

Motion Studies

Definition - Careful analysis of the human body motions used while performing a specific job.

Purpose - To eliminate or reduce inefficient movements and to facilitate and speed effective movements.

Results - Job is performed more easily and safely and output rate is increased.

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Motions Studies

Gilbreths -

Pioneered the study of manual motions.

Defined basic laws of motion economy.

Developed micro-motion studies.

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Motion Studies

Visual Motion Study

Careful observation of operator's movements.

Construction of an operator process chart.

Probing analysis of charted activities.

Application of laws of motion economy.

Micro-Motion Study

Video recording of operator movements.

More practical for highly repetitive, long-run operations.

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Motion Studies

Basic Premise

All work can be divided into a series of motions.

The time to perform a specific motion is the same, no matter where that motion is performed.

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Fundamental Motions

Gilbreth - Basic Division of Accomplishments

Fundamental operator hand motions that apply to all production work.

Seventeen basic divisions called "therbligs".

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Therbligs

Search

Select

Reach

Grasp

Move

Pre-Position

Position

Release

Hold

Assemble

Disassemble

Use

Inspect

Plan

Rest

Avoidable Delay

Unavoidable Delay

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Search

Basic operation element employed to locate an object.

Hands or eyes groping or feeling for an object.

Always strive to eliminate by providing an exact location for all tools, parts, and materials.

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Select

Takes place when an operator chooses one item in preference to another item.

Eliminate by using
common interchangeable parts
standardized tools
pre-positioning items

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Reach

Motion of an empty hand, without resistance, toward or away from an object (transport empty).

Reduce by arranging items to be close at hand.

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Grasp

Closing the fingers around an object.

An effective therblig that usually cannot be eliminated, but can be improved.

More than one item at a time

Use of vacuum, magnets, handles, jigs

Contact grasp (slide rather than pickup)

Conveyor

Pre-position parts to afford easy grasp

Swing bracket support of handtools

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Move

Basic motion of the hand carrying a load (transport loaded).

Basic effective therblig

Time to perform depends on distance, weight, type.

times can be reduced using same techniques as

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Pre-Position

Consists of positioning an object in a pre-determined place so that it can be grasped in the position in which is to be held when needed.

Improve by using -
holding devices, suspended tools, guides,
magazine feeds, stacking devices, rotating fixtures.

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Position

Locating an object so that it is properly oriented in a specific place.

can be reduced or eliminated by using - guides, funnels, bushings, stops, location pins, pilots, counterbored holes and chamfers, templates.

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Release

Operator intentionally relinquishes control of a object.

Minimum time requirement.

times can be even further reduced by - release in transit, mechanical ejectors, bin separators, release such that hands are in advantageous position for next therblig, multiple unit releases.

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Hold

Occurs when either hand supports or maintains control of an object.

The hand is seldom an efficient holding device and should not be part of any work assignment.

is an ineffective therblig and can be eliminated by - jigs, vises, pins, hooks, racks, clips, vacuums, magnets, friction.

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Assemble

An object related therblig.

Occurs when two mating parts are brought together.

is usually preceded by a or , and usually followed by a .

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Disassemble

Another object related therblig.

Occurs when two mating parts are separated.

is usually preceded by a , and is usually followed by a or .

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Use

Completely an objective therblig.

Occurs when either one or both hands have control of an object during that part of the cycle when productive work is being performed.

might improved by - jigs, fixtures, power tools, improved feeds and speeds, automated equipment.

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Inspect

Assures acceptable quality through regular checking.

Predominate purpose is to compare to some standard.

Shorten times by -
combining or eliminating inspections, multiple gauges/tests,
improved lighting and distances, automated inspections.

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Plan

Mental process that occurs when the operator pauses to determine next action.

can be eliminated though proper worker training
and on-the-job experience.

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Rest to Overcome Fatigue

Reduce times by -

Proper temperature, humidity, ventilation, light, noise levels.

Seats, benches, and tables at proper and comfortable heights.

Alternate sitting and standing if appropriate.

Use mechanical advantage for heavy loads.

Use larger muscle groups when appropriate.

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Avoidable Delays

Any idle time for which the operator is solely responsible,
either intentionally or unintentionally.

can be reduced by proper training, work
environments, and concerned management involvement.

Generally does not require changing the process or method.

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Unavoidable Delays

Interruptions beyond the operator's control.

Generally requires changing in procedures or methods to
reduce or eliminate from the work cycle.

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Therblig Summary

Effective Therbligs - Directly advances the progress of work.
Difficult to eliminate entirely, but can be improved upon.

Ineffective Therbligs - Should be eliminated by applying
principles of operation analysis and motion study.

Classifications - Physical, Mental, Objective, Delays

Ideally, a work center should comprise only
physical and objective therbligs.

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Therblig Summary - continued

Effective

Physical

Reach
Move
Grasp
Release
Pre-Position

Objective

Use
Assemble
Disassemble

Ineffective

Mental

Search
Select
Position
Inspect
Plan

Delay

Unavoidable
Avoidable
Rest to Overcome Fatigue
Hold

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Principles of Motion Economy

Three Basic Subdivisions

Use of the Human Body

Arrangement and Condition of the Workplace

Design of Tools and Equipment

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Use of Human Body

Both hands begin and end activities simultaneously.

Both hands should not be idle at the same time, except for rest periods.

Hand motions should be symmetric, either away from or towards the center of the body.

Momentum should be used to assist the worker, and be minimized if it must be overcome by muscle power.

Continuous curved motions preferable to straight-line motions, avoid sudden and sharp changes in direction.

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Use of Human Body - continued

Use least number of basic divisions, confined to lowest practical classification.

fingers; fingers & wrist; fingers, wrist, & lower arm;
fingers, wrist, lower arm, & upper arm;
fingers, wrist, lower arm, upper arm, & body

Feet and hands should work simultaneously.

Middle finger and thumb are strongest digits.

Seated position is most efficient for operating foot pedals.

Twisting motions should be performed with elbows bent.

Use segment of fingers closest to palm to grip tools.

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Arrangement and Condition of the Workplace

Fixed location for all tools.

Use gravity bins, drop delivery, and ejectors.

Locate all materials and tools within normal working area.

Comfortable chair and work table height.

Proper illumination, temperature, humidity, and ventilation.

Eliminate eye fixations.

Arrange work to permit easy and natural rhythm.

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Design of Tools and Equipment

Combine two or more tools into one (multiple operations).

Locate control devices (levers, handles, wheels) so that they are readily accessible to the operator and can be used by the strongest available muscle groups.

Use fixtures to hold parts.

Use power or semi-automatic handtools when practical.

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