

DFM/DFA Pro-DFM Criteria

DFM/DFA Evaluation Scores

As noted in the Pro-DFM Powerpoint lecture, use of the Pro-DFM spreadsheet tool requires the determination of certain part and assembly process evaluation factors. Equations for these evaluation factors are given in the Powerpoint slides. These equations require the user to assign values (between 0-10) to listed sub-criteria. In order to make this task easier, potential values are given below.

For each of the evaluation sub-criteria listed, a set of suggested levels and a range of scores have been provided. In each case, use your knowledge and background to make a “best judgment” estimation of the evaluation score. If you have no knowledge or basis upon which to make a judgment, use a value of zero for the criterion.

Definitions on some of the terms used are given following the sub-criteria lists.

Part Evaluation

Procurement

Material Knowledge

- (0-2) High material experience
- (3-6) General awareness of material
- (7-9) Low previous experience
- (10) No previous experience with material

Sourcing Difficulty

- (0-2) Readily available
- (3-6) Limited number of sources
- (7-9) Possible sources exist
- (10) No known sources

In-Bound Quality Control

- (0-3) High quality reputation for source
- (4-8) Typical reputation for quality
- (9-10) Unknown quality

Part Geometry

Dimensional Tolerance

- (0-2) Low: < .05 in.
- (3-5) Moderate < .005 in.
- (6-8) High < .0010 in.
- (9-10) Precision < .0005 in.

Alignment Ease

Use [Assembly Matrix](#) columns 17 thru 28

(sum of columns 17 thru 28)/ 1.7

Part Symmetry

Use [Assembly Penalty Points Table](#)

(penalty point value) * 5

Part Handling

Part Damage

- (0-2) Component robust
- (3-4) Low chance of handling damage
- (4-6) Moderate chance of handling damage
- (6-8) High chance of handling damage
- (9-10) Component highly fragile

Handling Difficulty

Use [Assembly Matrix](#) columns 6 thru 16

(sum of columns 6 thru 16)/ 1.3

Part Feed Automation

- (0-2) Automatic on existing equipment
- (2-4) Automatic needs new equipment
- (5-8) Manual assisted feeding
- (9-10) 100% manual feeding

Assembly Process Evaluation

Process Difficulty

Steady Yield Interval (**Steady Yield Interval** - Time for new batch to reach steady state, How long after setup is an acceptable yield is reached.)

- (0-3) Low amount of time
- (4-7) Moderate
- (8-10) High

Process Experience

- (0-3) Low
- (4-7) Moderate
- (8-10) High

Process Failure Modes (failures in manufacturing or assembly process, see Process FEMAs at end of document)

- (0-3) Low number of potential failure modes
- (4-7) Moderate
- (8-10) High

Fastening Type

- (0-2) Automated fastening, snap fit
- (3-5) Automated fastening, fastener
- (6-8) Hand fastened, snap fit
- (9-10) Hand fastened, fastener

Output Rate

- (0-3) Low
- (4-7) Moderate
- (8-10) High

Equipment Needs

Available Capacity (current)

- (0-3) Low
- (4-7) Moderate
- (8-10) High

New Machine

- (0-3) Use existing equipment
- (4-7) Moderate amount new equipment
- (8-10) Large amount new equipment

Process Control Design

Tooling Needs

New Tooling

- (0-3) Use existing tooling
- (4-7) Moderate amount new tooling
- (8-10) Large amount new tooling

Complexity (use best judgment of tooling complexity, #parts, #jigs, etc.)

- (0-3) Low
- (4-7) Moderate
- (8-10) High

Handling

Container (Containers used to reduce damage in handling and storage)

Orientation

Process Setup

Setup Time

- (0-3) Low
- (4-7) Moderate

(8-10) High

Commonality

(0-3) High

(4-7) Moderate

(8-10) Low

Inventory

Production Volumes

(0-3) High (> 100000 units)

(4-7) Moderate (1000s to 10000s)

(8-10) Low (10s to 100s)

Work-in-Process

Quality and Testing

Test Process Expertise

(0-3) Low

(4-7) Moderate

(8-10) High

Inspection Specifications (# of specifications and complexity)

(0-3) Low

(4-7) Moderate

(8-10) High

Process Capability

(0-3) Low

(4-7) Moderate

(8-10) High

Some Definitions to Assist in Setting Sub-Criteria Values:

Test Process: Documentation specifying the scope, approach, resources, and schedule of intended testing activities. It identifies test items, the features to be tested, the testing tasks, responsibilities, required resources, and any risks requiring contingency planning.

Inspection Activities: Activities such as measuring, examining, testing, gaging one or more characteristics of a product or service, and comparing these with specified requirements to determine conformity.

Process Capability: Competence of the process, based on tested performance, to achieve certain results.

Work-in-process: Products which are in the process of being fabricated or manufactured but not yet complete.

Process Performance Measures: process aspects such as cost, quality, flexibility, and speed. Some of the process performance measures that communicate these aspects include:

Capacity utilization: the percentage of the process capacity that actually is being used.

Throughput rate (also known as *flow rate*) - the average rate at which units flow past a specific point in the process. The maximum throughput rate is the process capacity.

Flow time (also known as *throughput time* or *lead time*) - the average time that a unit requires to flow through the process from the entry point to the exit point. The flow time is the length of the longest path through the process. Flow time includes both processing time and any time the unit spends between steps.

Cycle time - the time between successive units as they are output from the process. Cycle time for the process is equal to the inverse of the throughput rate. Cycle time can be thought of as the time required for a task to repeat itself. Each series task in a process must have a cycle time less than or equal to the cycle time for the process. Put another way, the cycle time of the process is equal to the longest task cycle time. The process is said to be in balance if the cycle times are equal for each activity in the process. Such balance rarely is achieved.

Process time - the average time that a unit is worked on. Process time is flow time less idle time.

- Idle time - time when no activity is being performed, for example, when an activity is waiting for work to arrive from the previous activity. The term can be used to describe both machine idle time and worker idle time.
- Set-up time - the time required to prepare the equipment to perform an activity on a batch of units. Set-up time usually does not depend strongly on the batch size and therefore can be reduced on a per unit basis by increasing the batch size.
- Direct labor content - the amount of labor (in units of time) actually contained in the product. Excludes idle time when workers are not working directly on the product. Also excludes time spent maintaining machines, transporting materials, etc.
- Direct labor utilization - the fraction of labor capacity that actually is utilized as direct labor.
- Process Capacity - The capacity of the process is its maximum output rate, measured in units produced per unit of time. The capacity of a series of tasks is determined by the lowest capacity task in the string. The capacity of parallel strings of tasks is the sum of the capacities of the two strings, except for cases in which the two strings have different outputs that are combined. In such cases, the capacity of the two parallel strings of tasks is that of the lowest capacity parallel string.
- Work In process - the amount of inventory in the process.

Process FMEAs. Examine the ways that failures in manufacturing and assembly processes can affect the operation and quality of a product or service. Process FMEAs indicate what can be done to prevent potential process failures prior to the first production run.