

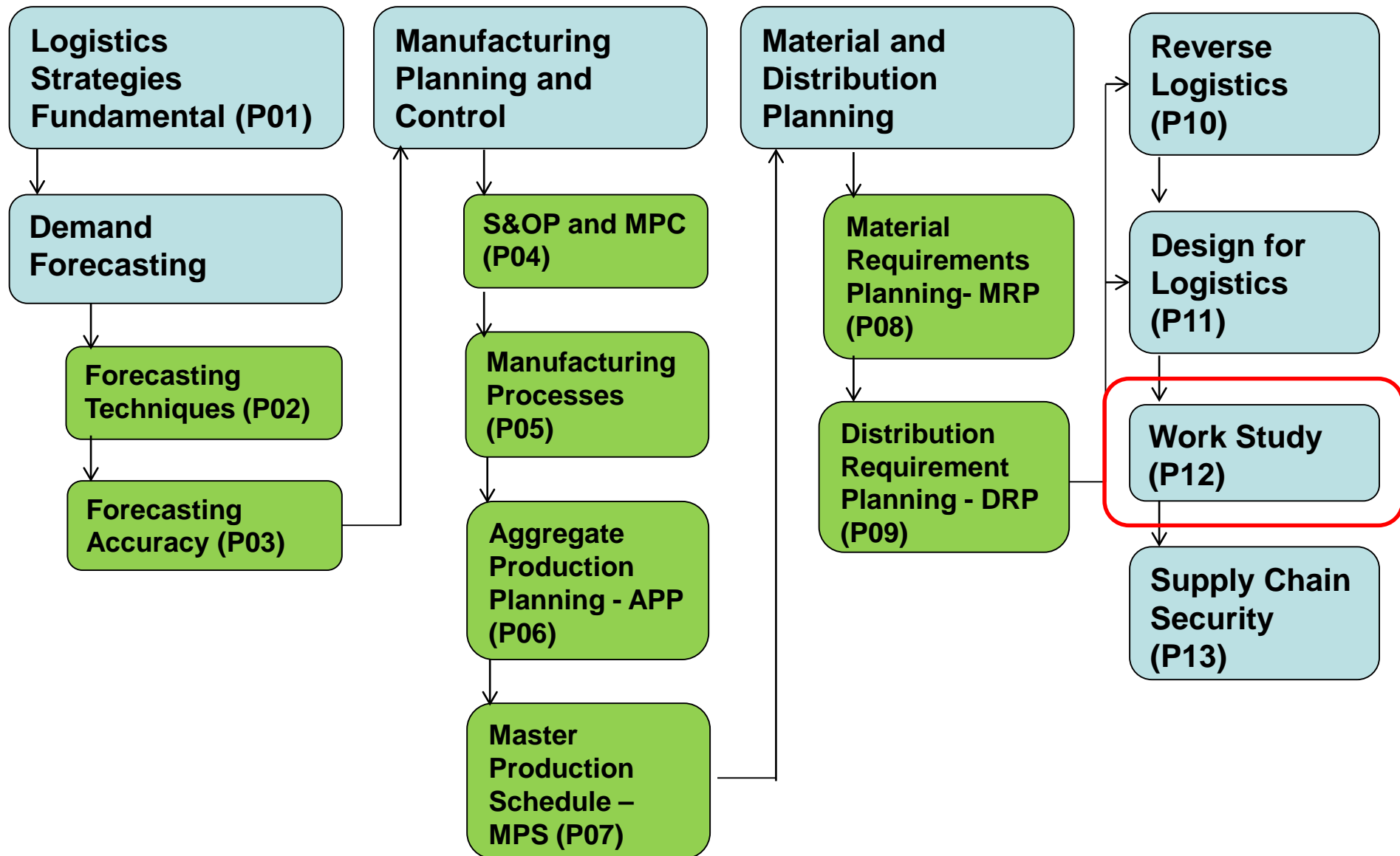
# Problem 12

## Time Study

SCHOOL OF  
ENGINEERING

E222 – Logistics  
Planning and  
Control

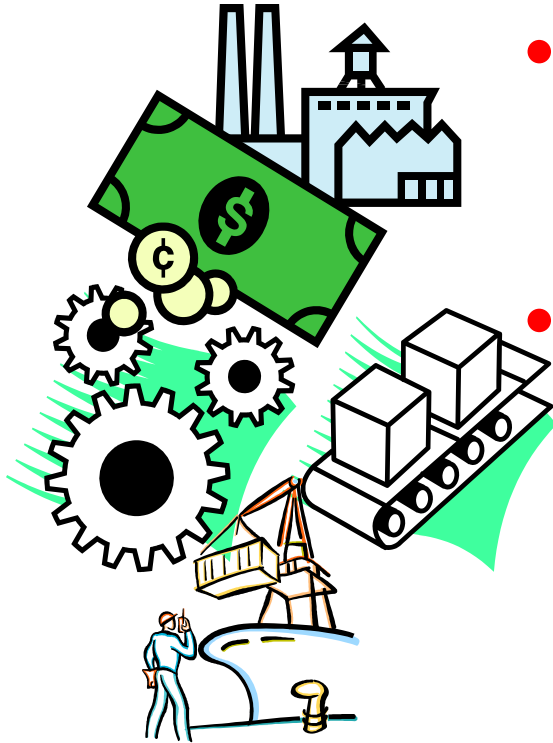
# E222 Logistics Planning and Control – Topic Tree



# P12 – Time Study



- Carry out time studies to determine the standard time for a task.
- Use a Predetermined Time System (PTS) to derive the normal time required for a repetitive task.
- Apply basic MODAPTS codes



# Time Study and Work Measurement

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- Time measurement
  - Measurement of time taken to complete a cycle of operation.
  - Cycle time:
    - Time taken to complete a cycle of operation
  - Tact time:
    - Time taken to produce a piece of product
- Ways to conduct time study
  - Stop watch (Direct Time Study)
  - Video and stop watch
  - Video time measurement (Time Study Software)

# Time Study and Work Measurement

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- Work measurement:
  - Capture and analyze the task and motion required to perform an operation.
  - Purpose is to look into ways to simplify, combine and reduce operation tasks elements in order to improve the work efficiency.

# Time Study and Work Measurement



- Work Elements
  - Define motion elements to each motion
  - Purpose is to understand the repeated/redundant elements for analysis

Time Study Type definition

Number	Type Name	Number	Type Name
1	Reach	2	Move
3	Grasp	4	Position
