Human Resources and Job Design

Dr. Richard Jerz
Learning Objectives

• Explain the importance of work design.
• Describe the two basic approaches to job design.
• Discuss the advantages and disadvantages of specialization.
• Explain the purpose of methods analysis, standard time, and describe how methods studies are performed.
• Contrast time and output pay systems.
• Understand “ergonomics”
The objective of a human resource strategy is to manage labor and design jobs so people are effectively and efficiently utilized.

- People should be effectively utilized within the constraints of other operations management decisions.
- People should have a reasonable quality of work life in an atmosphere of mutual commitment and trust.
Cultural Differences

- Americans
- Japanese
- Chinese
- Europeans
- Mexicans
- Canadians
- Other countries
Constraints on Human Resource Strategy

**Product strategy**
- Skills needed
- Talents needed
- Materials used
- Safety

**Process strategy**
- Technology
- Machinery and equipment used
- Safety

**Schedules**
- Time of day
- Time of year (seasonal)
- Stability of schedule

**Individual differences**
- Strength and fatigue
- Information processing and response

**Location strategy**
- Climate
- Temperature
- Noise
- Light
- Air quality

**Layout strategy**
- Fixed position
- Process
- Assembly line
- Work cell
- Product
Labor Planning

• **Follow demand exactly**
  - Matches direct labor costs to production
  - Incurs costs in hiring and termination, unemployment insurance, and premium wages
  - Labor is treated as a variable cost

• **Hold employment constant**
  - Maintains trained workforce
  - Minimizes hiring, termination, and unemployment costs
  - Employees may be underutilized during slack periods
  - Labor is treated as a fixed cost
Job Design

- **Job design** involves specifying the content and methods of job
  - What will be done
  - Who will do the job
  - How the job will be done
  - Where the job will be done
  - **Ergonomics**: Incorporation of human factors in the design of the workplace
Successful Job Design must be:

- Carried out by experienced personnel with the necessary training and background
- Consistent with the goals of the organization
- In written form
- Understood and agreed to by both management and employees
“Job Classification” and Work Rules

• Specify who can do what
• Specify when they can do it
• Specify under what conditions they can do it
• Often result of union pressure
• Restricts flexibility in assignments and consequently efficiency of production
Labor Specialization

- The division of labor into unique tasks
- First suggested by Adam Smith in 1776
  - Development of dexterity and faster learning
  - Less loss of time
  - Development of specialized tools
- Later Charles Babbage (1832) added another consideration
  - Wages exactly fit the required skill
Who Designs Work Systems

- Industrial Engineers (quantitative)
- Industrial Psychologists (qualitative)
“Psychological” Job Design

- Human resource strategy requires consideration of the psychological components of job design
- Adding more variety to jobs, reduce boredom

- Job enlargement
- Job rotation
- Job enrichment
- Employee empowerment
Behavioral Approaches to Job Design

- **Job Enlargement**
  - Giving a worker a larger portion of the total task by horizontal loading
- **Job Rotation**
  - Workers periodically exchange jobs
- **Job Enrichment**
  - Increasing responsibility for planning and coordination tasks, by vertical loading
- **Teams**
Job Enlargement/Enrichment

Enriched job
Planning
(participating in a cross-function quality-improvement team)

Present job
(manually insert and solder six resistors)

Enlarged job
Task #2
(adhere labels to printed circuit board)

Task #3
(lock printed circuit board into fixture for next operation)

Control
(Test circuits after assembly)
Benefits of Teams

- People are “social”
- Team decisions and productivity is greater than individuals
- Groups work together to reach a common goal
- Improved job satisfaction
- Increased motivation
- Improved productivity and quality
- Reduced turnover and absenteeism
“Work Schedules” Options

- **Standard work schedule**
  - Five eight-hour days
- **Flex-time**
  - Allows employees, within limits, to determine their own schedules
- **Flexible work week**
  - Fewer but longer days
- **Part-time**
  - Fewer, possibly irregular, hours
“Scientific Management”

- Frederick Taylor
- Gilbreths
Methods Analysis, Descriptive and Quantitative Techniques

• Focuses on how task is performed
• Methods Analysis
  • Flow process chart
  • Two hand simo charts
  • Worker-Machine charts
• Incentive Standards
  • Time study
  • Motion study
  • Work sampling
# Flow Process Chart

**Present Method [X]**  **PROCESS CHART**  **Proposed Method [ ]**

**SUBJECT CHARTED:** Hamburger Assembly Process  **DATE:** 8/1/05  
**CHART BY:** KH  **CHART NO:** 1  
**DEPARTMENT:**  **SHEET NO:** 1 OF 1

