Manufacturing Management (Part 9)
Management-Topics

- Communication
- Engineering ethics
- Supervision/Management
- Organizational psychology
Communication Model
We Remember

• 10% of what is read
• 20% of what is heard
• 30% of what is seen
• 50% of what is seen and heard
Engineering Ethics

• *Ethics* is a system of moral principals and values established and/or demonstrated by individuals

• Approximately 75% of U.S. firms have a written code of ethics
Managements Responsibility

• Demonstrate and demand ethical behavior

• Take clear and swift action to correct inappropriate conduct

• Place value on the use of ethics in training and performance evaluations
Society of Manufacturing Engineers

PREAMBLE
Practitioners of manufacturing engineering recognize that their professional, civic, and personal activities have a direct and vital influence on the quality of life and standard of living for all people. Therefore, manufacturing engineers should exhibit high standards of competence, honesty and impartiality; be fair and equitable; and accept a personal responsibility for adherence to applicable laws, the protection of the public health, and maintenance of safety in their professional actions and behavior. These principles govern professional conduct in serving the interests of the public, clients, employers, colleagues, and the profession. Honesty, integrity, loyalty, fairness, impartiality, candor, fidelity to trust, and inviolability of confidence are incumbent upon every member as professional obligations. Each member shall be guided by high standards of business ethics, personal honor, and professional conduct. The words “practitioner,” “manufacturing engineer,” and “member” as used throughout this Code include all classes of membership in the Society of Manufacturing Engineers.

THE FUNDAMENTAL PRINCIPLE
The manufacturing engineer is dedicated to improving not only the manufacturing process, but manufacturing enterprises worldwide. This includes striving to instill a sense of concern and awareness throughout the manufacturing community of public health, safety, conservation, and environmental issues that are related to the practice of manufacturing and through the application of sound engineering and management principles. Engineers realize that in carrying out this responsibility their individual talents and services can be more effective when funneled through the activities of the Society of Manufacturing Engineers. Therefore, engineers shall strive to support the mission of the Society of Manufacturing Engineers and the activities, products, and events sponsored and produced by them.

CANONS OF PROFESSIONAL CONDUCT
Members offer services in the areas of their competence and experience, affording full disclosure of their qualifications.
Members consider the consequences of their work and societal issues pertinent to it and seek to extend public understanding of those relationships.
Members are honest, truthful, and fair in presenting information and in making public statements reflecting on professional matters and their professional role.
Members engage in professional relationships without bias because of race, religion, sex, age, national origin or impairment.
Members act in professional matters for each employer or client as faithful agents or trustees, disclosing nothing of a proprietary nature concerning the business affairs or technical processes of any present or former client or employer without specific consent.
Members disclose to affected parties known or potential conflicts of interest or other circumstances which might influence—or appear to influence—judgement or impair the fairness or quality of their performance.
Members are personally responsible for enhancing their own professional competence throughout their careers and for encouraging similar actions by their colleagues.
Members accept responsibility for their actions; seek and acknowledge constructive criticism of their work; offer honest constructive criticism of the work of others; properly credit the contributions of others; and do not accept credit for work not theirs.
Members perceiving a consequence of their professional duties to adversely affect the present or future public health and safety shall formally advise their employers or clients and, if warranted, consider further disclosure.
Members of the Society of Manufacturing Engineers act in accordance with all applicable laws and the Constitution & Bylaws of the Society of Manufacturing Engineers and lend support to others who strive to do likewise.
Members of the Society of Manufacturing Engineers shall aid in preventing the election to membership of those who are unqualified or do not meet the standards set forth in this Code of Ethics.

Approved by: Society of Manufacturing Engineers Board of Directors
Date: December 2, 1990
Last modified: January 18, 2001
Supervision/Management

• Supervision is the motivation and guidance of subordinates toward goals established by the enterprise

• Management is the activity that allocates and utilizes resources to achieve organizational goals
Components of Management

- Leadership
- Planning
- Budgeting
- Control
Managerial Grid

<table>
<thead>
<tr>
<th>Concern for People</th>
<th>Concern for Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 1.9 Country Club Management</td>
<td></td>
</tr>
<tr>
<td>8 Thoughtful attention to needs of people for satisfying relationships leads to a comfortable, friendly organizational atmosphere and work tempo</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>6 5.5 Organization Man Management</td>
<td></td>
</tr>
<tr>
<td>Adequate organization performance is possible through balancing the necessity to get out work while maintaining morale of people at satisfactory level</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>4 1.1 Impoverished Management</td>
<td></td>
</tr>
<tr>
<td>Exertion of minimum effort to get required work done is appropriate and sustains organization membership</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2 9.1 Authority-obedience</td>
<td></td>
</tr>
<tr>
<td>Efficiency in operations results from arranging conditions of work in such a way that human elements interfere to a minimum degree</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

