



DIY

(Do It Yourself)

Wrench Time Study, Quick and Easy In-House

R.D. (Doc) Palmer, PE, MBA, CMRP

McGraw-Hill's *Maintenance Planning and
Scheduling Handbook*

Richard Palmer and Associates



What Is Wrench Time?

- The time a craft person is actually working on something
- Versus time available to supervisor (forget vacation and time in training)
- Not receiving assignment or idle during a job
- Not waiting on parts, tools, instructions, etc
- Not on break
- What you “would be willing to pay for”

Why is WT Important?

- Huge opportunity: industry avg only 25-35%
- Even when giving “benefit of the doubt” when observing, non-work outweighs work
- Planning and scheduling can boost to 50-55%
 - Sustainable world-class but achievable
- Leverage 55/35: 30 persons become 47
- Leverage 50/25: 30 persons become 60
- WT is primary measure of P&S effectiveness

Why WT Is Not the All-in-All

- Only measures one aspect – time on tools
- Does not measure if right way or right job
 - It is much better to be doing the right job slowly than the wrong job quickly
 - WT does not tell you anything about that

Don't Look at Just One Indicator



Don't Leave Out Common Sense





LOOK OUT THE WINDSHIELD, TOO!



Doc Palmer



Whew!



Nevertheless, WT Is Important

- We PRESUME if a person
- Is working **more**
- (at the same rate)
- Then they will complete **more** work

Dangers

- Measuring makes folk antsy
- Frederick Taylor 1911 *Principles of Scientific Measurement* espoused:
 - One Right Way
 - **Measure, Measure, Measure**
 - Specialize, Specialize, Specialize
 - Led to a US Congressional investigation



You Don't HAVE to Measure WT

- Use surrogate indicators such as Work Orders Completed per Month
- (Balance with an eye on the backlog)

You Don't HAVE to Measure WT

- $Y = f(X)$
- *Cannot* affect a Y directly
- *Can* affect an X directly to influence Y
- Analogy
 - Cannot affect daughters' school grades (Y)
 - Can affect their going to bed on time (X)
 - Can affect their doing homework (X)

Quality and Productivity

- $Y = f(X)$
- *Cannot* affect MTBF, high priority WO's, **wrench time**, and WO's completed/mo (Y's) directly
- *Can* affect planning and scheduling (X's)

Planning Is an X

- Affects quality
 - Better craft assignment, parts, tools, instructions lead to better jobs
- Affects productivity
 - Reduced delays *during* jobs

Scheduling Is an X

- Affects productivity
 - Reduced delays *between* jobs
- Affects quality
 - Increased productivity overall allows **more time** for troublesome jobs
 - Increased productivity overall allows **more time** for lower priority proactive work

Why You Might Measure WT

- Convince Self
- Benchmark to Improve
- Convince Plant and help change culture from:
 - “Our job is to be here” or “Our job is to take care of Opns calls and backlog is fill-in work)

TO

- “Our job is to take care of the backlog so Opns won’t have to call”

How **NOT** to Measure

- Self-reported
 - Commonly reported 70% or higher
 - Hard to account for each little delay
 - Hard to have common standards
 - Becomes a “liar’s club”
 - Damages everyone’s integrity

How **NOT** to Measure

- Follow folk around
 - Commonly reported 50% or higher
 - Non-sustainable “Hawthorne effect”
 - Non-typical work conditions
 - You wanna really make someone antsy?

How **NOT** to Measure

- Go out into Work Places and See Who Is Doing What
 - Commonly reported 50% or higher
 - Only measures delays in the work area (about half of total delays)

How **NOT** to Measure



How **NOT** to Measure



How TO Measure

- Statistically, each person has equal chance of selection
- Determine Categories & Definitions
- Presume % Observations = % Time
- Determine Representative Period
- Determine # Obs Needed for Acceptable MOE
- Use Forms



Categories

- **1. Working**
- 2. Travel
- 4. Assignment
- 5. Wrap-up
- 6. Matls
- 7. Tools
- 8. Instructions
- 9. Clearance delay
- 10. Interference
- 12. Operator
- 15. Short meetings
- 17. Idle
- 18. Rest room
- 19. Break
- 23. Unaccountable



