

Work Design and Measurement

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Lecture 7



Job Design

- The act of specifying the contents and methods of jobs
 - What will be done in a job
 - Who will do the job
 - How the job will be done
 - Where the job will be done
- Importance
 - Organizations are dependent on human efforts to accomplish their goals
 - Many job design topics are relevant to continuous and productivity improvement
- Objectives
 - Productivity
 - Safety
 - Quality of work life



Efficiency vs. Behavioral Job Design

- **Efficiency School**

- Emphasizes a systematic, logical approach to job design
- A refinement of Frederick Winslow Taylor's scientific management concepts

- **Behavioral School**

- Emphasizes satisfaction of needs and wants of employees

Specialization is a primary issue of disagreement between the efficiency and behavioral approaches

Specialization

Specialization is the primary area of disagreement between these two schools.

Advantages	
For management: 1. Simplifies training 2. High productivity 3. Low wage costs	For employees: 1. Low education and skill requirements 2. Minimum responsibility 3. Little mental effort needed
Disadvantages	
For management: 1. Difficult to motivate quality 2. Worker dissatisfaction, possibly resulting in absenteeism, high turnover, disruptive tactics, poor attention to quality	For employees: 1. Monotonous work 2. Limited opportunities for advancement 3. Little control over work 4. Little opportunity for self-fulfillment

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



Motivation

- Motivation is a key factor in many aspects of work life
 - Influences quality and productivity
 - Contributes to the work environment
- Trust is an important factor that affects motivation
- More motivated employees are more likely to suggest improvements in the work environment.



Teams

- Teams take a variety of forms:
 - Short-term team
 - Formed to collaborate on a topic or solve a problem
 - Long-term teams
 - **Self-directed teams**
 - Groups empowered to make certain changes in their work processes
 - Self-directed teams tend to be given responsibility only for their processes



Teams (cont.)

- **Benefits of teams**
 - Higher quality
 - Higher productivity
 - Greater worker satisfaction
- **Team problems**
 - Some managers feel threatened
 - Conflicts between team members



Requirement for successful team building

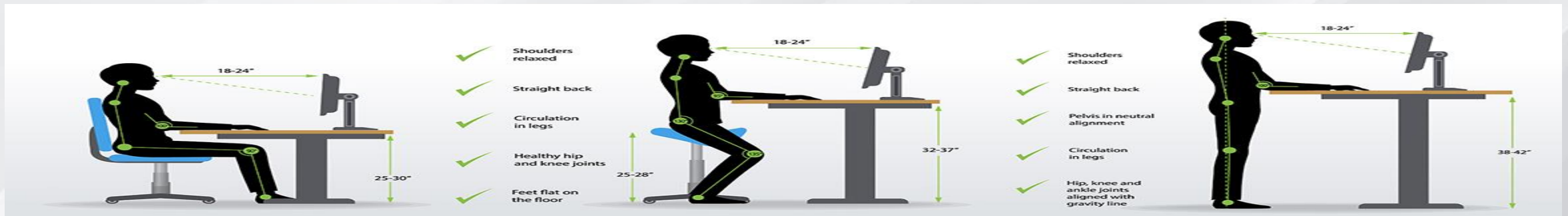
Expert Robert Bacal has a list of requirements for successful team building:

1. Clearly stated and commonly held vision and goals.
2. Talent and skills required to meet goals.
3. Clear understanding of team members' roles and functions.
4. Efficient and shared understanding of procedures & norms.
5. Effective and skilled interpersonal relations.
6. A system of reinforcement and celebration.
7. Clear understanding of the team's relationship to the greater organization.

Ergonomics

Scientific discipline concerned with the understanding of human interaction with the elements of a system. An ergonomically designed system or part

- Increases productivity
- Reduces worker's discomfort and fatigue
- Reduces to injuries to the back, neck, arms, etc
- Automation reduces human interaction with the system; therefore, ergonomics becomes a lesser concern..