F 45-3
Planning System Key Elements

- Plan or desired state
- Actual performance
- Controls to compare the plan with actual performance
- Suggested changes for improvement
Budgeting

• A *budget* is a financial plan for an organizational unit

• It permits planning, coordinates, and controlling the flow of capital for a given unit in conjunction with divisional company budgets
Control

• *Management control* – is the process by which managers ensure that resources are obtained and used effectively and efficiently in achieving the organizations objectives

• The function of management control is to facilitate reaching organizational goals by implementing strategies identified in the planning process
Management Systems

• Centralization – Decentralization
• Line-and-staff
• Span of management (span-of-control)
Centralization – Decentralization

• If authority resides in one person, the organization is highly centralized
• Decentralization is the extent to which authority is delegated
• The more decisions made at the lower levels, the more decentralized the organization
Line and Staff

- *Line relationships* are established by the flow of authority
- Line departments are performing activities critical to the operation of the company
- *Staff relationships* are advisory in nature
- Staff departments contribute financial, legal, and engineering advice to the organization
Line and Staff Organizational Chart

- Plant Manager
  - Legal Department
  - Finance Department
  - Area Manager
    - Manufacturing Engineer
    - Project Engineer
  - Line Supervisor
Span of Management
or
Span of Control

• Refers to the number of subordinates a manager has under his/her control

• The higher a manager position in a line-and-staff organization the greater their control in the corporation
Management Product Control Tools

- Critical Path Method (CPM)
- Gantt Chart
- Program Evaluation and Review Technique (PERT)
Critical Path Method (CPM)
Gantt Chart

F 45-6 (Veilleux and Petro, 1988)
Program Evaluation and Review Technique (PERT)

• Best suited in planning and controlling large and complex projects

• PERT identifies tasks that are not being accomplished within the time estimates
Problem Solving Steps

- Problem recognition
- Problem definition or specification
- Developing possible causes
- Testing for the most probable causes
- Verifying the problem solution
- Updating documentation
- Training personnel
Common Problem Solving Tools

• *Ishikawa* or fishbone diagrams used for cause and effect analysis

• *Pareto analysis* – focus on the few problems that are generating the majority of the defects
Ishikawa Diagram

F 45-7 (Bakerjian, 1993)
Organizational/ Industrial Psychology Techniques

- Use of teams
- Participatory management
- Goal setting, Example: MBO System
- Continuous improvement
- Deming’s 14 points
Components of a Successful Team

- Clear sense of direction (goal)
- Members with diverse and appropriate skills
- Clear and motivating responsibilities and the authority to fulfill them
- Fair operating guidelines and practices
- Supportive relationships between team members
- Positive reinforcement
- Supportive relationships between team members and nonteam members
Participatory Management

- *Participatory Management* techniques are based on power sharing among managers who, in a traditional command-and-control organization are the sole executors of power.
- The organization is based on the premise that group participatory problem solving and decision-making contribute to higher quality problem solutions, while increasing the level of worker commitment
Characteristics of Participatory Management Systems

• Unwavering commitment to the process by the highest levels of management
• Effective and constant communication up, down, and sideways throughout the organization
• Trust between management and the work force
• True empowerment of employees to implement their decisions
Continuous Improvement Concept

• U.S. companies view manufacturing process as static and spend 1/3 of R+D budget on process improvement and 2/3 on product improvement

• Japanese companies see the company as dynamic and spend 2/3 budget on process improvement and 1/3 on product improvement
Deming’s 14 Points

1. Create constancy of purpose toward improvement of product and service, with the aim to become competitive, stay in business, and provide jobs.

2. Adopt the new philosophy. We are in a new economic age. Western management must awaken to the challenge, learn their responsibilities, and take on leadership for change.

3. Cease dependence on inspection to achieve quality. Eliminate the need for inspection on a mass basis by building quality into the product in the first place.

4. End the practice of awarding business on the basis of price tag. Instead, minimize total cost. Move toward a single supplier of any one item on a long term relationship of loyalty and trust.