<table>
<thead>
<tr>
<th>DIST. IN FEET</th>
<th>TIME IN MINS</th>
<th>CHART SYMBOLS</th>
<th>PROCESS DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>—</td>
<td>.05</td>
<td>○⇒□⇒□●▼</td>
<td>Meat Patty in Storage</td>
</tr>
<tr>
<td>1.5</td>
<td>2.50</td>
<td>○⇒□⇒□●▼</td>
<td>Broiler</td>
</tr>
<tr>
<td>.05</td>
<td></td>
<td>○⇒□⇒□●▼</td>
<td>Visual Inspection</td>
</tr>
<tr>
<td>1.0</td>
<td>.05</td>
<td>○⇒□⇒□●▼</td>
<td>Transfer to Rack</td>
</tr>
<tr>
<td>.15</td>
<td></td>
<td>○⇒□⇒□●▼</td>
<td>Temporary Storage</td>
</tr>
<tr>
<td>.5</td>
<td>.10</td>
<td>○⇒□⇒□●▼</td>
<td>Obtain Buns, Lettuce, etc.</td>
</tr>
<tr>
<td>.20</td>
<td></td>
<td>○⇒□⇒□●▼</td>
<td>Assemble Order</td>
</tr>
<tr>
<td>.5</td>
<td>.05</td>
<td>○⇒□⇒□●▼</td>
<td>Place in Finish Rack</td>
</tr>
<tr>
<td>3.5</td>
<td>3.15</td>
<td>2 4 1 — 2</td>
<td>TOTALS</td>
</tr>
</tbody>
</table>

Value-added time = Operation time/Total time = (2.50+.20)/3.15 = 85.7%

○ = operation; ⇒ = transportation; □ = inspection; ▽ = delay; ▼ = storage.
# Two-Hand Simo Chart

## SIMO Chart

<table>
<thead>
<tr>
<th>TIME</th>
<th>LEFT HAND-DESCRIPTION</th>
<th>ACTION CLASS</th>
<th>RIGHT HAND-DESCRIPTION</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:00</td>
<td>Reach for finger</td>
<td>RE</td>
<td>Reach for finger</td>
<td>12</td>
</tr>
<tr>
<td>0:05</td>
<td>Grip</td>
<td>G</td>
<td>Grip</td>
<td>19</td>
</tr>
<tr>
<td>0:15</td>
<td>Move</td>
<td>M</td>
<td>Move</td>
<td>21</td>
</tr>
<tr>
<td>0:20</td>
<td>Position and release</td>
<td>P</td>
<td>Position and release</td>
<td>25</td>
</tr>
<tr>
<td>0:25</td>
<td>Grip-clamp</td>
<td>G</td>
<td>Grip-clamp</td>
<td>15</td>
</tr>
<tr>
<td>0:30</td>
<td>Unwrap</td>
<td>U</td>
<td>Unwrap</td>
<td>10</td>
</tr>
<tr>
<td>0:35</td>
<td>Move and release</td>
<td>M</td>
<td>Move and release</td>
<td>12</td>
</tr>
<tr>
<td>0:40</td>
<td>Release</td>
<td>RL</td>
<td>Release</td>
<td>22</td>
</tr>
<tr>
<td>0:45</td>
<td>TOTALS</td>
<td></td>
<td></td>
<td>2911</td>
</tr>
</tbody>
</table>

### Summary

- **Left Hand Summary**
  - Reach: 249, 2.45%
  - Grip: 219, 2.21%
  - Move: 354, 3.43%
  - Position: 887, 8.84%
  - Use: 926, 9.26%
  - Idle: 30, 0.30%
  - Release: 29, 0.29%

- **Right Hand Summary**
  - Reach: 249, 2.45%
  - Grip: 219, 2.21%
  - Move: 354, 3.43%
  - Position: 887, 8.84%
  - Use: 926, 9.26%
  - Idle: 30, 0.30%
  - Release: 29, 0.29%

- **Total Time**: 2911 ms

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# Worker-Machine Chart

**Product:** Bulk Food  
**Process:** Weigh/price  
**Operator:** L.W.  
**Charted by:** R.G.

<table>
<thead>
<tr>
<th>Step</th>
<th>Employee</th>
<th>Time (seconds)</th>
<th>Machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Accepts plastic bag from customer and places on scale</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Enters price/lb</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Obtains price sticker and removes bag</td>
<td>3</td>
<td>Calculates and displays total price. Dispenses price sticker.</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Places price sticker on bag</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Hands bag to customer</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

