sum the work element normal times to obtain the total normal time for the task.
4. Add an appropriate allowance factor to the total normal time to obtain the standard time for the task.

12.3 Different Classifications of Work Elements in Standard Data Systems

The Standard Data System database is organized by work elements. By searching for a similar work element in the database, a normal time for that work element is given. This normal time is a predicted value rather than an observed value; hence, the classification of work elements is an important consideration, because it must account for differences in the following types of work elements:

1. Setup and production work elements
2. Constant and variable work elements
3. Worker-paced and machine work elements

4. Regular and irregular work elements
5. Internal and external work elements

12.3.1 Setup and production work elements

Standard Data Systems are commonly applied to batch production, which typically consists of a ***setup time*** (or ***changeover time***) and production run time for each batch. Setups involve breaking down the setup from the previous work order and setting up the new work order. This may involve replacing tooling and either using a computerized user interface to reprogram setup parameters or manually setting up new parameters for the next work order by physically moving machine parts, heads, tooling, etc. in accord with new specifications required by the work order. Setups are necessary but consume valuable time in a batch production environment because it diminishes the available production run time during a shift. Hence, setup elements are associated with all the activities required to perform the changeover.

Conversely, ***production work elements*** are associated with all the activities required to process the work units during the production run. Production elements typically occur once per cycle; however, on occasion, irregular work elements (i.e., replacing a full pallet unit load with an empty pallet to start a new batch) occur. An important distinction is that setup elements occur once per batch while production work elements occur once per work unit. The total batch time is given by Eq. 12.1.

$$T_b = T_{su} + QT_c \tag{12.1}$$

where

- T_b = total batch time
- T_{su} = setup, or changeover time
- Q = batch quantity, or lot size
- T_c = cycle time per unit. Note that QT_c represents the production run time.

12.3.2 Constant and Variable Work Elements

Setup and production work elements may be either constant elements or variable elements. Whereas ***constant work elements*** maintain the same time value in all time studies, the time value varies for ***variable work elements*** due to differences in work variable values, even with the same basic motion patterns and functions between jobs. The normal time for variable work elements is dependent on its job characteristics.

Examples of Constant Work Elements:

1. *Depress safety button and start button.* On a given power tool, such as a cutting tool like a circular saw, the time to depress the safety button and press the start button should be a constant time value regardless of the power tool used, assuming worker familiarity with where the safety button and start button are located.
2. *Stamping operation.* A stamping operation (i.e., stamping out parts) on a particular machine should have a constant time value per cycle regardless of the work unit.
3. *Automated work cycles.* Automated work cycles on a particular machine should have a constant, programmed time value per cycle regardless of the work unit.

Examples of Variable Work Elements:

1. *Load work unit into machine and hit Start button*. The size and weight of the work unit, as well as the distance the operator must reach to retrieve the work unit, will affect the time required to load it into the machine.
2. *Inspect a work unit*. The time required to inspect a part may vary due to the time required to retrieve the work unit, characteristics that must be inspected, degree of difficulty of the inspection (i.e., special tools required), skill level of the inspector, and so on.
3. *Move a machine part, like a head, and tighten*. The size and weight of the machine part, any friction incurred (i.e., dirty surface, grease, dust buildup) when moving the part, availability of proper tools, and skill level of the worker affects the time required to move the part.

12.3.3 Operator-Paced and Machine-Controlled Work Elements

Operator-paced work elements involve manual activities that may include the use of tools or other materials. Operator-paced work elements may be performed on setups or production runs and may be constant or variable work elements. Variation is inherent in every process, and this includes random variation for constant work elements and causal factors for variable work elements.

In contrast, ***machine-pace work elements*** are dependent upon the operating parameters and condition of the machine and characteristics of the work unit. For example, machine capability (i.e., min/max machine limitations), whether the machine is well-maintained and operating properly vs. neglected PMs resulting in machine downtime, and characteristics specific to the work unit (i.e., difficult to run on current equipment, requires extra tooling and extended setup times, quality issues with this work unit in the past so requires close inspection) affect machine-paced work elements.

12.3.4 Regular and Irregular Work Elements

Regular work elements occur once every cycle and may be constant or variable, operator-paced or machine-paced. An irregular work element occurs with a frequence of less than once per cycle. Stated differently, an irregular work element occurs once every *x* number of cycles. An example of an irregular work element is changing the cutting blade on a utility knife every 100 cuts rather than after every cut.