5. Improve constantly and forever the system of production and service, to improve quality and productivity, and thus constantly decrease costs.
Deming’s 14 Points

6. Institute training on the job.

7. Institute leadership. The aim of supervision should be to help people and machines and gadgets to do a better job. Supervision of management is in need of overhaul, as well as supervision of production workers.

8. Drive out fear, so that everyone may work effectively for the company.


10. Eliminate slogans, exhortations, and targets for the work force asking for zero defects and new levels of productivity.
Deming’s 14 Points

11. Eliminate work standards (quotas) on the factory floor. Eliminate management by objective, management by numbers, numerical goals. Substitute leadership.

12. Remove barriers that rob the hourly worker, and people in management and engineering of their right to pride and workmanship.

13. Institute a vigorous program of education and self-improvement.

14. Put everybody in the company to work to accomplish the transformation. It is everybody’s job.
Labor, Safety, and Human Factors

Chapter 46
Labor Management Relations Act(s)

- 1935 – (Wagner Act) National Labor Relations Act
- 1947 – (Taft-Hartley Act) Labor Management Relations Act (LMRA)
- 1957 – (Landrum-Griffin Act) Labor-Management Reporting and Disclosure Act
Labor Management Relations Act
(Basic Employee Rights as Defined in Section 7)

- Self-organization to form, join, or assist labor organizations
- To bargain collectively through representatives of their own choosing
- To engage in other concentrated activities for the purpose of collective bargaining
- To refrain from any of all such activities except to the extent that such right may be affected by an agreement requiring membership in a labor organization as a condition of employment
OSHA - December 1970
Occupational Safety & Health Act

- Federal Standards For:
- 1. Inspection
- 2. Citations
- 3. Penalties
- 4. New Standards
- 5. Revise Old Standards
Public Law 91-596

• Section 5 (a) Each employer....

• Shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees....
Public Law 91-596

• Section 5(b) Each employer….

• Each employee shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to this Act which are applicable to his own actions and conduct.
Ergonomics (Health Factors)

• Concerned with the effective and safe application of workers as elements of a system

• Human factors include: engineering anthropometry, lighting, noise, vibration, and repetitive motion
## Anthropometric Data for Common Working Positions

<table>
<thead>
<tr>
<th>Feature</th>
<th>5th Percentile</th>
<th>95th Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men (in.)</td>
<td>Women (in.)</td>
</tr>
<tr>
<td>Stature—clothed</td>
<td>66.4</td>
<td>61.8</td>
</tr>
<tr>
<td></td>
<td>1,687</td>
<td>1,570</td>
</tr>
<tr>
<td>Functional forward reach</td>
<td>28.3</td>
<td>25.2</td>
</tr>
<tr>
<td></td>
<td>719</td>
<td>640</td>
</tr>
<tr>
<td>Overhead reach, standing</td>
<td>78.9</td>
<td>73.0</td>
</tr>
<tr>
<td></td>
<td>2,004</td>
<td>1,854</td>
</tr>
<tr>
<td>Overhead reach, sitting</td>
<td>50.3</td>
<td>46.2</td>
</tr>
<tr>
<td></td>
<td>1,278</td>
<td>1,174</td>
</tr>
<tr>
<td>Functional leg length</td>
<td>43.5</td>
<td>39.2</td>
</tr>
<tr>
<td></td>
<td>1,105</td>
<td>996</td>
</tr>
<tr>
<td>Kneeling height</td>
<td>48.0</td>
<td>45.1</td>
</tr>
<tr>
<td></td>
<td>1,219</td>
<td>1,146</td>
</tr>
<tr>
<td>Kneeling leg length</td>
<td>25.2</td>
<td>23.3</td>
</tr>
<tr>
<td></td>
<td>640</td>
<td>592</td>
</tr>
</tbody>
</table>
Safety Hazards

- Electrical/Lighting
- Fire
- Noise
- Vibration
- Repetitive Motion
- Visual
Lighting and Workplace Effectiveness

• Illumination in the workplace can strongly affect worker performance

• Proper lighting is required for the safe and effective execution of work
Intensity and Quality of Light

• *Luminance* is a measure of the light intensity emitted from a light source per unit area normal to the direction of the light flux

• *Illuminance*, the part of the total light flux that is incident on a given surface
## Recommended ranges of Illumination