5	Assemble	6	Disassemble
7	Use	8	Release
9	Search	10	Select
11	Inspect	12	Plan
13	PrePosition	14	Hold
15	Unavoidable Delay	16	Avoidable Delay
17	Rest	18	
19		20	
21		22	

# Motion Elements



Classification	Serial No.	Motion type	Definition
Type I	1	Reach (Reach—RE)	Move with empty hands
	2	Move (Move—M)	Move object from one place to another place with hands or certain parts.
	3	Grasp (Grasp—G)	Control object with hand or palm.
	4	Position (Position—P)	Place object on certain position.
	5	Assemble (Assemble—A)	Match two objects.
	6	Disassemble (Disassemble—DA)	Make object sever from other objects.
	7	Use (Use—U)	Use tool or equipment for the purpose of operation.
	8	Release (Release—RL)	Release the object held.
Type II	9	Search (Search—SH)	Feel the position of object with eyes or hands.
	10	Select (Select—ST)	Select one from two or above similar objects.
	11	Inspect (Inspect—I)	Inspect the object if it complies with standard.
	12	Plan (Plan—PN)	Consideration for the next step during the operation.
	13	Preposition (Preposition—PP)	Pre-place the object on the positioned place before positioning.
Type III	14	Hold (Hold—H)	Hold the object continually with hands or palm, and keep static.
	15	Unavoidable Delay (Unavoidable Delay—UD)	Work is interrupted due to the factors uncontrollable.
	16	Avoidable Delay (Avoidable Delay—AD)	Work is interrupted due to the artificial reason (intentionally or negligently).
	17	Rest (Rest—RT)	Work stops working due to over-fatigue.

