U.S. Department of Justice
Federal Bureau of Prisons

Program Statement

OPI: FPI
NUMBER: 8281.02
DATE: 7/31/2003
SUBJECT: Work Measurement Program - FPI

1. **PURPOSE AND SCOPE.** To establish and maintain a work measurement program at all Federal Prison Industries (FPI) factories. Production standards provide the basic data for many components of production management such as:

- Capacity planning;
- Determination of accurate standard direct labor costs;
- Shop floor control;
- Factory loading;
- Item Standard Routings;
- Line balancing; and
- Manufacturing methods improvements.

Work measurement is defined as the process of determining a standard time for performing a task using industrial engineering techniques. Engineered production standards give the manager the assurance that the analysis is based on quantitative, reliable, and objective data. Accuracy of work measurement data is essential to effective use of the **Millennium** production planning system and the establishment of accurate cost standards.

2. **SUMMARY OF CHANGES.** Highlights of changes included:

- The work measurement program was revised to correlate with **Millennium** software functionality.
- The Work Measurement Technical Reference Manual (TRM) was incorporated into the Program Statement.
- Instructions for using obsolete work measurement software were eliminated.
- Data collection forms were deleted.

3. **PROGRAM OBJECTIVES.** The expected results of this program are:

a. Accurate labor standards will be established at every factory on all production operations or processes using approved work measurement techniques.

b. Product or process files will be maintained appropriately and consistently at the Product Support Center (PSC) and the factory to support production standards.

4. **DIRECTIVES RESCINDED**

PS 8281.01 FPI Work Measurement Program (6/1/95)

TRM 8301.01 Work Measurement, General Use (6/1/95)

5. **STANDARDS REFERENCED.** None

6. **RESPONSIBILITIES**

a. The **Manager, Product Support Center (PSC)** must:

(1) Provide technical guidance and oversight to Associate Wardens/Superintendents of Industries (AW/SOIs) to support their work measurement programs.

(2) Provide work measurement training for Work Measurement Coordinators.

(3) Designate PSC staff to review and approve work measurement data for all manufactured products or processes.

b. **AW/SOIs** at each institution must:

(1) Implement and manage a comprehensive work measurement program in his or her factory.

(2) Appoint, in writing, a work measurement coordinator(s).

(3) Ensure work measurement coordinators have formal training in work measurement techniques within six months of appointment.

c. The **Factory Manager** must:

(1) Review work measurement documentation and develop methods improvement recommendations.

(2) Ensure that PSC-approved work measurements support all standard routings in the **Millennium** System. Set-up, machine, and run times on the routing must match work measurement and work center efficiency and must be set at 100% unless the PSC approved another standard.

d. **Work Measurement Coordinators** must:

(1) Develop and maintain standards for all products and processes using PSC-approved methods.

(2) Maintain an approved copy of all product/process files for all locally produced production items.

(3) Review changes in manufacturing methods and request adjustments through the PSC to work measurement data for all products and processes throughout the factory.

7. **PRODUCT/PROCESS FOLDER.** All work measurement information and documentation for a product/process will be included in the folder. The folders may be labeled according to an individual product number, product family description, process description, or by the group number/group counter of the routing. Group number/group counter should be used when a routing is assigned to multiple materials.

The product/process folder consists of the following sections:

- Blueprints & Specifications
- Standard Routing
- Work Center Equipment List & Set-up Times
- Work Measurement Analysis
- Average Lot Size & Labor/Capacity Analysis
- Appendix

8. **BLUEPRINTS/SPECIFICATIONS.** The product/process folder will contain a copy of all drawings and specifications for the item. Only drawings that apply to the applicable product structure level need to be included in the folder. An assembly routing only needs to include the assembly level drawings.

A drawing/specification list may be included in place of large or electronically maintained drawings/specifications provided they are readily accessible and their location is referenced in the folder.

9. **STANDARD ROUTING.** A routing is a list of operations that defines the sequence of processes used to manufacture a product. A routing consists of a:

- header,
- sequence description, and
- operation descriptions.