Quality of Work Life

- Quality of work life affects not only workers' overall sense of well-being and contentment, but also their productivity
- Important aspects of quality of work life:
 - How a worker has a good relationship with co-workers
 - Quality of management
 - Working conditions
 - Compensation



Compensation

- It is important for organizations to develop suitable compensation plans for their employees
- Compensation approaches
 - Time-based systems
 - Output-based systems
 - incentives to increase output
 - Knowledge-based systems
 - Management compensation



Compensation Systems

- **Time-based system**

- Compensation based on time an employee has worked during the pay period

- **Output-based (incentive) system**

- Compensation based on amount of output an employee produced during the pay period

Comparing Compensation Approaches

	Management	Worker
TIME-BASED Advantages	• Stable labor costs • Easy to administer • Simple to compute pay • Stable output	• Stable pay • Less pressure to produce than under output system
Disadvantages	• No incentive for workers to increase output	• Extra efforts not rewarded
OUTPUT-BASED Advantages	• Lower cost per unit • Greater output	• Pay related to efforts • Opportunity to earn more
Disadvantages	• Wage computation more difficult • Need to measure output • Quality may suffer • Difficult to incorporate wage increases • Increased problems with scheduling	• Pay fluctuates • Workers may be penalized because of factors beyond their control (e.g., machine breakdown)

Individual and Group Incentive Plans

- **Individual incentive plans**
 - Straight piecework
 - Worker's pay is a direct linear function of his or her output
 - Minimum wage legislation has reduced their popularity
 - Base rate + bonus
 - Worker is guaranteed a base rate, tied to an output standard, that serves as a minimum
 - A bonus is paid for output above the standard
- Group incentive plans
 - Tend to stress sharing of productivity gains with employees

Knowledge-Based Pay Systems

- A pay system used by organizations to reward workers who undergo training that increases their skills
- Three dimensions:
 - Horizontal skills
 - Reflect the variety of tasks the worker can perform
 - Vertical skills
 - Reflect the managerial skills the worker is capable of
 - Depth skills
 - Reflect quality and productivity results

Management Compensation

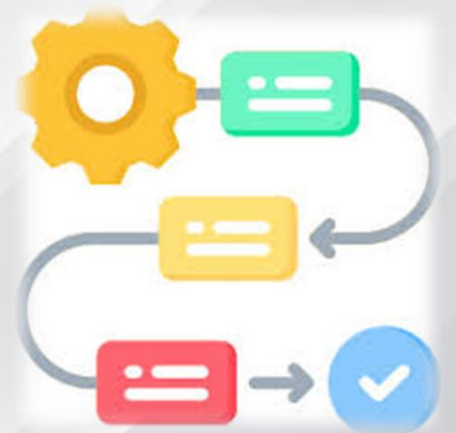
- Many organizations used to reward managers based on output
- New emphasis is being placed on other factors of performance
 - Customer service
 - Quality
- Executive pay is increasingly being tied to the success of the company or division for which the executive is responsible



Methods Analysis

- **Methods Analysis**

- Analyzing how a job gets done
 - It begins with an analysis of the overall operation
 - It then moves from general to specific details of the job concentrating on
 - Workplace arrangement
 - Movement of workers and/or materials



The Need for Methods Analysis

- The need for methods analysis can arise from a variety of sources
 1. Changes in tools and equipment
 2. Changes in product design or introduction of new products
 3. Changes in materials and procedures
 4. Government regulations or contractual agreements
 5. Accidents or quality problems
 6. Establishes the method for new jobs.

Methods Analysis Procedure

1. Identify the operation to be studied, and gather relevant data
2. Discuss the job with the operator and supervisor to get their input
3. Study and document the present methods
4. Analyze the job
5. Propose new methods
6. Install the new methods
7. Follow up implementation to assure improvements have been achieved

Guidelines for Selecting a Job to Study

- Consider jobs that:
 1. Have a high labor content
 2. Are done frequently
 3. Are unsafe, tiring, unpleasant, and/or noisy
 4. Are designated as problems
 - Quality problems
 - Processing bottlenecks
 - etc.