Presume % Obs = % Time

Example

- Take 100 observations
- 35 obs are Cat. 1 Working
- WT is 35% (35/100)
- We infer that out of a 10 hour shift, 3.5 hours are typically in Cat. 1 Working
- For 8 hr shift, 2.8 hrs are Cat. 1 Working

Determine Representative Period

- Representative of on-going normal maint
- Avoid abnormal such as a once per year outage
- Probably at least a month

Determine # Obs Needed for MOE

- Margin of Error

- $$\text{MOE} = 1.96 \sqrt{\frac{(1-p)p}{n}}$$

- 1.96 = stats constant for 95% confidence interval
- p = proportion
- n = size of sample (# of observations)

Determine # Obs Needed for MOE

- Let's backfit to see how a month would look
- Try 1 month and 1 day each month: 1 Monday, 1 Tues, 1 Wed, 1 Thu, 1 Fri because this would seem representative (modify for your situation)
- Sample 2 persons each half hour for an 8 hour shift
- 5 days x 32 obs/day = 160 total observations
- We expect p to be 0.35 for wrench time

Determine # Obs Needed for MOE

- Margin of Error
- $$\text{MOE} = 1.96 \sqrt{\frac{(1-0.35) 0.35}{160}}$$
- MOE = 0.0739 or 7%
- WT is 35% (+/- 7%); between 28 and 42%
- Wrench time is certainly NOT 80%
- This MOE allows distinguishing that a 50-55% WT would be an improvement

(FYI – Sensitivity Analysis)

- If **p = 55%** (with **n = 160**), then **MOE = 8%**
- If **p = 5%** , then **MOE = 2%**

- If **p = 35%** with **n = 80**, then **MOE = 10%** (loose)
- If **n = 40**, then **MOE = 15%** (way too loose)
- If **n = 320**, then **MOE = 5%** (not much better)

Use Forms

- Helps to collect and organize data



Start Sampling!

- Give the crew a heads up – no surprises
- Get crew list, privately assign #'s per person
– NO NUMBERS ON HARD HATS
- Start at top, look for next 2 persons each half hour IN ORDER (“sequential sampling”)
- The INSTANT you first see them, assign Cat
- It’s OK to ask a few what they are doing

But First. . .

- **Stretch!!!** Ok, now we can start
- We can only look for a 1/2 hour for these 2 persons
- Here are example situations we observed during the study:

Example Observation

- You glimpse person across the plant walking
- **Category 2, Travel**

Example Observation

- The person is carrying a tool and he says he is coming from the tool room
- **Category 2, Travel**

Example Observation

- The person is at a piece of equipment doing something that looks like work
- **Category 1, Work**

Example Observation

- The person is waiting at the parts counter
- **Category 6, Waiting for Materials**



Example Observation

- The person is putting stuff away in a locker at the end of the day
- **Category 5, Wrap up**

Example Observation

- The person is assembling something together in the shop.
- **Category 1, Work**

Example Observation

- The person is talking to their supervisor away from the job-site
- **Category 8, Waiting for Instructions** (Would be Cat 4, Waiting for Assignment, if the person were between jobs)

Example Observation

- You see the person is in the morning check-in meeting
- **Category 4, Waiting for Assignment,**
(Not Category 15, Meetings, per definition)

Example Observation

- The person is watching the other crew member work at the job-site
- **Category 1, Work**

Example Observation

- The person is in the breakroom but it is not break time
- **Category 19, Break** (per definition)

Analyze Results

- 3 out of 10 in Cat 1 (for the obs we just did)
- Wrench Time is 30% (+/- 28%)
- Well, we are not at 80%
- But we definitely need some more observations to lower that MOE

Analyze Results

- 56 out of 160 in Cat 1 (for typical study)
- Wrench Time is 30% (+/- 7%)
- Well, we are not at 80%
- We are not at 50%
- We have determined an opportunity

Analyze Results

An opportunity:

- To complete more work
- Extra work that should improve plant availability, reliability, and efficiency
- Presuming we have identified that extra valid work

