DEWI HARDININGTYAS, ST, MT, MBA

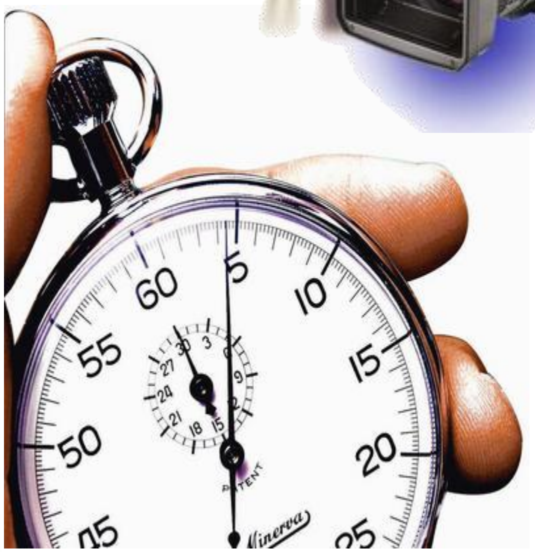
#10_STANDARD DATA SYSTEM

ANALISA DAN PENGUKURAN KERJA

METODE PENGUKURAN [WAKTU] KERJA

PENGUKURAN [WAKTU] KERJA

- **DIRECT**
  - STOP-WATCH
  - WORK SAMPLING
- **INDIRECT**
  - STANDARD DATA
  - PMTS



A standard data system (SDS) in work measurement is a **database of normal time values**, usually organized by work elements that can be used to establish time standards for tasks composed of work elements similar to those in the database.

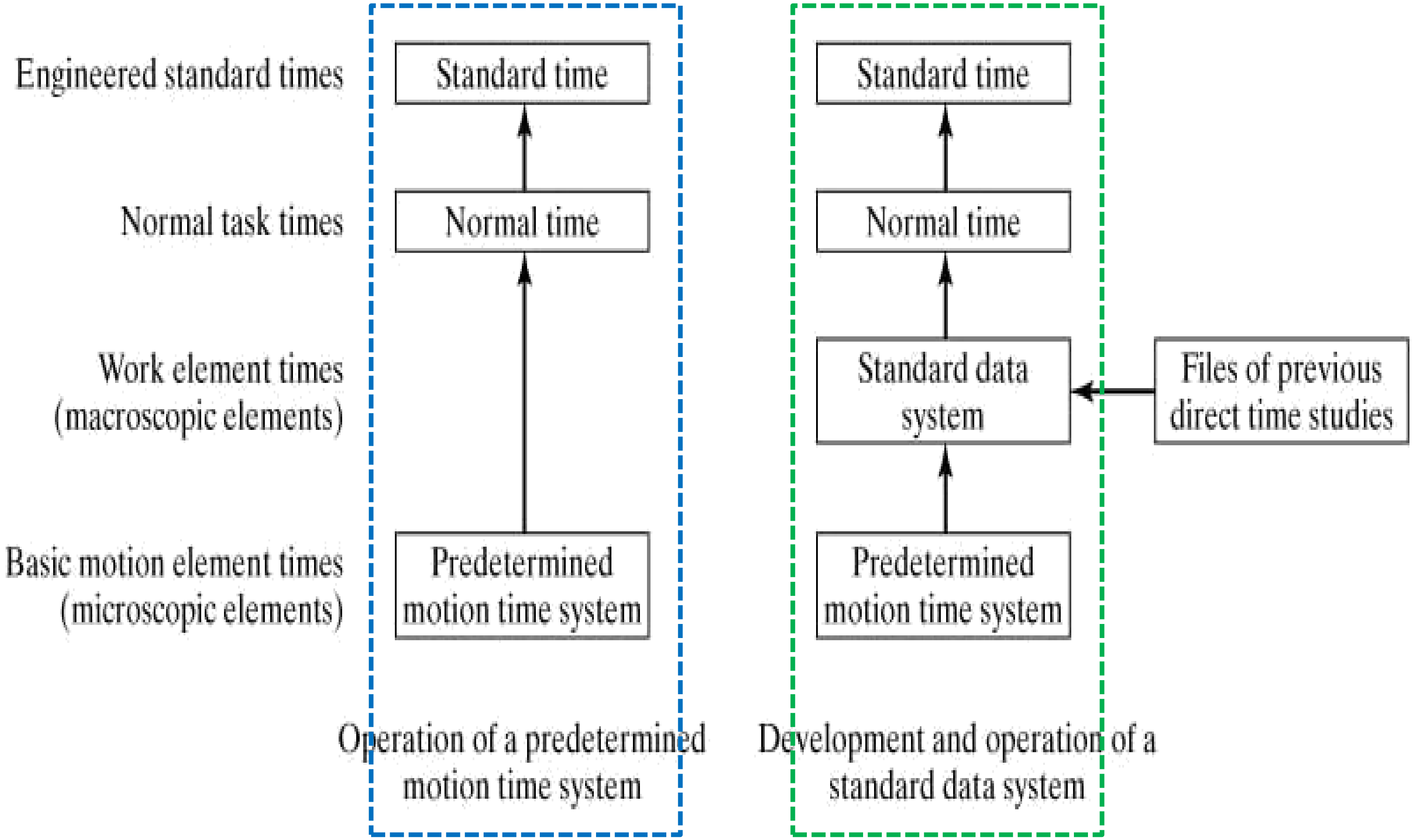
Standard data is **a catalog (list) of elemental time standards** developed from a database collected over years of motion and time study.