# Ratings



- The speed of the operator during the study could be varying from the normal speed due to physiological effect.
- The time recorded is to be adjusted so that the record could reflect the actual time.
- The percentage of the adjustment is known as Ratings.



# Predetermined Time Study



- **Predetermined time study (without using stopwatch)**
  - To define the time taken to perform a certain standard motion using international recognized time data.
  - Such as:
    - ✓ MODAPTS
    - ✓ MTM/MTM I/MTM II/MTM X
    - ✓ Work factors
    - ✓ MOST
- **Steps in performing PTS:**
  - Breaking the motion into element tasks:
    - Such as reach, grasp, move, release and others.
  - Apply the modification factors
    - such as distance, weight, texture of material and others.
  - Get time data from the time standard
  - Sum them up

# Common Predetermined Time Systems:

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- **Use of common predetermined time systems like :**
- **MTM – Methods Time Measurement.** Analyzes any manual operation or method into basic motions required to perform it, and assigns to each motion a predetermined time standard, by the nature of the motion and the conditions.
- **MODAPTS - MODular Arrangement of Predetermined Time Standards.** The accuracy of the system has been found comparable to most other such systems. It differs from most other systems in that it is based on human physiology.
- **MOST - Maynard Operation Sequence Technique.** A simplified and faster standard establishment system. Establish standards at least 5 times faster than with MTM. Utilizes larger blocks of fundamental motions than MTM – hence quicker.

# Direct Time Study Vs Predetermined Time Systems



- **Direct Time Study**

- **Advantages:**

- a. Can be applied to any operation
- b. Data reflects reality, based on actual activities performed

- **Disadvantages:**

- a. Requires observer to be patient, sharp and quick
- b. Need to handle apprehension/anxiety of operator under timing

- **Predetermined Time Standards (PTS)**

- **Advantages:**

- a. Time value can be computed almost immediately
- b. Simulation of time impact of various work methods done easily

- **Disadvantages:**

- a. Specific classification of work motion using tables not always possible
- b. Needs extensive training and practice to achieve proficiency



- **Overview**
- MODular Arrangement of Predetermined Time Standards
- Developed by Chris Heyde in 1966
- Predetermined time system (like MTM and MOST) where work is divided into micro elements. These elements are assigned standard time values
- Can be used to validate time studies, calculate production standards, evaluate plant capacity and identify unnecessary movements
- Relatively simple to use, low cost and widely accepted in many countries





- Steps (similar for all other predetermined time systems)
  - Document (or determine the best method if the operation is new) the method of operation
  - Analyze the operation by projecting the body parts used to carry out the actions
  - Determine the codes and the time values (in units of MOD) assigned to each work element
  - Sum up the times (assuming additivity and independence) and divide the total by 7.75 to obtain the **normal time** in seconds

<b>1 MOD = 0.129 sec</b>
<b>1 MOD = 0.00215 min</b>
<b>1 sec = 7.75 MODS</b>
<b>1 min = 465 MODS</b>

# MODAPTS Codes



- Contains 21 basic alphanumeric codes
- Alpha code depends on the type of activity.  
The number attached to the code is the distance moved or effort required for the move.
- For example, M2 is the movement of the palm which will take 2 MODS (0.258 seconds) to complete
- Major classes of motions are:
  - Upper limb (shoulder to finger) movement
  - Terminal movements: done at the end of upper limb motion
  - Auxiliary activities: walking, bending, inspection, deciding, etc



# Types of Motions

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- Movement
  - Done by the finger-hand-arm-shoulder trunk system
  - Required to position a part of the arm to perform the Terminal activities
- Terminal Activities (GET and PUT)
  - Done at the end of a movement
  - In close proximity to the things being worked on
- Auxiliary Activities
  - Walking, bending, inspection, deciding, etc.