Either a copy of the routing, or reference to an electronic version of the routing, must be maintained in the product folder. SAP routings must be referenced by:

- Task List Type
- Group Number
- Group Counter

Reference operation sets are routings that define standard operations and may be inserted into a standard routing or job routing. Reference operation sets may be standard processes a factory uses to produce custom or non-standard products. Reference operation sets must be supported by a work measurement folder the same as routings for standard products.

a. **Group.** Routings used to produce a product, product family, or a standard process should be created under the same group number.

b. **Group Counter.** Group counter number denotes individual routings within a group. All materials produced using the same operational steps should be assigned to a single routing via the routing material assignment function.

c. **Sequence.** The sequence defines which operations are grouped together and may be done in parallel or using an alternative method. Operations that can be performed at the same time should be assigned to parallel sequences.

d. **Operations.** Operations specify the work center where the operation is to be performed and describe:

- the production procedures,
- components allocated to the operation,
- set-up time,
- machine time, and
- labor time required to accomplish each operation.

The operation detail also includes:

- the number of splits (crew size),
- inter-operation times (move, queue, wait), and
- the minimum send-ahead quantity.

e. **Sub-Operations.** Sub-operations within operations may be used to break down large or complex operations into smaller steps. A summary sheet is required when multiple work measurement analysis forms are totaled and used in a single operation. The summary sheet must total the set-up, machine, and run times of each work measurement analysis form.

The use of sub-operations is highly recommended when more than one work measurement analysis form is required to define an operation. SAP will total the sub-operation times to the operation level times. Summary sheets are not required when sub-operations are used since SAP does the summarization internally.

10. **WORK CENTER EQUIPMENT LIST AND SET-UP TIMES.** A work center is a production area of machines and workers performing similar functions. Work center equipment lists include all set-up times used to configure a machine or work area to complete a production operation. A complete work measurement analysis must support each set-up time. Work measurement analysis for set-up is completed in the same manner as machine or run time.

Work center equipment lists, set-up times and the supporting work measurement analysis may be included in the product/process folder or may be kept in a factory binder and referenced in the product/process folder.

a. **Factory Binder.** Referencing a factory binder that contains an equipment list with set-up times and supporting work measurement analysis will eliminate keeping multiple copies of set-up data in product/process folders. A table of contents should be included in the front of the binder listing:

- each work center,
- equipment in the work center,
- set-up methods, and
- set-up times.

b. **Set-up Used on Multiple Production Orders.** Set-up time is allowed once per production order. Production orders are sometimes grouped together to minimize the number of set-ups required. The difference between production orders may be different materials or material quantity differences (size, color) and do not require operational changes. Then, the average frequency that a set-up is used must be identified and documented. Data collection forms and instructions are available from PSC work measurement points of contact.

c. **Machine Delay.** Machine delay is the amount of time required to reload or maintain a piece of equipment. *Do not enter machine delay in set-up time.* Machine delay time is used as a factor when calculating machine process time. Supporting data may be included in the product/process folder or may be kept in a factory binder and referenced in the product/process folder.

Machine delay time is usually stated as a percentage of machine run-time. A sewing machine may require eight percent delay time to rewind and load the bobbin. Supporting documentation is required and is available from manufacturer's data sheets.

11. **WORK MEASUREMENT ANALYSIS**

a. **Approved Methods.** Prior to timing an operation, the analyst must evaluate the work methods used to complete the operation being studied. The analyst must ensure that

unnecessary movements are eliminated prior to completing the study. Use only the minimum crew size required to complete the task efficiently.

The analyst must identify and record each operational element on the analysis form before timing the operation. Data collection spreadsheets and forms for work measurement studies are available from PSC work measurement points of contact.

Videotaping an operation is a powerful tool for the work measurement analyst. It provides objective documentation of the work area configuration and can be stopped to record elements, replayed, and timed to analyze each element of a task closely. It is much easier to videotape operations on the shop floor and then return to the office to analyze the tapes. Videotapes must be well documented regarding the item being manufactured and the manufacturing operation being studied.

Work measurement analyses of each operation must be completed using one or more of the methods listed.

(1) **Predetermined Time Standards.** Predetermined time standards are a reliable and consistent method of expressing a fair day's work. They do not rely upon an analyst's evaluation of the speed and effectiveness of the employee being studied.