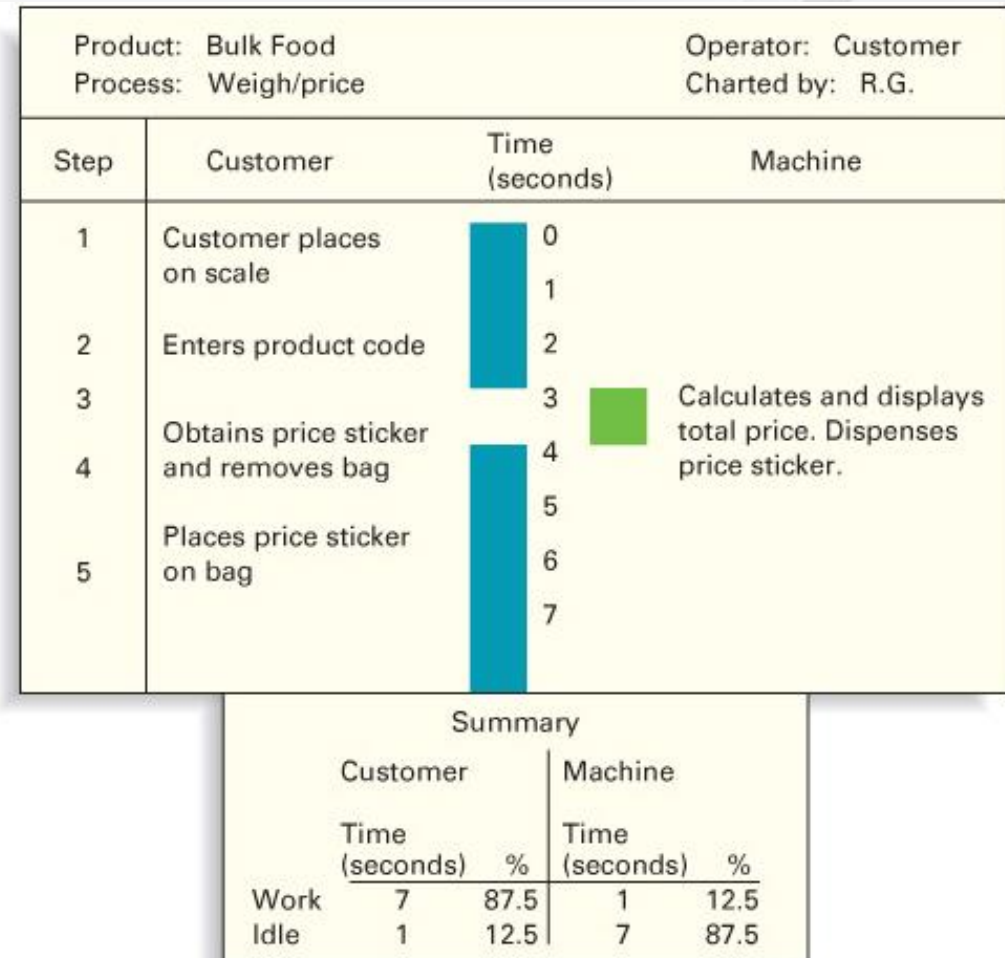
Analyzing the Job: Flow Process Charts

Chart used to examine the overall sequence of an operation by focusing on movements of the operator or flow of materials

FLOW PROCESS CHART	ANALYST	PAGE	Operation	Movement	Inspection	Delay	Storage
Job Requisition of petty cash	D. Kolb	1 of 2					
Details of method							
Requisition made out by department head			●	→	□	○	▽
Put in "pick-up" basket			○	→	□	●	▽
To accounting department			○	→	□	○	▽
Account and signature verified			○	→	■	○	▽
Amount approved by treasurer			●	→	□	○	▽
Amount counted by cashier			●	→	□	○	▽
Amount recorded by bookkeeper			●	→	□	○	▽
Petty cash sealed in envelope			●	→	□	○	▽
Petty cash carried to department			○	→	□	○	▽
Petty cash checked against requisition			○	→	■	○	▽
Receipt signed			●	→	□	○	▽
Petty cash stored in safety box			○	→	□	○	▽
			○	→	□	○	▽
			○	→	□	○	▽
			○	→	□	○	▽
			○	→	□	○	▽
			○	→	□	○	▽

Analyzing the Job: Worker-Machine Chart

Chart used to
determine portions of
a work cycle during
which an operator and
equipment are busy or
idle



Developing Work Methods

- In developing work methods that are motion efficient, the analyst attempts to
 - Eliminate unnecessary motions
 - Combine activities
 - Reduce fatigue
 - Improve the arrangement of the workplace
 - Improve the design of tools and equipment



Work Measurement

- Work measurement is concerned with how long it should take to complete a job.
- It is not concerned with either *job content* or *how the job is to be completed* since these are considered a given when considering work measurement.
- Jobs at the lowest levels often involve heavy standardization.



Work Measurement (cont.)