12.3.5 Internal Work Elements and External Work Elements

Whereas internal work elements are performed when the machine is stopped, external work elements are performed while the machine is running.

Examples of Internal Work Elements

1. Stepping inside a machine to perform setup activities after it opens in sections.
2. Adjusting, or moving, an internal machine part or component.
3. Performing a washup cycle on a printing machine.

Examples of External Work Elements

1. Retrieving tooling, dies, fixtures for the next order.
2. Retrieving pallets, dunnage, and materials for the next order.
3. Adjusting an external machine part or component.

12.4 Standard Data for Work Cycles

In many cases, it may be more appropriate to study the entire task rather decomposing a task into distinct work elements for several reasons:

1. The individual work element times are highly variable.
2. Work elements may overlap or are difficult to separate.

3. Several work elements are involved to complete the entire task.
4. Many work elements are similar and are difficult to distinguish separately.
5. The time standards are used with the intent to evaluate and compare the performance of the worker and will not be used for wage incentive purposes.

Examples of the use of Standard Data for Work Cycles

1. *Preparing an income tax report*. Whether performed by individuals or a tax professional annually, the time required to complete this task varies and involves inputting data from a variety of sources, such as bank statements, mortgage loans, other types of loan documents, investment statements, employer W-2 forms, charitable donation statements, etc. The income tax statements may be completed by hand or via an electronic form with data entered in several fields, culminating with signatures of both the tax preparer and the taxpaying individual(s).
2. *Supermarket checkout*. The time required to checkout at a supermarket depends on several factors: (1) Cashier-checkout or self-checkout, (2) number of items purchased, (3) bar code scanned items or manual scanned items (i.e., produce that must be weighed), (4) payment method (cash vs credit card), (5) machine malfunctions (i.e., credit card reader inadvertently rejects credit card that requires customer assistance), (6) staffing availability for customer support, (7) who bags the groceries – cashier, separate bagger, or customer?
3. *Proofreading a document*. The time required to proofread a document is contingent on several factors: (1) the number of pages, (2) single-spaced vs. double-spaced, (3) font size, (4) font style, (5) type of text (i.e., word text vs. mathematical or scientific notation, technical vs. nontechnical content).

The obvious advantages for using standard data for work cycles rather than individual work elements includes time and labor savings, use of a simpler, aggregated predictive time standard model, and accuracy may be similar in an appropriate work cycle application to the more detailed, time-consuming approach associated with obtaining time standards for individual work elements.

12.5 Examples of a Standard Data System

Example 1. Manufacture of Corrugated Boxes

1. Scope and Objectives:
   - Standardize the process for manufacturing corrugated boxes.
   - Objectives include reducing production time, ensuring consistent box

quality, and improving worker efficiency.

2. Work Studies:
    - Conduct time and motion studies on various tasks involved in the manufacturing process, such as cutting, folding, gluing, and quality inspection.
    - Break down the process into smaller elements and measure the time taken for each element.
3. Establish Standard Time:
    - Calculate standard times for each task in the manufacturing process.
    - Example: Printing the corrugated sheets takes 2 seconds, slotting and scoring through the machine the takes 6 seconds, gluing takes 2 seconds, folding sheets via the folding rails takes 5 seconds, stacking takes 2 seconds, and quality inspection takes 1 minute per box.
4. Develop Standard Operating Procedures (SOPs):
    - Document the best practices for each step of the corrugated box manufacturing process.
    - Create detailed SOPs for each task, specifying tools, techniques, and sequences.
    - Example SOP: "For folding the box, use the following steps: (1) Align the edges of the cardboard sheet, (2) Fold along the pre-scored lines, (3) Press firmly to ensure sharp creases."
5. Implement Data Collection Systems:
    - Install electronic workstations with time-tracking software to record task completion times and deviations.
    - Use barcoding or RFID systems to track the movement of materials through the production line.
6. Analyze and Update Data:
    - Regularly review the collected data to identify trends, bottlenecks, and areas for improvement.
    - Update standard times and SOPs, as necessary, to reflect changes in materials, technology, or production methods.
    - Example: If a new adhesive is introduced that reduces gluing time, update the SOPs and adjust standard times accordingly.
7. Train Employees:
    - Conduct training sessions on the updated standards and procedures.
    - Provide hands-on practice and simulations to ensure workers are familiar with the new methods and tools.
    - Emphasize the importance of following the SOPs to maintain quality and efficiency.
8. Monitor and Enforce Standards:

- Supervisors regularly monitor the manufacturing process to ensure compliance with SOPs and standard times.
- Implement performance metrics and feedback mechanisms to address deviations and recognize top performers.
- Example: Weekly performance reports highlighting individual worker efficiency, adherence to standard times, and quality inspection pass rates.