Predetermined time standards allow creation of reliable time standards before a product is available to be studied. The analyst needs to know how to make the product but does not need to observe actual production. This distinction is critical when products are costed, priced, and quoted/marketed prior to production startup.

Modular Arrangement of Predetermined Time Standards (MODAPTS) is the most commonly used predetermined time standard; however, others are acceptable with PSC approval.

(2) **PSC-Approved Formula Based Work Measurement.** Work measurement data may be converted to mathematical formulas for standard manufacturing processes. The formulas must be supported by the work measurement data used to develop the formulas. Documentation used to develop process formulas for work measurement must be submitted to the PSC for review and written approval prior to their use.

(3) **Published Industry Standards.** Published industry standards are available from manufacturers and trade groups. The industry standards must be submitted to the PSC for written approval prior to their use.

(4) **Time Studies.** Long duration tasks with natural variations are more suited to time studies. Operations must be broken down into small measurable segments called "elements." Each element must be small enough to describe the processes required to manufacture an item. "Build cable" must be broken down to "Cut wire," "Strip wire," "Crimp," "Connector," and "Pack."

Time should be removed from the study when a non-standard event occurs and the reason for removal stated in remarks. A cause for removal of a time might include the operator stopping to talk to someone or dropping a work piece. Time for interruptions is included in Personal Fatigue and Delay (PF&D) and efficiency factors.

The analyst must performance rate individual workers to adjust times to an average worker pace. An average worker is a 100% performance rate. A slow worker is less than 100% and a fast worker is greater than 100%.

A performance rating is distinctly different from an efficiency rating and must not be used interchangeably or combined. Performance rating is subjective and makes time studies less reliable and less consistent than predetermined time standards. Performance rating must be included on each time study. Use of a "generic" performance rate is not acceptable.

An Excel spreadsheet version of the time study form is available from the PSC work measurement points of contact.

(5) **Machine Process Time.** Machine process time may be documented based on machine speed and feed settings, cycle time, or other objective data that is a function of the machine's performance characteristics. Document the machine characteristic(s) that define the machine's production rate and show the mathematical calculation of how the time per unit was calculated.

Machine time must be adjusted for machine delay when it exists. Calculate machine delay time by multiplying the delay factor (normally a percentage) by the machine process time and add it to the machine process time.

Machine process time may be combined with other work measurement methods as appropriate. Machine delay should be applied on predetermined time standard on the line where the element is recorded. Machine delay time should be applied on time studies after the element times have been averaged instead of performance rating which is used only on labor elements.

b. **Time Calculation Procedures.** Allowed times are calculated from data collected using one of the five approved methods. Times are totaled and adjusted according to procedures specific to each method. The factors used to calculate allowed times are described in further detail below.

PF&D is no longer included as part of the work measurement analysis calculation procedures. It is included in the work center break time and reduces the available capacity hours per day.

(1) **Unit of Measure.** The unit of measure for time will be in hours, minutes, or seconds. The time value should be stated in a unit of measure that is readily understood. As a general rule, convert the unit of measure to a lower unit if more than three decimal places of precision are required.

Example: A time of 0.003 minutes should be converted to 0.18 seconds.

(2) **Sub-Total and Average Element Times.** Sub-total time study element times and average each element time based on the number of observations.

Convert predetermined time standard units to time units. Most commonly this will be the conversion of MODAPT MODs to minutes by multiplying MODs by 0.00215 min/MOD.

Machine time on predetermined time standards must be adjusted for machine delay when a machine delay factor exists. Multiply the machine time by 100% plus the machine delay percentage.

Example: A machine time of 2.55 minutes and a delay factor of eight percent would be adjusted by multiplying 2.55 minutes x 1.08 to equal 2.75 minutes.

(3) **Performance Rating.** Each element of a time study must be performance rated.

Example: Enter 0.90 for a worker who is working at 90% of an average workers pace. A time of 1.5 minutes x 0.90 performance rate equals 1.35 minutes.

Machine time is not performance rated but may have a machine delay factor. A machine time of 1.5 minutes x 1.08 for a machine with an 8% machine delay equals an adjusted machine time of 1.62 minutes.