<table>
<thead>
<tr>
<th>Type of Activity or Area</th>
<th>Recommended Illumination fc (lux)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public areas with dark surroundings</td>
<td>2–5 (22–54)</td>
</tr>
<tr>
<td>Areas for brief visits</td>
<td>5–10 (54–108)</td>
</tr>
<tr>
<td>Working areas where visual tasks are occasionally performed</td>
<td>10–20 (108–215)</td>
</tr>
<tr>
<td>Performance of visual tasks of high contrast or large size</td>
<td>20–50 (215–538)</td>
</tr>
<tr>
<td>(reading printed matter or rough assembly)</td>
<td></td>
</tr>
<tr>
<td>Performance of visual tasks of low contrast or small size</td>
<td>100–200 (1,076–2,153)</td>
</tr>
<tr>
<td>(reading handwritten text or difficult inspection)</td>
<td></td>
</tr>
<tr>
<td>Performance of visual tasks of extremely low contrast and small size</td>
<td>1,000–2,000 (10,764–21,528)</td>
</tr>
<tr>
<td>(surgical procedures or circuit-board repair)</td>
<td></td>
</tr>
</tbody>
</table>

T 46-2
## Control of Electrical Hazards

<table>
<thead>
<tr>
<th>Type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical</td>
<td>Materials used</td>
</tr>
<tr>
<td></td>
<td>Design of Components</td>
</tr>
<tr>
<td></td>
<td>Placement of Equipment</td>
</tr>
<tr>
<td>Switching Devices</td>
<td>Lockouts</td>
</tr>
<tr>
<td></td>
<td>Interlocks</td>
</tr>
<tr>
<td></td>
<td>Thermal and Overspeed Cutouts</td>
</tr>
<tr>
<td>Overcurrent Devices</td>
<td>Fuses</td>
</tr>
<tr>
<td></td>
<td>Circuit Breakers</td>
</tr>
<tr>
<td></td>
<td>Ground Fault Circuit Interrupter (GFC)</td>
</tr>
</tbody>
</table>
Fire Classifications

• A. Trash - Wood - Paper
• B. Liquid - Grease
• C. Electrical
• D. Metal
Fire Symbols

- Ordinary combustibles
- Flammable liquids
- Electrical equipment
- Combustible metals
Noise (Unwanted Sound)

- Frequency measured in Hertz (Hz)
- Intensity defined in decibels (dB)
- Most industrialized countries have legally enforceable maximum noise levels for workers
OSHA Noise Exposure Levels

<table>
<thead>
<tr>
<th>Duration per Day (hours)</th>
<th>Sound Level (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>90</td>
</tr>
<tr>
<td>6</td>
<td>92</td>
</tr>
<tr>
<td>4</td>
<td>95</td>
</tr>
<tr>
<td>3</td>
<td>97</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>1.5</td>
<td>102</td>
</tr>
<tr>
<td>1</td>
<td>105</td>
</tr>
<tr>
<td>0.5</td>
<td>110</td>
</tr>
<tr>
<td>0.25 or less</td>
<td>115</td>
</tr>
</tbody>
</table>

(Drozda and Wick 1983)
Vibration

- Vibration from 4-8 Hz cause internal organs to resonate
- Prolonged exposure to vibrations of approximately 1g can cause abdominal pain, loss of equilibrium, and nausea
- Sequential vibrations to the hands in the range of 1.5-80-g with frequencies from 8-5,000 Hz may result in stiffness, numbness, and loss of strength with prolonged exposure
Repetitive Motion

- Repetitive-motion disorders or cumulative trauma disorders (CTD) may result from the execution of a simple task over a long period of time.

- Common types: Tendinitis, Carpel Tunnel Syndrome, Rotary Cuff Injury, and Tenosynovitis.
Engineering Economics

• Techniques for evaluating financial decisions in the engineering enterprise

• Objective is to provide a means of making economically sound decisions
## Compound Interest Formulas

