



Motion Study and Work Design

Sections:

1. Basic Motion Elements and Work Analysis – **part 1**
2. Micromotion Analysis – **part 1**
3. Principles of Motion Economy and Work Design – **part 2**



Definitions

- **Motion study** - *analysis* of the basic hand, arm, and body *movements* of workers *as they perform work*

- **Work design** - *design* of the *methods and motions* used to perform a *task*

- Includes:
 - Workplace layout and environment
 - Tooling and equipment used in the task



Motion Study and Work Design

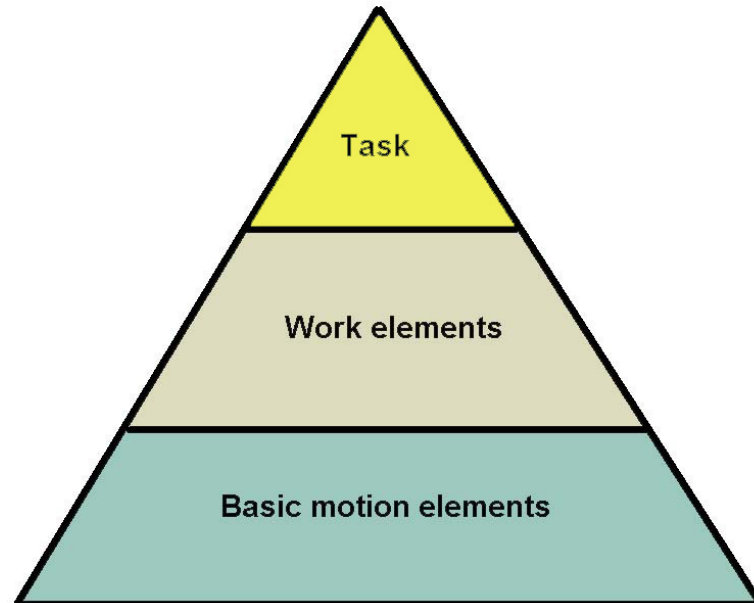
1. Basic Motion Elements and Work Analysis



The Pyramidal Structure of Work

Remember?

- Work consists of **tasks**
 - Tasks consist of work **elements**
 - Work elements consist of **basic motion elements**





Basic Motion Elements

- **Therbligs* – 17** basic motion elements**
 - Basic **building blocks** of virtually **all manual work** performed at a single location
 - Invented/refined by **Frank and Lillian Gilbreth** (1908 – 1924): “**motion cycles**”
 - Used to
 - examine **smallest of motions**
 - **categorize** motions
 - Identify unnecessary / **fatigue producing motions**
 - Note, not related to “time study” (only motion)***





















Basic Motion Elements

- Watch movie “Frank & Lillian Gilbreth”
<https://youtu.be/ZsQ7KPO6DOw>
- **Reading assignment:**
“Therbligs: The Keys to Simplifying Work”
<http://web.mit.edu/allanmc/www/Therbligs.pdf>
Or here:
<http://gilbrethnetwork.tripod.com/therbligs.html>



Therbligs










Therbligs symbols chart (18)










	Search		Use
	Find*		Disassemble
	Select		Inspect
	Grasp		Preposition
	Hold		Release Load
	Transport Loaded		Unavoidable Delay
	Transport Empty		Avoidable Delay
	Position		Plan
	Assemble		Rest



Therbligs

Therbligs symbols chart (18)

Abbreviation	Symbol	Name of symbol
<i>Sh</i>		SEARCH
<i>F</i>		FIND
<i>St</i>		SELECT
<i>G</i>		GRASP
<i>TL</i>		TRANSPORT LOADED
<i>P</i>		POSITION
<i>A</i>		ASSEMBLE
<i>U</i>		USE
<i>DA</i>		DISASSEMBLE

Abbreviation	Symbol	Name of symbol
<i>I</i>		INSPECT
<i>PP</i>		PRE-POSITION
<i>RL</i>		RELEASE LOAD
<i>TE</i>		TRANSPORT EMPTY
<i>R</i>		REST FOR OVERCOMING FATIGUE
<i>UD</i>		UNAVOIDABLE DELAY
<i>AD</i>		AVOIDABLE DELAY
<i>Pn</i>		PLAN
<i>H</i>		HOLD



Therbligs

1. Transport empty (TE) – reach for an object

- {icon shows an empty hand}



2. Grasp (G) – grasp an object

- {icon suggesting by a hand poised over an object, ready to grasp it}



3. Transport loaded (TL) – move an object with hand and arm

- {icon shows a hand cupped, holding an object}





Therbligs

4. Hold (H) – hold an object

- {icon suggested by a horseshoe magnet holding a bar}



5. Release load (RL) – release control of an object

- {icon suggested by a hand with an object poised to drop}



6. Use (U) – manipulate a tool

- {icon is simple the letter U
---for Use}





Therbligs (continued)

7. Pre-position (PP) – position object for next operation

- {icon suggests a bowling pin being placed into proper position}



8. Position (P) – position object in defined location

- {icon suggests an object, such as a pen, being placed in the hand, ready to Use}