- **Standard time**
 - The amount of time it should take a qualified worker to complete a specified task, working at a sustainable rate, using given methods, tools and equipment, raw material inputs, and workplace arrangement.
- Commonly used work measurement techniques
 - Stopwatch time study
 - Historical times
 - Predetermined data
 - Work sampling

Work Measurement Techniques

- **Stopwatch Time Study**
 - Used to develop a time standard based on observations of one worker taken over several cycles.
- **Standard Elemental Times**
 - Derived from a firm's own historical time study data.
- **Predetermined time standards**
 - Involve the use of published data on standard elemental times.
- **Work sampling**
 - A technique for estimating the proportion of time that a worker or machine spends on various activities and idle time.

Stopwatch Time Study

- Used to develop a time standard based on observations of one worker taken over a few cycles.
- Basic steps in a time study:
 1. Define the task to be studied and inform the worker who will be studied
 2. Determine the number of cycles to observe
 3. Time the job, and rate the worker's performance
 4. Compute the standard time

Number of Cycles to Observe

- The number of observations to collect is a function of
 - Variability of the observed times
 - The desired level of accuracy
 - Desired level of confidence for the estimated job time

$$n = \left(\frac{zs}{ax} \right)^2 \quad \text{or} \quad n = \left(\frac{zs}{e} \right)^2$$

where

z = # of normal stddev. needed for desired confidence

s = Sample standard deviation

a = Desired accuracy percentage

e = Maximum acceptable error

$\bar{x}$ = Sample mean

Observed Time

The time measured to complete the task.

Performance rating factor: The number pace the person is working at. 90% is working slower than normal, 110% is working faster than normal, 100% is normal. This factor is calculated by an experienced worker who is trained to observe and determine the rating.

$$OT = \frac{\sum x_i}{n}$$

where

OT = Observed time

$\sum x_i$ = Sum of recorded times

n = Number of observations

Standard Time

The length of time it should take a qualified worker using appropriate process and tools to complete a specific job, allowing time for personal fatigue and unavoidable delays.

The third component in work system design, work measurement, is a way of determining how long it should take to do a job.

$$ST = NT \times AF$$

where

ST = Standard time

AF = Allowance factor

and

$$AF_{\text{job}} = 1 + A \quad A = \text{Allowance percentage based on job time}$$

$$AF_{\text{day}} = \frac{1}{1 - A} \quad A = \text{Allowance percentage based on workday}$$

Historical Times

- *Standard Elemental Times* are derived from a firm's own historical time study data.
 - Over time, a file of accumulated elemental times that are common to many jobs will be collected.
 - In time, these standard elemental times can be retrieved from the file, eliminating the need to go through a new time study to acquire them.

Predetermined Time Standards

Involve the use of published data on standard elemental times.

- The MTM (methods-time-measurement) tables are based on extensive research of basic elemental motions and times.
- To use this approach, the analyst must divide the job into its basic elements (reach, move, turn, etc.) measure the distances involved, and rate the difficulty of the element, and then refer to the appropriate table of data to obtain the time for that element

Work Sampling

- **Work sampling** is a technique for estimating the proportion of time that a worker or machine spends on various activities and the idle time.
 - Work sampling does not require timing an activity or involve continuous observation of the activity
 - Uses:
 1. Ratio-delay studies which concern the percentage of a worker's time that involves unavoidable delays or the proportion of time a machine is idle.
 2. Analysis of non-repetitive jobs.

Work Sampling vs. Stopwatch Time Studies

Advantages of Work Sampling

1. Observations are spread out over a period, making results less susceptible to short-term fluctuations
2. There is little or no disruption of work
3. Workers are less resentful
4. Studies are less costly and less time-consuming, and the skill requirements of the analyst are much less
5. Studies can be interrupted without affecting the results
6. No timing device is required
7. It is well suited for nonrepetitive tasks

Disadvantages of Work Sampling

1. There is much less detail on the elements of a job
2. Workers may alter their work patterns when they spot the observer, thereby invalidating the results
3. In many cases, there is no record of the method used by the worker
4. Observers may fail to adhere to a random schedule of observations
5. It is not well suited for short, repetitive tasks
6. Much time may be required to move from one workplace to another and back to satisfy the randomness requirement

Job Design Success

- Success factors:
 - Carried out by personnel with appropriate training and background
 - Consistent with the goals of the organization
 - In written form
 - Understood and agreed to by both management and employees
 - Job design must take technology into consideration.

Operations Strategy

- It is important to make design of work systems a key element of strategy:
 - People are still at the heart of the business
 - Workers can be valuable sources of insight and creativity
 - It can be beneficial to focus on quality of work life and instilling pride and respect among workers
 - Companies are reaping gains through worker empowerment



Thank You