(4) **Frequency.** After element times have been averaged and adjusted for performance or machine delay they must be adjusted for the frequency in which they occur. The work measurement time must be stated per the item's base unit of measure. Always including the units of measure for clarity.

Example: A time study for sewing a glove would normally measure the time to produce one glove. A frequency of two would double the time to equal the time to produce a pair of gloves. This would match the base unit of measure in the item master of one (pair) each.

An element that measures the time to place 10 pairs of gloves in a box and seal the box would have a frequency of 1/10. A boxing time of 2.00 min/box times a frequency of 1/10 box/pair equals 0.20 min/box.

Frequency Factor. A machine set-up that is used on multiple production orders must also include a frequency factor. A common occurrence is when a single machine set-up is used to produce multiple production orders of a similar item in multiple colors or laminates.

A data collection form for set-ups used on multiple production orders and a spreadsheet with embedded formulas to do the mathematical calculations are available from PSC Work Measurement points-of-contact. The spreadsheet data may be used directly when a set-up time study only has one element. When a set-up time study has multiple elements the frequency factor calculated on this spreadsheet can be used on the standard time study format. Include both forms in the set-up time documentation when both are used.

(5) **Production Per Day.** Calculation of production per day is not required but provides useful data for line balancing and management analysis. Calculate the production per day by dividing the work center operating time by the work measurement allowed time.

Example: A work center that has an operating time of 5.75 hrs (345 minutes) produces parts at the rate of 1.5 units/minute. Dividing 345 minutes/day by 1.5 units/minute equals 230 units/day.

(6) **Crew Size.** The appropriate application of crew size depends upon the nature of the work center. SAP uses both machine-hours and run-hours (man-hours). Work measurement times should be multiplied by crew size except when a crew is dedicated

to a machine and the labor cost has been included in the machine's activity rate. To transfer work measurement data to SAP there are three work center alternatives that must be considered:

- **A machine with a dedicated crew.** The cost of operating the machine includes the cost of the dedicated crew. The work measurement study must be completed based on machine output. Crew size is not relevant. Enter the work measurement time in SAP as machine time (machine-hours).

- **A machine that does not have a dedicated crew.** The cost of operating the machine does not include the crew's cost. This situation occurs most frequently when a pool of labor is assigned to multiple machine work centers. The work measurement study must first calculate machine time (machine-hours). Machine time is then multiplied by the crew size required for the specific task to calculate the run-time (man-hours) for SAP.

- **A labor work center.** The work measurement study must be based on the entire operation's completion. Time spent waiting by other crew members must be included in the operation's total cost since they may not leave the operation to perform other work. Multiply the total allowed operation time by the crew size to calculate the run time (man-hours) for SAP.

12. **AVERAGE LOT SIZE AND LABOR/CAPACITY ANALYSIS**

a. **Average Lot Size.** The average lot size is the average of historical production order lot sizes. Set-up time is divided by the average production run to determine the set-up time per unit. Use the Production Order Information System (SAP TCode COOIS) to extract historical production lot size data from the system.

(1) The date range used when running the report should capture data from 10 - 50 production orders for an item. Export the data to Excel, sort the data and calculate the average production run. Your PSC Work Measurement point of contact can provide assistance. The completed spreadsheet will document the data source and the average production run.

(2) Run the analysis when significant changes to average production run sizes occur. The average production run size should be entered into the Costing Lot Size field of SAP's Material Master located on the Costing 1 tab. Do not change this field more than once a year, unless correcting an error.

Set-up cost variances on production orders are normal and expected since the actual production lot size will vary from the average production lot size. Changing the costing lot size to eliminate individual production order cost variances is expressly prohibited.

This section may be omitted if set-up time is not used on routings and there are no fixed quantity materials on BOMs.

b. **Labor/Capacity Analysis.** Additional analysis may be required for products produced on a dedicated production line. Design of a production line requires:

- balancing operational times,
- determining equipment and labor requirements, and
- calculating piece rates based on job grading data.

Inadequate capacity at any one operation will create a bottleneck that restricts daily production below the goal. Excess capacity cannot be used and will add unnecessary production costs.

