Project Performance Control

TCM 545/645 – Project Control Systems
Week 4

Overview

- As stated in week 1, the main components of project control are:
  - Defining project objectives
  - Planning the project
  - Performance measurement and control action
- Of these, **MEASUREMENT** is generally the most overlooked piece even though it is the fundamental data collection tool that project control is based-upon
  - **Remember "If you can't measure it, you can't control it."**

A Quick History of Measurement and Productivity

- **Frederick W. Taylor** (1856-1915) is often considered the "father" of scientific management by looking for ways to improve industrial efficiency
- In his studies, Taylor sought to improve the productivity of a single laborer by optimizing work stations and tool layout/usage/design.
- Taylor's work involved using **time studies** to break down work into basic movements and then analyzing those movement to maximize efficiency

Using work measurement and productivity studies in project management

- Work measurement is key to many of today's top management "systems" including Six Sigma, Lean, TQM, 5s, theory of constraints, etc.
- Project management can leverage work measurement as a tool to help **improve project performance** by improving productivity at the activity level
  - **"Controlling" work elements is the key to improved productivity and ultimately improved project performance**

Two Techniques to Measure/ Understand Work Activities

- **Method 1: Continuous Time Studies**
  - Observations are taken on the time it takes to perform a sequence of tasks
  - Useful for better understanding "how" work is done and ways to improve the process
  - Questions to ask oneself while analyzing work during a time and motion study:
    - What is its purpose?
    - Why do it this way?
    - When is the best time to do it?
    - Where is the best place to do it?
    - How is the best way to do it?
    - Who is the best qualified to do it?

Try to minimize the number of "moves", minimize the length of "moves", and maximize efficient use of equipment.

Two Techniques to Measure/ Understand Work Activities

- **Method 2: Work Sampling**
  - Statistically based observations look to classify laborer and/or machines as either "working" or "idle"
  - Rigorous procedures must be followed to ensure statically validity of observations
  - Observations can be expanded to also categorize actions as: 1) Direct work, 2) Support Work, and 3) Delays
  - Ultimately, knowing relative worker/equipment efficiency can lead to improved performance

Work Sampling Guidelines & Limitations

- **Overall, observations must be:**
  - **Random**
  - **Unbiased**
  - **Independent**
- Requires a skilled observer
- Does not differentiate between rework and original work
- Reviewed with suspicion by craft/line workers
- Final results may take some time to process the large amounts of data
  - Especially problematic if activities studied are over by the end of the analysis period

Work Sampling Fundamentals

- **Work sampling is based upon the laws of probability**
  - A binomial distribution can represent the likelihood that an event will or will not happen
- **When the # of observations is large, the binomial distribution can be approximated to the normal distribution**
  - The standard deviation for this approximation can be represented by the equation:
    - $\sigma_p = \sqrt{\frac{p(1-p)}{n}}$ Where: p = proportion of occurrence of an event
n = # of observations

Work Sampling Fundamentals

- If the absolute accuracy desired in a measurement is "A", and the relative accuracy for the proportion "p" is designated as "s", then:
  - $A = sp$
  - $A = z\sigma_p$
- Therefore, the # of observations to obtain that absolute accuracy can be found by:
  - $A = z\sigma_p = z\sqrt{\frac{p(1-p)}{n}}$ or
  - $n = \frac{z^2}{A^2}[p(1-p)]$ KEY EQUATION

Where: A is usually 5% or 0.05
p = percentage of total work time during which a component occurs
z = # of standard deviations; depends on confidence level desired

Confidence Intervals for Standard Normal Curve

Confidence Level	z Standard Deviation
68.30%	1σ
80%	1.28σ
90%	1.64σ
95%	1.96σ
95.45%	2σ
99%	2.58σ
99.73%	3σ
99.90%	3.29σ
99.99%	4σ

Work Sampling Applicability

- Work sampling is most suitable for:
  - Machine utilization
  - Allowances for unavoidable delays
  - Work standards for direct and indirect work
- In particular, this technique is well-suited for determining standards for indirect and service work in project management

Week 4 Book Error

- It looks like the author can't do math (page 141 specifically).
- I will work their example through below. The basic formula used for most of the calculations is:
  - $n=(Z^2/A^2)[p(1-p)]$ *** call this equation "1"
    - Where:
      - n=number of observations
      - Z=number of standard deviations (based upon confidence interval, see bottom of page 138)
      - A=absolute accuracy = (s x p)
        - s = relative accuracy; 5% generally for industrial work
        - p = percentage of time the desired work event time occurs

Week 4 Book Error – continued (2)

Thus, for the example on page 141:

- We need to figure out what “s” we actually performed given our actual data collection efforts.
- Solve equation “1” for A, where
  - n = 2000
  - p = 25% (the company wanted us to investigate idle times)
  - Z = 1.96 because of 95% confidence interval
- A = SQRT{(Z^2/n) [p(1-p)] }
- A = SQRT{ $(1.96^2/2000)$ [.25(1-.25)] } = .0189776

Week 4 Book Error – continued (3)

Therefore, s = A / p = .0189776 / .25 = 7.591%; not enough accuracy, we need 5% for “s”

- Solve equation “1” for the needed number of samples:
  - n=(Z^2/A^2)[p(1-p)] = $[1.96^2/(.05*.25)^2]$[.25(1-.25)] = 4609.92 = **4610 TOTAL observations needed**