9. Assemble (A) – join two parts

- {icon shows several items (lines) placed together}





Therbligs (continued)

10. Disassemble (DA) – separate multiple parts that were previously joined

- {icon shows Assemble symbol with one part removed}



11. Search (Sh) – attempt to find an object using eyes or hand

- {icon suggested by an eye turned, as if searching}





Therbligs (continued)

12. Select (St) – choose among several objects in a group

- {icon suggested by an arrow aimed at an object, much the same as a computer cursor in form and intent}



13. Plan (Pn) – decide on an action

- {icon shows a worker with fingers on head, thinking}



14. Inspect (I) – determine quality of object

- {icon suggests a magnifying glass}





Therbligs (continued)

15. Unavoidable delay (UD) – waiting due to factors beyond worker control

- {icon suggested by a man bumping his nose unintentionally}



16. Avoidable delay (AD) – worker waiting

- {icon shows a worker intentionally lying down on the job}



17. Rest (R) – resting to overcome fatigue

- {icon shows a person resting in a seated position}





Classification of Therbligs

Effective therbligs:

- Transport empty
- Grasp
- Transport loaded
- Release load
- Use
- Assemble
- Disassemble
- Inspect
- Rest

Ineffective therbligs:

- Hold
- Pre-position
- Position
- Search
- Select
- Plan
- Unavoidable delay
- Avoidable delay



Classification of Therbligs

Types of Therbligs

1. Motions required for performing an operation
2. Motions that tend to slow down type 1 motion
3. Motions that do not perform an operation



Classification of Therbligs

Types of Therbligs

1. Motions required for performing an operation:
 - Transport empty
 - Grasp
 - Transport loaded (carry)
 - Position
 - Use
 - Assemble
 - Disassemble
 - Release load
 - Inspect



Classification of Therbligs

Types of Therbligs

2. Motions that tend to slow down type 1 motion :
 - Search
 - Find*
 - Select
 - Plan (person thinking)
 - Pre-position (set up)



Classification of Therbligs

Types of Therbligs

3. Motions that do not perform an operation :
 - Hold
 - Unavoidable delay
 - Avoidable delay (standby)
 - Rest



Benefits of Classification

- Use motions which are **easy** and **effective**,
- **Discard** motions which are **awkward**, **fatiguing** and **ineffective**
- People who **accomplish the most** do not necessarily **work hardest**
- Watch video on application of therbligs on a simple task: <https://youtu.be/z2EYyPA2Gik>



Benefits of Classification

- **Identifying/solving** avoidable delay
 - e.g. person selecting parts for assembly
 - exclusively with one hand
 - while the other remains idle
 - Effects:
 - work is slowed down, also
 - hand being used is becoming more fatigued
 - Solution: use of both hands
 - How? encouraging workers to become more “ambidextrous”



Motion Study and Work Design

2. Micromotion Analysis



Micromotion Analysis

- **Activities** of two or more **workers** on group work
- Relationship: **operator's activities and machine**
- **Timing** operation
- Obtain **time-motion data** for time standards
- **Permanent record** of method and time
- **Research** (motion and time study)



Micromotion Analysis

- Main objectives:
 - Finding the **preferred method** of doing work
 - **Training** individuals to understand the meaning of motion study
 - **Analysis of therbligs** that make up a repetitive task



Micromotion Analysis

- Detailed objectives:
 1. **Eliminate ineffective** therbligs if possible
 2. **Avoid holding** objects with hand – Use workholder
 3. **Combine therbligs** – Perform right-hand and left-hand motions simultaneously
 4. **Simplify** overall method
 5. **Reduce time** for a motion, e.g., shorten distance



Micromotion Analysis – Technique

1. **Filming** operation
 2. **Analyzing** the film
 3. **Charting** the results
 4. Developing an **improved method**
- **Reading assignment 2:**
“Micromotion Analysis Checklist for Possible Improvements” (course website)



Micromotion Analysis – Example

S.No.	Left hand description	Therblig	Time	Therblig	Right hand
1.	Searching and lifting work piece.	SH, H	400		
2.			400	U	Opening the vice
3.	Clamping work piece in vice	PP	800	PP	Clamping work piece in the vice
4.			400	TL	Take the file.
5.	Do the hand filling operation.	U	2000	U	Do the hand filling Operation.
6.			400	TL	Taking the micrometer
7.	Check the dimension	I	1600	I	Check the dimension
8.			400	U	Open the vice
9.	Remove the work piece	TL	400		

- Part of “**Micromotion study analysis sheet**” (aka left-right hand chart)
- Operation: Finish hand filing copper work piece



Micromotion Analysis – Exercise

Sitting at her desk, the writer reached for the mechanical pencil, picked it up, positioned it, and then began to write on notepad of paper. After finishing one sentence, she lifted the pencil, and read the sentence. She then put the pencil aside and reached for the rectangular eraser nearby. Grasping and positioning it, she erased one of the words in the sentence.

Write a list of the therbligs that comprise this motion sequence and label each basic motion with a brief description.