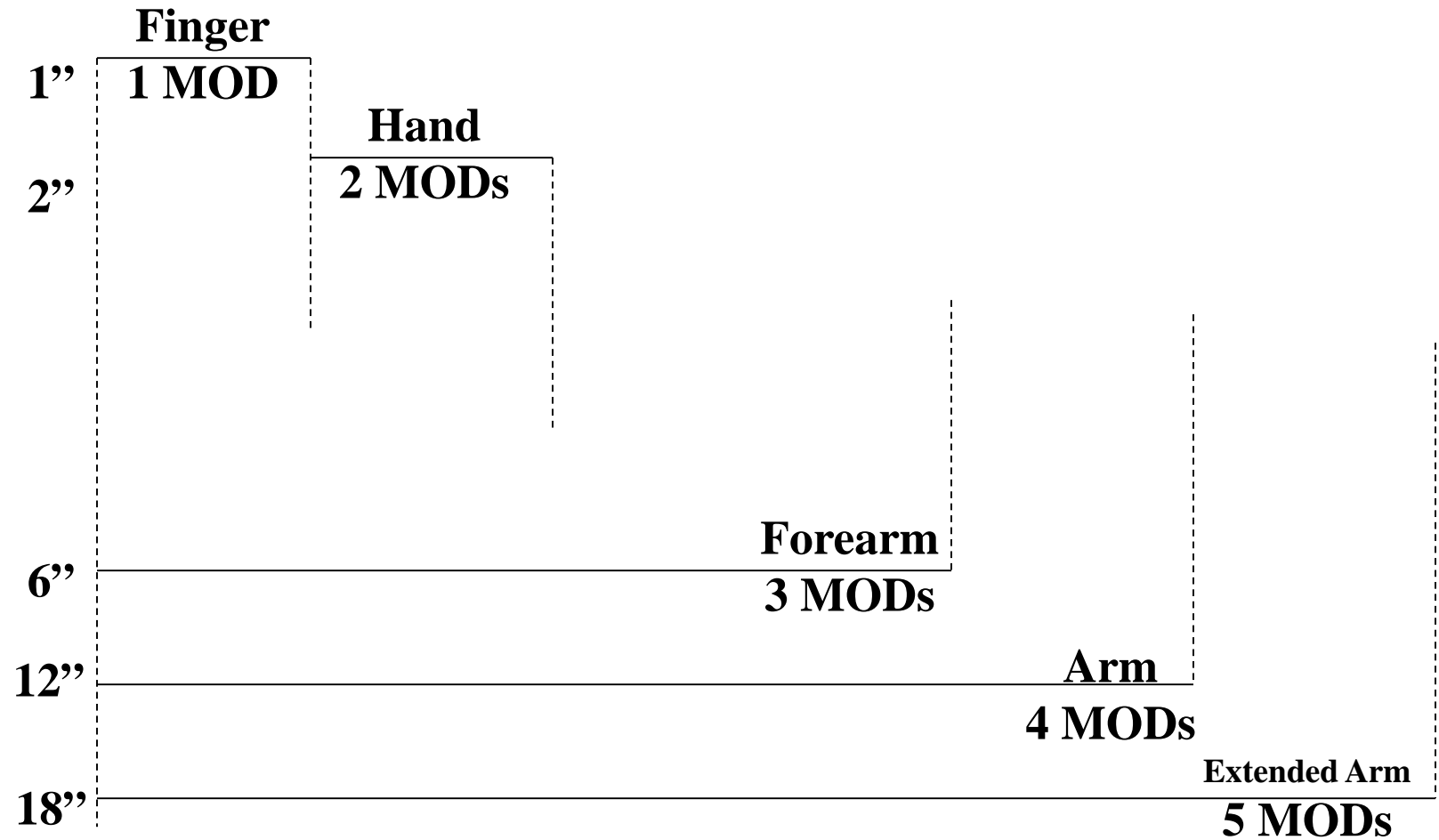
# Movements



- Movements and terminal activities take place in pairs.
- Movement first then terminal activities
  - Move to get, move to put
  - Examples: M3GO (move to touch)
- Movement activities are classified by:
  - Distance moved
  - Body part required to perform the move
- Light/small objects vs. heavy/large objects
  - Large objects : 16" x 16" x 16"
  - Heavy objects : over 18 lbs.
- Award the lowest category that is possible to successfully complete the activity



# Movements



# Moves with Small/Light Objects



Type	Movement	MODs	Distances
Finger (M1)	Knuckle	1	1"
Hand (M2)	Wrist	2	2"
Forearm (M3)	Elbow	3	6"
Whole Arm (M4)	Shoulder directly forward, perhaps body assistance	4	12"
Extended Arm (M5)	Shoulder fully left, right, or across the body	5	18"
Trunk (M7)	Shoulder involving the body trunk	7	30"

***Note: Body assistance means to require the body to bend slightly (simultaneously with Move). It increases distances not time.***

# Movements



## Basic motions of upper limbs

	Type	Code	Description	MODs (1 MOD = 0.129 sec)	Value
Moving Motion	Finger	M1	Knuckle	1	1"
	Palm	M2	Wrist	2	2"
	Forearm	M3	Elbow	3	6"
	Arm	M4	Shoulder directly forward, perhaps body assistance	4	12"
	Shoulder	M5	Shoulder fully left, right, or across the body	5	18"
Terminal Motion	Get	G0	Touch only (Low conscious)		
		G1	Pick up easy object (Low conscious)		
		G3	Pick up flat object, or objects in a bin, hard to pick up object (High conscious)		