Contact the PSC Work Measurement coordinator for business group specific labor/capacity analysis spreadsheets and formats.

When the data provided by SAP is sufficient this section may be omitted.

13. **APPENDICES.** A product/process folder that is used for more than one routing and/or material must include an appendix.

A routing group for a product family may have multiple routings that are similar except for a few unique operations due to minor variances between products within the product family. The base routing is covered in the standard sections of the folder.

Documentation for variant routings in the appendix must identify the unique operations. The unique operations must have supporting work measurement analysis documentation.

A routing may be used for multiple materials. A material assignment listing from SAP must be included if the work measurement folders are identified by material number. The listing is not required if the work measurement folder is identified by group/group counter number. By using the group/group counter to identify the work measurement folder, materials can be added or deleted from the routing without updating the work measurement folder.

14. **PF&D, UTILIZATION, AND EFFICIENCY**

a. **PF&D.** PF&D has been eliminated from work measurement procedures and are now part of **Millennium**'s work center standard available capacity. All factories will use a 30% PF&D rate unless the PSC authorizes another standard in writing. The break time of two hours and fifteen minutes (2:15) is comprised of the following allowances:

Allowance Description	**Time**
Morning check-in & tool issue	15 minutes
Morning break	15 minutes
Lunch tool check-in	15 minutes
Lunch (unpaid)	30 minutes
Lunch tool issue	15 minutes
Afternoon break	15 minutes
Afternoon tool check-in, cleanup, shakedown	20 minutes
Unavoidable delays, personal and fatigue time (Q.A. inspection, foreman, conferences, etc.)	10 minutes
Total	2:15 minutes

The standardized PF&D rate above and shift times listed below are for consistency within **Millennium.** Actual factory break times, lunch times, and shift times will vary from the times listed below.

(1) **Standard Shift.** Factories will use *start* time will be 07:30:00; finish time will be 15:30:00; length of breaks will be 02:15:00; and capacity utilization will be 100%.

(2) **Extended shift** (exceeding eight production hours per day) and **multiple shift** factories will use the standard available capacity configuration listed below:

- **Start time** = 07:30:00
- **Finish time** = 07:30:00 + paid production hours + meal break hours
- **Length of breaks** = (Paid production hours * 0.233)+ meal break hours

b. **Utilization.** Utilization is defined as the theoretically available hours less technical and organizational downtime and is subtracted from theoretically available hours to calculate operating time. PF&D currently includes technical and organizational downtime under the headings of tool check-in/out, unavoidable delays, and personal and fatigue time.

Allowances for technical and organizational downtime have been added to break time.

Capacity utilization will normally be set at 100%. Utilization may be reduced as warranted by unusual circumstances. An example would be to account for the learning curve of an unskilled crew during factory startup. Another example would be loss of a major portion of the skilled workforce.

c. **Efficiency.** The performance efficiency rate is the ratio of standard time to the actual time attained. The performance efficiency rate is assigned to the work center. The system assumes 100% efficiency if you do not enter a performance efficiency rate. Use utilization to adjust available capacity to match schedule performance. Adjusting efficiency rates will increase costs.

Standard times (set-up, machine, and run) in routings is always based on a performance efficiency of 100%. The past practice of adjusting operation run times for efficiency will be discontinued when set-up, machine, and labor times are entered into **Millennium.**

15. **INTER-OPERATION TIME.** Inter-operation times are times that affect scheduling but do not incur costs. Inter-operation times include move, queue, and wait times.

a. **Move.** Move time is the time required to move materials between work centers. Generally, move times are less than queue times and therefore do not need to be included in routings. Only include move time in routings if it delays production schedules significantly. Movement through the rear gate is the most common reason a move time should be included in a routing.

b. **Queue.** Queue time is the amount of time a job waits at a work center before work is performed. Queue time is calculated by multiplying the number of units waiting at a work center by the schedule time required to process the item.

c. **Wait.** Wait time is the amount of time a unit must wait before being sent to the next operation. Paint drying, potting, compound setting, and rubber curing are all common examples of wait time. Wait time should be noted on the work measurement analysis but not included in the work measurement time. Wait time is generally obtained from product specification data.

/s/
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