<table>
<thead>
<tr>
<th>Symbol</th>
<th>To Find</th>
<th>Given</th>
<th>Formula</th>
<th>Name and Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>$(F/P, i, n)$</td>
<td>$F$</td>
<td>$P$</td>
<td>$(1 + i)^n$</td>
<td>Single-payment compound amount factor (find the amount that results from leaving a given amount in a bank account)</td>
</tr>
<tr>
<td>$(P/F, i, n)$</td>
<td>$P$</td>
<td>$F$</td>
<td>$\frac{1}{(1+i)^n}$</td>
<td>Single-payment present worth factor (find the amount that must be left in a bank account in order to yield a desired amount)</td>
</tr>
<tr>
<td>$(A/P, i, n)$</td>
<td>$A$</td>
<td>$P$</td>
<td>$\frac{i(1+i)^n}{(1+i)^n - 1}$</td>
<td>Uniform series capital recovery factor (find the payment on a car loan)</td>
</tr>
<tr>
<td>$(P/A, i, n)$</td>
<td>$P$</td>
<td>$A$</td>
<td>$\frac{(1+i)^n - 1}{i(1+i)^n}$</td>
<td>Uniform series present worth factor (find the amount that can be borrowed given a fixed monthly payment)</td>
</tr>
<tr>
<td>$(A/F, i, n)$</td>
<td>$A$</td>
<td>$F$</td>
<td>$\frac{i}{(1+i)^n - 1}$</td>
<td>Uniform series sinking fund factor (find the amount that must be deposited into an individual retirement account each month to yield a desired amount at retirement)</td>
</tr>
<tr>
<td>$(F/A, i, n)$</td>
<td>$F$</td>
<td>$A$</td>
<td>$\frac{(1+i)^n - 1}{i}$</td>
<td>Uniform series compound amount factor (find the amount that results from a series of fixed deposits into a bank account)</td>
</tr>
</tbody>
</table>
Equivalent Uniform Annual Cost (EVAC)

• Allows the comparison of a non-uniform series of cash flows to identify the minimum cost alternative

• Assumptions in applying this approach
  – There is a uniform time value or interest rate on all money involved in the problem whether it is borrowed or not.
  – The annual cost of an asset is reduced by the money made from the sale or salvage of an asset at the end of its useful life
  – If two alternatives have different useful service lives, it is assumed that asset with the shorter life will be replaced with an identical item
Cost Estimating

- **Manufacturing cost estimating** is the process of forecasting total cost associated with the completion of a set of manufacturing costs.
- Cost control is the process of updating or refining prior initial cost estimates for a sequence of manufacturing operations currently in process.
- Cost control is a function related to project performance (living within the budget).
Three Cost Categories

- **Fixed**: set up costs for machine tools, indirect labor, and indirect manufacturing

- **Variable**: per-piece direct labor and direct material costs for assembled and machined parts

- **Semi fixed**: costs to change cutting tools and scheduled maintenance
Direct Labor

• Is the cost of all “hands-on” effort associated with the manufacture of a specific product.

• Example: machining and assembly
Direct Material

• Is the cost of all components included in the end product being produced

• Examples: components or raw materials that are permanent parts of the end product
Indirect Labor

• Is the cost of all labor effort that cannot be directly associated with the manufacture of a product

• Examples: Salaries of workers, purchasing, accounting, personnel, marketing, managers and supervisors
Indirect Manufacturing Costs

• Indirect Manufacturing Cost (IMC) or Overhead Costs

• Examples: rent, utilities, building and equipment, depreciation, and expendable factory supplies
General and Administrative Costs

• Incurred at the plant level that are not associated with a specific work center or department

• Examples: executive salaries, mainframe computers, computer operation costs, and technical library facilities
Tooling and Equipment Costs

• Are incurred for the fabrication of jigs and fixtures for machining

• Tooling and test equipment costs are generally fixed
Value Engineering

• Provides a systematic approach to evaluating design alternatives

• Obtaining the maximum performance per unit costs is the primary objective of value engineering
Value Engineering Variables

- *Functional value* reflects the properties or qualities of a product that accomplish the intended work or service.
- *Esteem value* is composed of the properties, features, or attractiveness that make ownership of the product desirable.
- *Waste* describes features or properties of the design providing neither functional value nor esteem value.
## Estimated Scale of Value

<table>
<thead>
<tr>
<th>Tie</th>
<th>5% function</th>
<th>90% esteem</th>
<th>5% waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hammer</td>
<td>80% function</td>
<td>15% esteem</td>
<td>5% waste</td>
</tr>
<tr>
<td>Tie clasp</td>
<td>20% function</td>
<td>75% esteem</td>
<td>5% waste</td>
</tr>
<tr>
<td>Button</td>
<td>90% function</td>
<td>10% esteem</td>
<td></td>
</tr>
</tbody>
</table>

F 47-1 (Courtesy Industrial Technology Institute)