	Put	P0	No conscious (Low conscious)		
		P2	Requires one feedback** (information) (High conscious)		
		P5	Requires two feedbacks (High conscious)		

# Movements



## Auxiliary motions

	Type	Code	Description	MODs (1 MOD = 0.129 sec)	Value
	Footstep	F3	Place foot on a step	3	
	Walking	W5	Move one step on foot	5	
	Bend motion	B17	Bend and arise (if hand goes below the knee)	17	
	Sit-down	S30	Sit and stand (up and down movement)	30	



## Correction motions

	Type	Code	Description	MODs (1 MOD = 0.129 sec)	Value
	Weight revision	L1	Weight correction	1	NA: Below 2kg 1x: 2 ~ 6 kg 2x: 6 ~ 10 kg +1: each 4 kg
	Eye motion	E2	Eye movement and requires focusing	2	
	Revision	R2	Hold position adjustment	2	
	Decide motion	D3	Check or determine	3	Sound, colour, measure, etc
	Pressure motion	A4	Apply pressure	4	Applicable for more than 2 kg
	Circle- rotate	C4	Rotate or turn		Applicable to more than half a turn

# Practice Solution (Recommended)



ID	Motion	Operation	Cycle	TIME	ST(...)	Rating
0	Start		0	0.12	0.12	1.00
1	Walk 4 steps towards table	walk	1	2.52	2.60	0.97
2	Bend and pick 1st box	Bend/arises/grasp	2	1.92	2.32	0.83
3	Place 1st box on table	Move and put	2	2.16	1.56	1.38
4	Bend and pick 2nd box	Bend/arises/grasp	3	1.92	2.32	0.83
5	Place 2nd box	Move and put	3	2.16	1.56	1.38
6	Bend and pick 3rd box	Bend/arises/grasp	4	2.04	2.32	0.88
7	Place 3rd box	Move and put	4	2.04	0.91	2.00
8	Move arm to keyboard	Move and see	5	0.72	0.78	0.92
9	Hit the keyboard	Enter	6	0.24	0.13	1.85
10			6	---->		1.00