## Summary

<table>
<thead>
<tr>
<th>Employee</th>
<th>Machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time (seconds)</td>
<td>Time (seconds)</td>
</tr>
<tr>
<td>Work</td>
<td>7</td>
</tr>
<tr>
<td>Idle</td>
<td>1</td>
</tr>
</tbody>
</table>
Activity Chart

ACTIVITY CHART

<table>
<thead>
<tr>
<th>OPERATOR #1</th>
<th>OPERATOR #2</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIME %</td>
<td>TIME %</td>
</tr>
<tr>
<td>WORK 12 100</td>
<td>12 100</td>
</tr>
<tr>
<td>IDLE 0 0</td>
<td>0 0</td>
</tr>
</tbody>
</table>

OPERATION: Oil change & fluid check
EQUIPMENT: One bay/pit
OPERATOR: Two-person crew
STUDYNO: ANLYST: NG

SUBJECT: Quick Car Lube
DATE: 8-1-05

<table>
<thead>
<tr>
<th>TIME</th>
<th>Operator #1</th>
<th>Operator #2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Take order</td>
<td>Move car to pit</td>
</tr>
<tr>
<td>4</td>
<td>Vacuum car</td>
<td>Drain oil</td>
</tr>
<tr>
<td>6</td>
<td>Clean windows</td>
<td>Check transmission</td>
</tr>
<tr>
<td>8</td>
<td>Check under hood</td>
<td>Change oil filter</td>
</tr>
<tr>
<td>10</td>
<td>Fill with oil</td>
<td>Replace oil plug</td>
</tr>
<tr>
<td>12</td>
<td>Complete bill</td>
<td>Move car to front for customer</td>
</tr>
<tr>
<td>14</td>
<td>Greet next customer</td>
<td>Move next car to pit</td>
</tr>
<tr>
<td>16</td>
<td>Vacuum car</td>
<td>Drain oil</td>
</tr>
<tr>
<td>18</td>
<td>Clean windows</td>
<td>Check transmission</td>
</tr>
</tbody>
</table>

Repeat cycle
Motion study is the systematic study of the human motions used to perform an operation.
Motion Study Techniques

- **Motion study principles** - guidelines for designing motion-efficient work procedures
- **Analysis of therbligs** - basic elemental motions into which a job can be broken down
- **Micromotion study** - use of motion pictures and slow motion to study motions that otherwise would be too rapid to analyze
Motion Study Techniques

- **Motion study principles** - guidelines for designing motion-efficient work procedures
- **Analysis of therbligs** - basic elemental motions into which a job can be broken down
- **Micromotion study** - use of motion pictures and slow motion to study motions that otherwise would be too rapid to analyze

<table>
<thead>
<tr>
<th>18 therbligs</th>
</tr>
</thead>
<tbody>
<tr>
<td>➡️ Search</td>
</tr>
<tr>
<td>➡️ Find</td>
</tr>
<tr>
<td>➤ Select</td>
</tr>
<tr>
<td>🍃 Grasp</td>
</tr>
<tr>
<td>🎥 Hold</td>
</tr>
<tr>
<td>🌿 Transport Loaded</td>
</tr>
<tr>
<td>🌿 Transport Empty</td>
</tr>
<tr>
<td>🌿 Transport Loaded</td>
</tr>
<tr>
<td>🌿 Transport Empty</td>
</tr>
</tbody>
</table>
Developing Work Methods

- Eliminate unnecessary motions
- Combine activities
- Reduce fatigue
- Improve the arrangement of the workplace
- Improve the design of tools and equipment
Labor Standards and Time Standards

• Effective manpower planning is dependent on a knowledge of the labor required
• Labor standards are the amount of time required to perform a job or part of a job
• Accurate labor standards help determine labor requirements, costs, and fair work

• The time to perform tasks should be established by “scientific” methods
Work Measurement

- **Work measurement**: Determining how long it should take to do a job.
  - Standard time
  - Stopwatch time study
  - Historical times
  - Predetermined data
  - Work Sampling
Stopwatch Time Study

• **Stopwatch Time Study**: Development of a time standard based on observations of one worker taken over a number of cycles.