Example 2. Assembly Line for Electronic Devices

1. Scope and Objectives:
    - Improve assembly line efficiency for a smartphone manufacturing process.
    - Objectives include reducing cycle time and increasing output without compromising quality.
2. Work Studies:
    - Conduct time and motion studies on various tasks such as component placement, soldering, and quality inspection.
3. Establish Standard Time:
    - Calculate standard times for each task, (i.e., placing a microchip takes 5 seconds, soldering a connection takes 10 seconds, and inspecting a unit takes 15 seconds).
4. Develop SOPs:
    - Document the exact methods for each task, including the tools to be used and the sequence of actions.
    - Example SOP: "For soldering connections, use soldering iron at 350°C, apply solder for 2 seconds per joint, inspect visually for completeness."
5. Implement Data Collection:
    - Install electronic real-time tracking tools at each workstation to record task completion times.
    - Use barcode scanners to track the progress of each unit through the assembly line.
6. Analyze and Update:
    - Review data weekly to identify any deviations from standard times.
    - Update standard times and methods if, for example, a new soldering technique is introduced that reduces time by, say, 2 seconds.
7. Train Employees:
    - Conduct training sessions on the updated SOPs and the importance of following standard times.
    - Provide hands-on practice and feedback.
8. Monitor and Enforce:
    - Supervisors regularly check compliance with SOPs and standard times.

- Implement a reward system for employees who consistently meet or exceed standards.

Example 3. Preparing a Monthly Profit and Loss Statement

1. Scope and Objectives:
    - Standardize the process for preparing monthly profit and loss (P&L) statements in the accounting department.
    - Objectives include reducing preparation time, ensuring accuracy, and improving consistency.
2. Work Studies:
    - Conduct studies on the various tasks involved in preparing a P&L statement, such as data collection, entry, reconciliation, calculation, and review.
    - Break down the process into smaller elements and measure the time taken for each element.
3. Establish Standard Time:
    - Calculate standard times for each task involved in the P&L preparation process.
    - Example: Data collection takes 1 hour, data entry takes 2 hours, reconciliation takes 1.5 hours, calculations take 1 hour, and review takes 1 hour.
4. Develop Standard Operating Procedures (SOPs):
    - Document the best practices for each step of the P&L preparation process.
    - Create detailed SOPs for each task, specifying tools, techniques, and sequences.
    - Example SOP: "For data entry, follow these steps: (1) Collect sales data from the ERP system, (2) Verify data accuracy against sales records, (3) Enter verified data into the P&L template."
5. Implement Data Collection Systems:
    - Use accounting software to automate data collection and ensure accuracy.
    - Implement a centralized database to store and retrieve financial data efficiently.
6. Analyze and Update Data:
    - Regularly review the collected data to identify trends, bottlenecks, and areas for improvement.
    - Update standard times and SOPs as necessary to reflect changes in financial reporting standards, software, or processes.
    - Example: If a new accounting software is implemented that speeds up data

entry, update the SOPs and adjust standard times accordingly.

7. Train Employees:
    - Conduct training sessions on the updated standards and procedures.
    - Provide hands-on practice and simulations to ensure accountants are familiar with the new methods and tools.
    - Emphasize the importance of following the SOPs to maintain accuracy and efficiency.
8. Monitor and Enforce Standards:
    - Supervisors regularly monitor the P&L preparation process to ensure compliance with SOPs and standard times.
    - Implement performance metrics and feedback mechanisms to address deviations and recognize top performers.
    - Example: Monthly performance reports highlighting individual accountant efficiency, adherence to standard times, and error rates.