Screenshot of Double-E <sup>TM</sup> software interface

# Practice Solution (Recommended)



	Sequence of Work Activities	Practical Time (sec)	Code	Freq	Mod	Remarks
1	Walk 4 steps towards table	2.64	W5	4	20	Walk
2	Bend and pick up 1st Box	1.92	B17G1	1	18	Bend/Rise/Grasp
3	Place 1st box on table	2.08	M5P2M5	1	12	Shoulder/Put/Shoulder
4	Bend and pick up 2nd Box	2.12	B17G1	1	18	Bend/Rise/Grasp
5	Place 2nd Box on table	2	M5P2M5	1	12	Shoulder/Put/Shoulder
6	Bend and pick up 3rd box	2.04	B17G1	1	18	Bend/Rise/Grasp
7	Place 3rd box on table	2.04	M5P2	1	7	Shoulder/Put
8	Move arm to keyboard	0.68	M4E2	1	6	Forearm/eye
9	Hit the keyboard	0.28	M1P0	1	1	Finger/Press

# Practice Solution (Recommended)

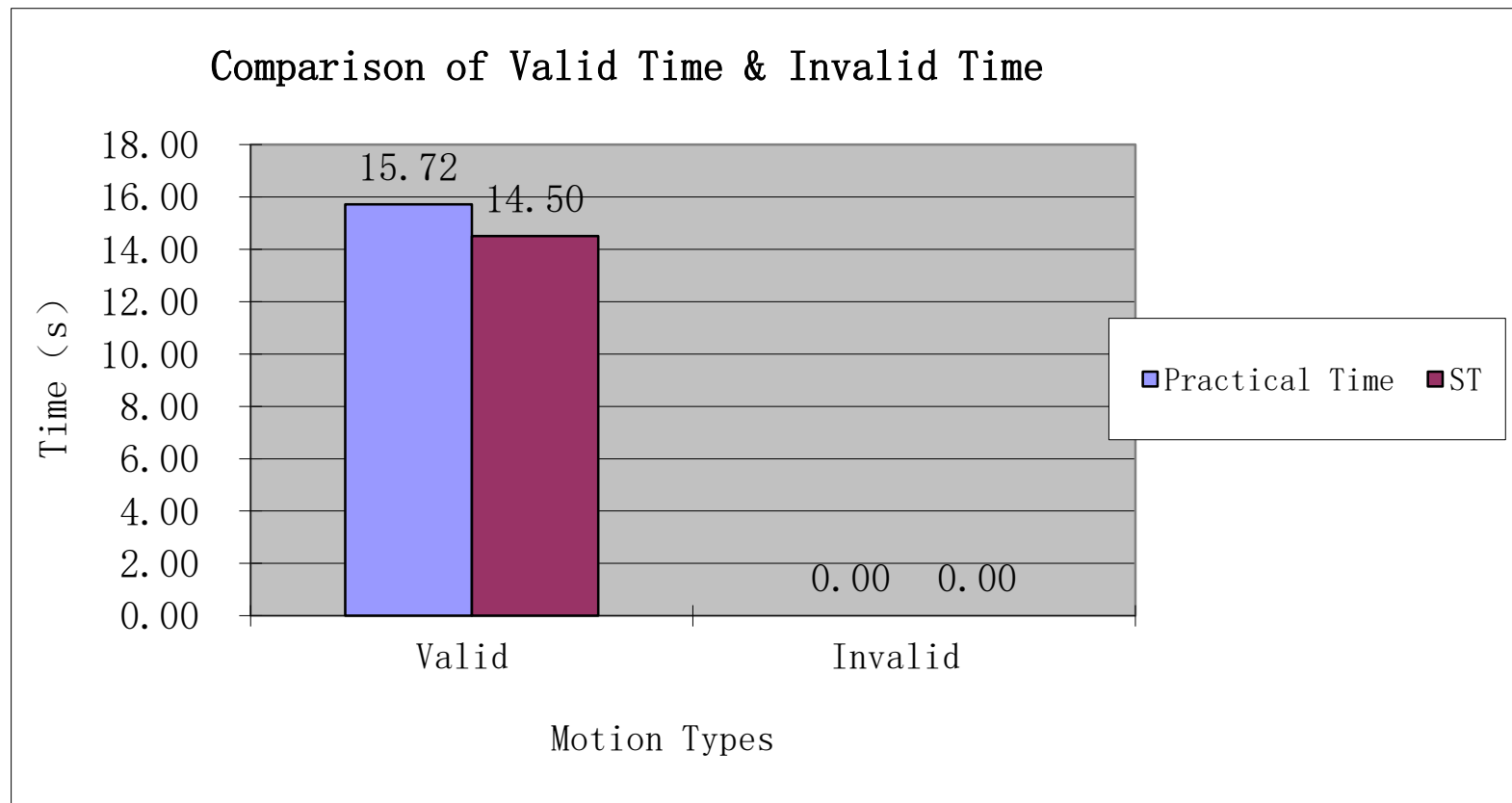


Summary of Motion Types			
Motion Type	Practical Time	ST	No. of Datas
1st Type	15.72	14.50	9
2nd Type	0.00	0.00	0
3rd Type	0.00	0.00	0
Other Types	0.00	0.00	0

Motion Name	Count	Average	Median	Minimum	Maximum	Variance	Preimprovement	Improvement
Walk 4 steps towards table	1	2.52	2.52	2.52	2.52	0.00	2.52	2.60
Bend and pick 1st box	1	1.92	1.92	1.92	1.92	0.00	1.92	2.32
Place 1st box on table	1	2.16	2.16	2.16	2.16	0.00	2.16	1.56
Bend and pick 2nd box	1	1.92	1.92	1.92	1.92	0.00	1.92	2.32
Place 2nd box	1	2.16	2.16	2.16	2.16	0.00	2.16	1.56
Bend and pick 3rd box	1	2.04	2.04	2.04	2.04	0.00	2.04	2.32
Place 3rd box	1	2.04	2.04	2.04	2.04	0.00	2.04	0.91
Move arm to keyboard	1	0.72	0.72	0.72	0.72	0.00	0.72	0.78
Hit the keyboard	1	0.24	0.24	0.24	0.24	0.00	0.24	0.13