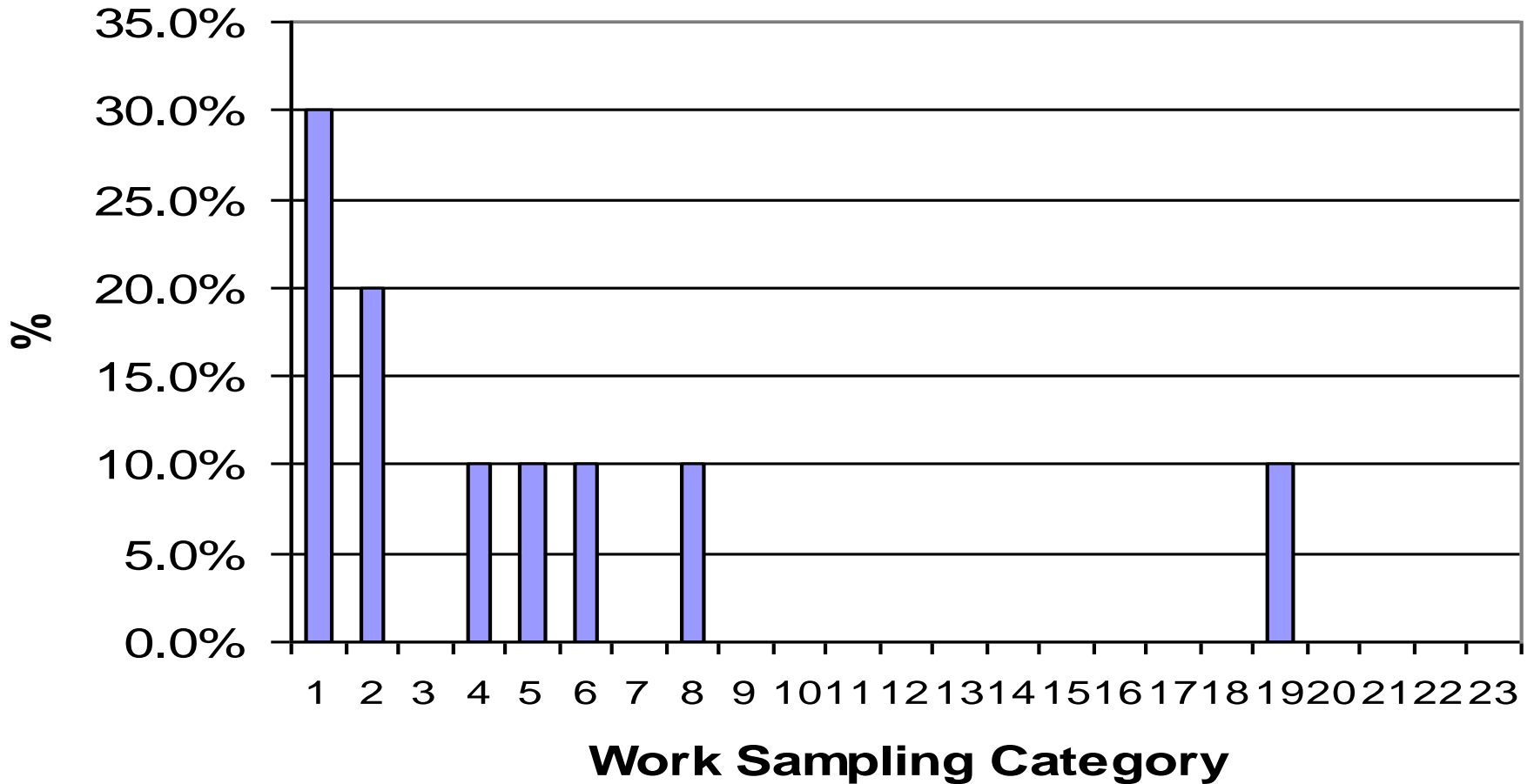


The 1:10 Rule

Every additional \$1 invested in proper maintenance returns \$10 to the company bottom line



Distribution of Time



Wrap-up (Category 5)

You could take 8 days over the course of a month and do an entire wrench time study

- 1 day set up (definitions, etc) incldng talk to crews
- 1 day practice
- 5 days of observations
- 1 day to analyze and write the report



Conclusion

- Wrench time is an important issue that could potentially double our work force
- We can do an in-house study fairly easily
- Wrench time is not the “silver bullet” alone
- There are some cautions in doing studies and we **don't** necessarily have to measure (We **do** have to plan and schedule)



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Doc Palmer

www.palmerplanning.com

docpalmer@palmerplanning.com

(904) 228-5700