Example 4. Workflow for Preparing a P&L Statement

1. Data Collection:
    - Retrieve sales data from ERP system: 1 hour
    - Collect expense reports from department heads: 1 hour
2. Data Entry:
    - Enter sales data into P&L template: 1 hour
    - Enter expense data into P&L template: 1 hour
3. Reconciliation:
    - Verify sales data accuracy against sales records: 0.5 hours
    - Verify expense data accuracy against receipts and reports: 1 hour
4. Calculations:
    - Calculate gross profit (Sales - Cost of Goods Sold): 0.5 hours
    - Calculate net profit (Gross Profit - Expenses): 0.5 hours
5. Review:
    - Review P&L statement for accuracy and completeness: 1 hour
    - Submit P&L statement for managerial approval: 0.5 hours

12.6 Advantages and Disadvantages of Standard Data Systems

12.6.1 Advantages of Standard Data Systems on Determining the Normal Time

Some advantages of Standard Data Systems are discussed below.

1. Improved Productivity:

- Establishing clear benchmarks and best practices leads to more efficient use of time and resources.
- It results in a simpler predictive model that is much easier to use by the time study analyst.
- Workers can be trained to perform tasks more consistently and quickly.

2. Capability to set standards before production.
3. Avoids the need for performance rating, which is a subjective and controversial step in direct time study.
4. Consistency in the Standards and Quality Control:
    - Based on average much of the direct time study data.
    - Standardized methods help ensure that tasks are performed uniformly, reducing variability and defects.
    - Consistent quality can enhance customer satisfaction and reduce rework and scrap rates.
5. Improved efficiency and accuracy:
    - Reduces time required by eliminating redundancies and optimizing workflows.
    - Minimizes errors by standardizing data entry and reconciliation processes.
    - It may be just as accurate for setting standards as a system based on dividing the task into work elements.
6. Performance Measurement:
    - Provides a clear basis for evaluating worker performance and productivity.
    - Facilitates the identification of high-performing employees and areas needing improvement.
7. Cost Control:
    - Helps in accurately estimating labor costs and setting budgets.
    - Reduces waste and inefficiencies, leading to cost savings.
8. Training and Onboarding:
    - Simplifies the training process for new employees by providing clear guidelines and standards.
    - Reduces the learning curve and accelerates the onboarding process.
9. Process Improvement:
    - Data collected can be analyzed to identify bottlenecks and areas for process improvement.
    - Facilitates continuous improvement initiatives and Lean manufacturing practices.
10. Regulatory Compliance:
    - Ensures that operations comply with industry standards and regulatory requirements.

- Helps in maintaining documentation and records necessary for audits and certifications.

Despite the many advantages afforded by Standard Data Systems, several disadvantages are discussed below.

12.6.2 Disadvantages of Standard Data Systems

1. High investment cost:
    - Creating a Standard Data System requires significant time and cost resources.
    - Requires investment in time and motion studies, data collection tools, and training programs.
2. Data Source:
    - A considerable volume of direct time study data must be available
3. Rigidity:
    - Can lead to a lack of flexibility in operations, making it difficult to adapt to changes or unforeseen circumstances.
    - Workers may feel constrained by rigid procedures and may find it challenging to innovate or suggest improvements.
4. Methods Descriptions:
    - Thorough methods documentation is still required.
5. Resistance to Change:
    - Employees may resist adopting new standards and procedures, especially if they are accustomed to old methods.
    - Change management efforts are necessary to overcome resistance and ensure compliance.
6. Maintenance and Updates:
    - Standard data systems require regular updates and maintenance to remain effective.
    - Changes in technology, processes, or products necessitate ongoing adjustments to standards.
7. Potential for Inaccurate Data:
    - If the initial data collection is flawed or if the standards are not regularly updated, the system may rely on inaccurate or outdated information.
    - Inaccurate data can lead to poor decision-making and inefficiencies.
8. Risk of Improper Applications:
    - By attempting to set time standards for tasks not covered by the Standard

Data System.

9. Focus on Quantitative Metrics:
    - Overemphasis on time and performance metrics can lead to neglect of qualitative factors, such as worker satisfaction and creativity.
    - May create a high-pressure environment that prioritizes speed over quality.
10. Complexity:
    - For large or diverse operations, developing and managing a comprehensive standard data system can be complex and challenging.
    - Requires coordination and consistency across different departments and processes.

12.7 Summary

By creating and maintaining a standard data system, the production line or office operations can achieve higher productivity, better quality control, and more predictable production schedules. Moreover, by carefully weighing the advantages and disadvantages, organizations can decide how best to implement and manage standard data systems to optimize their operations.

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