# Lecture #7

# Luis R. Garcilaso

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**Service Processes & Systems**
**Dept. of Mechanical Engineering - Engineering Mechanics**
**Michigan Technological University**

# Motion Study, Time Study, Social Impact

- We've described motion study in order to be able to analyze tasks in detail, in that way we could improve/optimize our manufacturing or service processes. What could be a social impact of optimizing our processes?

# Motion Study, Time Study, Social Impact

- Let's say we do a motion study and a time study (to be described today), what could happen if we discover that the STD time for doing a task is 12.5 sec, and the operators are doing it in 15 sec?
- What if we eliminate motions/steps? Will the task be completed in less time?

# Motion Study, Time Study, Social Impact

- Less Labor needed…
- Improve labor…
- Motivate workers…
- Ethics…


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# Work Measurement

- Estimate standard time required to perform a task
- Methods of performing work measurement
  - Stopwatch time study
  - Elemental standard time files
  - Predetermined motion times
  - Work sampling

# Time Study

- Time Study measures how long it takes an average worker to complete a task at a normal pace
- The actual time taken by the above-avg. operation must be increased, and the time taken by the below-avg. must be reduced to the value representative of normal performance.


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# Time Study

- **Performance rating is a technique for equitably determining the time required to perform a task by the normal operator after the observed values of the operation under study have been recorded.**

- **A "normal" operator is defined as a qualified, thoroughly experienced operator who is working under conditions as they customarily prevail at the work station, at a pace that is neither fast nor slow, but representative of average.**

# Time Study

- **Allowance Factor: Addition of an allowance to take care of the many interruptions, delays, and slowdowns brought on by fatigue which enter into every work assignment (e.g. car trip)**


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# Time Study

- **Frederick W. Taylor**
  **-1881, he started to develop time study**
- **Started at a machine shop at home with his family**
- **Tools**
  - **Stopwatch & Clipboard**
- **Tools Used Today:**
  - **Computers**
  - **Bar codes**
  - **Accustudy Software**


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# Stopwatch Time Study Basic Steps

1. Establish the standard job method
2. Break down the job into elements
3. Study the job
4. Rate the worker's performance (RF)
5. Compute the average time (t)


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# Stopwatch Time Study Basic Steps

## 6. Compute the normal time

Normal Time = (Elemental average) (rating factor)

$$Nt = ( t )(RF)$$

$$\text{Normal Cycle Time} = NT = Nt$$

## 7. Compute the standard time

Standard Time = (normal cycle time)(1+allowance factor)

$$ST = (NT)\ (1 + AF)$$

## Time Study Observation Sheet

| **Identification of operation** *Sandwich Assembly* | | | **Date** |
|---|---|---|---|
| | **Operator** *Smith* | **Approval** *Jones* | **Observer** *Russell* |

| | | | **Cycles** | | | | | | | | | | **Summary** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **$\Sigma t$** | **$\bar{t}$** | ***RF*** | ***Nt*** |
| **1** | *Grasp and layout bread slices* | ***t*** | .04 | .05 | .05 | .04 | .06 | .05 | .06 | .06 | .07 | .05 | .53 | .053 | 1.05 | .056 |
| | | ***R*** | .04 | .38 | .72 | 1.05 | 1.40 | 1.76 | 2.13 | 2.50 | 2.89 | 3.29 | | | | |
| **2** | *Spread mayonnaise on both slices* | ***t*** | .07 | .06 | .07 | .08 | .07 | .07 | .08 | .10 | .09 | .08 | .77 | .077 | 1.00 | .077 |
| | | ***R*** | .11 | .44 | .79 | 1.13 | 1.47 | 1.83 | 2.21 | 2.60 | 2.98 | 3.37 | | | | |
| **3** | *Place ham, cheese, and lettuce on bread* | ***t*** | .12 | .11 | .14 | .12 | .13 | .13 | .13 | .12 | .14 | .14 | 1.28 | 1.28 | 1.10 | .141 |
| | | ***R*** | .23 | .55 | .93 | 1.25 | 1.60 | 1.96 | 2.34 | 2.72 | 3.12 | 3.51 | | | | |
| **4** | *Place top on sandwich, slice and stack* | ***t*** | .10 | .12 | .08 | .09 | .11 | .11 | .10 | .10 | .12 | .10 | 1.03 | 1.03 | 1.10 | .113 |
| | | ***R*** | .33 | .67 | 1.01 | 1.34 | 1.71 | 2.07 | 2.44 | 2.82 | 3.24 | 3.61 | | | | |



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# Stopwatch Time Study Basic Steps

- **Compute average element time**

$$\bar{t} = \frac{\sum t}{n} = \frac{0.53}{10} = 0.053$$

- **Normal time = (Elemental average) (rating factor)**
- **Nt = ( t )(RF) = (0.053)(1.05) = 0.056**
- **Normal Cycle Time = NT = Nt = 0.387**


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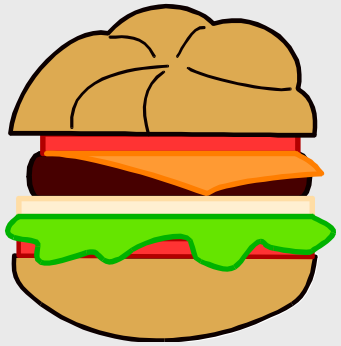
# Time Study Example

**ST = (NT) (1 + AF) = (0.387)(1+0.15) = 0.445 min**

**How many sandwiches can be made in 2 hours?**

$$\frac{120\,\text{min}}{0.445\,\text{min/sandwich}} = 269.7 \text{ or } 270 \text{ sandwiches}$$



# Time Study Exercise

- Motion studies and Time studies are performed not only in manufacturing processes but also to Services processes (e.g. McDonald's, Bank's tellers, etc.).
- We will perform 6 tasks while time is taken out of each repetition
- The level of detail on each task description is low for simplification purposes.
- Objective – Get std times in order to measure performance, do capacity analysis
- Performed at early stages of design

# Time Study Exercise

- Student 1: worker
- Student 2: collecting times
- Student 3: data recorder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# Time Study Exercise

| Time Study Observation Sheet | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Identification of operation | | | | | | | | | | | | Date | | | | |
| | | Operator | | | | | Approval | | | | | Observer | | | | |
| | | | Cycles | | | | | | | | | | Summary | | | |
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | t | t avg | RF | Nt |
| 1 | Search and grab 4 quarters wrappers and put them into an envelope, close it | t | | | | | | | | | | | | | | |
| | | R | | | | | | | | | | | | | | |
| 2 | Search and grab 5 dimes wrappers and put them into a different envelope, close it | t | | | | | | | | | | | | | | |
| | | R | | | | | | | | | | | | | | |
| 3 | Search and grab 2 nickels wrappers and put them into a third envelope, close it | t | | | | | | | | | | | | | | |
| | | R | | | | | | | | | | | | | | |
| 4 | Grab the three envelopes and take them to the table where the balloons are, put them on the table | t | | | | | | | | | | | | | | |
| | | R | | | | | | | | | | | | | | |
| 5 | Grab a balloon and blow it up until it reaches a measurement of 8 inches from edge to edge | t | | | | | | | | | | | | | | |
| | | R | | | | | | | | | | | | | | |
| 6 | Tie a knot in the balloon | t | | | | | | | | | | | | | | |
| | | R | | | | | | | | | | | | | | |

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# Assumptions

- Rating factors:
  - Task 1-4: 5%
  - Task 5-6: 10%
- Allowance factor: 15%