• **The basic steps in a time study:**
  • Define the task to be studied
  • Determine the number of cycles to observe
  • Time the job
  • Compute the standard time
Standard Time

- The amount of time it should take a qualified worker to complete a specific task, working at a sustainable rate, using given methods, tools and equipment, raw materials, and workplace arrangement.
<table>
<thead>
<tr>
<th>Step</th>
<th>Action Description</th>
<th>Time (s)</th>
<th>% of the total time</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Turn to bench from fin. stock pallet bay. Pick up carton. Push carton up. Push with B.H. and lower carton.</td>
<td>.079</td>
<td>1/1</td>
<td>105 107 93</td>
</tr>
<tr>
<td>2</td>
<td>Reach to tape dispenser with L.H. and remove 10&quot; piece.</td>
<td>.065</td>
<td>1/1</td>
<td>105 107 110 109</td>
</tr>
<tr>
<td>3</td>
<td>Reach to cover in pallet box with R.H. Grasp cover.</td>
<td>.065</td>
<td>1/1</td>
<td>107 110 112 109</td>
</tr>
<tr>
<td>4</td>
<td>Fold carton at end and. Reach to tape dispenser with L.H. and remove pieces while R.H. holds down flaps.</td>
<td>.07</td>
<td>1/1</td>
<td>104 109 112 109</td>
</tr>
<tr>
<td>5</td>
<td>Reach to label on bench with L.H. Grasp label and run through writing application. While R.H. holds carton.</td>
<td>.096</td>
<td>1/1</td>
<td>104 107 110 109</td>
</tr>
</tbody>
</table>

Total time: 1.338 seconds

Standard time: 1.338 seconds
“Modern” Time Study

• “With WorkStudy+ you can:”
  • Perform virtually any time study projects
  • Perform sampling and random sampling study projects
  • Perform multi-subject simultaneous studies
  • Fully customize element lists that can be organized hierarchically
  • Generate detailed statistical reports
  • Import study data to Excel or Access for further analysis, and more!

Digital Video
Predetermined Time Standards

- Predetermined time standards: Published data based on extensive research to determine standard elemental times.
- Advantages:
  - Based on large number of workers under controlled conditions
  - Analyst not requires to rate performance
  - No disruption of the operation
  - Standards can be established
Work Sampling

- **Work sampling**: technique for estimating the proportion of time that a worker or machine spends on various activities and idle time.
- Work sampling involves making brief observations of a worker or machine at random intervals
- Work sampling does not require
  - timing an activity
  - continuous observation of an activity
Other Human Considerations

- Motivation
- Compensation
- Ethics
Motivation and Incentive Systems

- Bonuses - cash or stock options
- Profit-sharing - profits for distribution to employees
- Gain sharing - rewards for improvements
- Incentive plans - typically based on production rates
- Knowledge-based systems - reward for knowledge or skills
Compensation Alternatives

- **Time-based system**
  - Compensation based on time an employee has worked during a pay period
- **Output-based (incentive) system**
  - Compensation based on the amount of output an employee produces during a pay period
Compensation

- Individual incentive plans
- Group incentive plans
- Knowledge-based pay system
- Management compensation
Ethics and the Work Environment

• Fairness, equity, and ethics are important constraints of job design
• Important issues may relate to equal opportunity, equal pay for equal work, and safe working conditions
• Helpful to work with government agencies, trade unions, insurers, and employees
Ergonomics/Human Factors

- Ergonomics is the study of the interface between man and machine
  - Often called human factors
- The work environment
  - Illumination
  - Noise
  - Temperature
  - Humidity
- The equipment and tools that people use
Hawthorne Studies

- They studied light levels, but discovered productivity improvement was independent from lighting levels
- Introduced psychology into the workplace
- The workplace social system and distinct roles played by individuals may be more important than physical factors
- Individual differences may be dominant in job expectation and contribution
## Levels of Illumination

<table>
<thead>
<tr>
<th>Task Condition</th>
<th>Type of Task or Area</th>
<th>Illumination Level</th>
<th>Type of Illumination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small detail, extreme accuracy</td>
<td>Sewing, inspecting dark materials</td>
<td>100</td>
<td>Overhead ceiling lights and desk lamp</td>
</tr>
<tr>
<td>Normal detail, prolonged periods</td>
<td>Reading, parts assembly, general office work</td>
<td>20-50</td>
<td>Overhead ceiling lights</td>
</tr>
<tr>
<td>Good contrast, fairly large objects</td>
<td>Recreational facilities</td>
<td>5-10</td>
<td>Overhead ceiling lights</td>
</tr>
<tr>
<td>Large objects</td>
<td>Restaurants, stairways, warehouses</td>
<td>2-5</td>
<td>Overhead ceiling lights</td>
</tr>
</tbody>
</table>
Ergonomic Keyboards
Ergonomic Snow Shovels
The Visual Workplace

- Use low-cost visual devices to share information quickly and accurately
- Displays and graphs replace printouts and paperwork
- Able to provide timely information in a dynamic environment