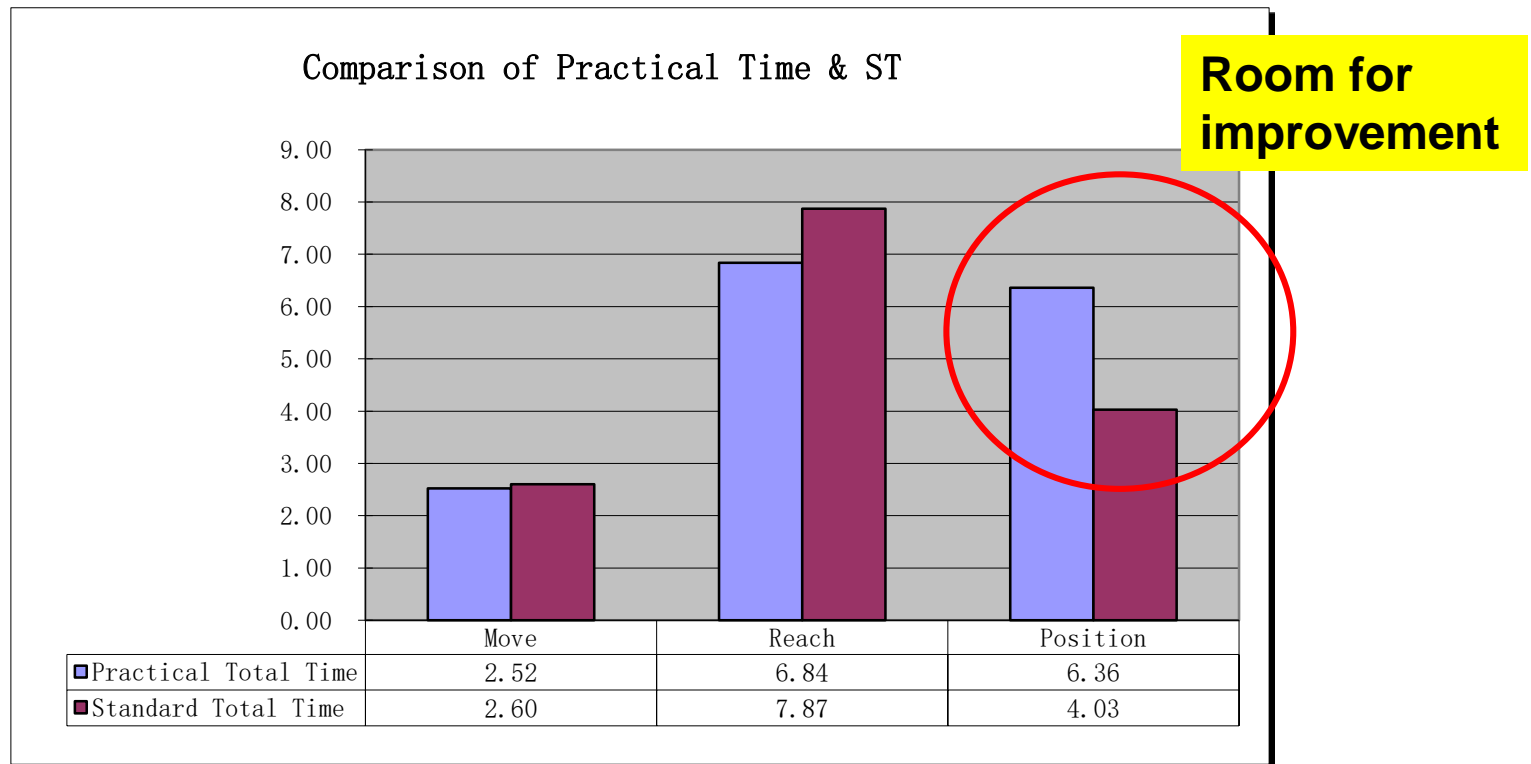


# Practice Solution (Recommended)



**Since the Standard Time determined by MODAPTS is 14.50secs which is less than the practical time of 15.72secs, the material handler is not efficient. It means he can increase his efficiency.**

# Practice Solution (Recommended)



The above chart shows the areas for improvement. Do take note that the classification of the motions are important to ensure this comparison is valid. (eg, Position motions should be improved)

## How can the material handler do better?

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Based on the chart in the previous slide, the position motions are the placing of the boxes on the conveyor.

The material handler should be informed that he can be faster in this aspects.

# Other Ways to Improve Efficiency

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We should always try to make the process more efficient with some of the below suggestions:

- Start walking from closer starting point
- Move trolley closer to work-station
- Raise height of trolley
- Move computer terminal nearer
- Carry two boxes per bend/arise cycle

# Other Scenarios

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- **Scenario A:**

- Set allowance to be 10% comprising
  - 4% fatigue
  - 2% standing
  - 4% mental stress
- The standard time would be  $1.1 \times 14.50$  or 15.95 seconds
- Hence time to perform this manual task should be 15.95 sec

- **Scenario B:**

- Apply L1 weight adjustment in the PTS. Applicable when the weight is more than 2kg. Each increment of 4kg, time increases by 1 MOD

# Learning Outcome

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- Carry out time studies to determine the standard time for a task.
- Use a Predetermined Time System (PTS) to derive the normal time required for a repetitive task.
- Apply basic MODAPTS codes