Standard Data Systems

Standard Data System Defined

- The normal time values for the work elements are usually compiled from previous direct time studies (DTS).
- Using a standard data system, time standards can be established before the job is running.
- When a predetermined motion time system is used to develop times for a standard data system, it is for either of the following purposes:
  - to supplement the database of direct time study values because some of those data are missing, or
  - to develop the SDS database of work element normal times from the basic motion element times in the PMTS.

PMTS and SDS Compared



Why do we need Standard Data?

- **Reduce time required to develop time standards (as compared to time study).** Standard data times standards are chosen from a book or database of standards. It takes about 2 minutes to select a standard, compared to about 30 minutes per standard using stopwatch time standards techniques.
- **Reduce cost of developing time standards (due primarily from reduced time required to develop the standards).** Because we can set time standards so quickly, we can afford to set time standards for jobs that were previously too small to be covered economically by time standards. A job that occurs only once a month and lasts only an hour is an example.
- **Permit the establishment of accurate time standards before the job is performed.** This feature enables you to estimate the cost of new work, to estimate quotes and to subcontract products or services with confidence.

Why do we need Standard Data?

- **Time standards from standard data are more consistent** (and fair) than time standards that originate from a guess or from historical data. Standard data time standards are more consistent than other techniques because individual differences between jobs are smoothed out in curves, formulas, or graphs. During time studies, rating and watch readings may vary, creating small errors (+/- 5%) , but these small errors creating what the employees call good jobs or bad jobs because the time standards are easy to achieve or difficult to achieve.
- **Standard data time standards are more accurate** than other time standard techniques because individual time studies are compared to all other time studies of the same machine or work center, and differences are averaged to make all standards uniform.
- **Simplifies issues associated with unions**. Time standards are easier to explain and adjust if needed.
- **Could be used as a check for time study**

When a SDS is Most Suitable ?

- **Similarity in tasks**
  - If the tasks performed in a given work facility are similar, and there are many such tasks, then a standard data system is probably a more efficient way to set standards than direct time study.
- **Batch production**
  - Best suited to medium production quantities
- **Large number of standards to be set**
  - More productive than direct time study
- **Need to set standards before production**
  - Direct time study requires direct observation of the task in order to set a standard. This means that the job must already be in production. With a standard data system, the standard can be established before the job is running.

Classification of Work Elements

- The database in a standard data system is organized by work elements.
- The classification of work elements in a standard data system must account for differences between the following element types:
  - Setup versus production elements
  - Constant versus variable elements
  - Worker-paced versus machine elements
  - Regular versus irregular elements
  - Internal versus external elements

Setup vs. Production Elements

- **Setup elements** - associated with activities required to change over from one batch to the next
  - Performed once per batch
- **Production elements** - associated with the processing of work units within a given batch
  - Performed once per work unit
- **Batch time**

$$T_b = T_{su} + Q\, T_c$$

where T_b = batch time, T_{su} = setup time, Q = quantity, and T_c = cycle time

Constant vs. Variable Elements

- **Constant elements** - same time value in all time studies and tasks
  - Replace cutting tool in tool post
  - Dial telephone number of customer

- **Variable elements** - same basic motion elements but normal times vary due to differences in work units
  - Load work piece into machine
  - Keypunch address

Operator-Paced vs. Machine Elements

- **Operator-paced elements** - manual elements
  - Can be setup or production cycle elements
  - Can be constant or variable
- **Machine-controlled elements** - machine time depends on machine operating parameters
  - Once parameters are set, the machine time can be determined with great accuracy
  - Characterized by little or no random variations

Other Work Element Differences

- **Regular elements** - performed once every cycle
- **Irregular elements** - performed less frequently than once per cycle
  - Must be prorated in regular cycle
- **External elements** - manual elements performed in series with machine elements
- **Internal elements** - manual elements performed at same time machine is running

TABLE 6-4 Time Study Data for Zero Washer Company's Database

Model	ID	OD	Thickness	Hours/1000
A-1	1/16	1.5	1/16	.60
A-2	1/8	1.5	1/16	.65
A-3	1/4	1.5	1/16	.70
A-4	3/8	1.5	1/16	.76
A-5	1/2	1.5	1/16	.82
A-6	3/4	1.5	1/16	.97
A-7	5/8	1.5	1/16	.90
A-8	7/8	1.5	1/16	1.03
B-1	1/16	2.0	1/8	.64
B-2	1/8	2.0	1/8	.78
B-3	1/4	2.0	1/8	.96
B-4	3/8	2.0	1/8	1.09
C-1	1/16	1.0	3/32	.81
C-2	1/8	1.0	3/32	.91
C-3	1/4	1.0	3/32	1.04
C-4	3/8	1.0	3/32	1.16
C-5	1/2	1.0	3/32	1.22
E-1	1/16	1.25	1/32	.67
E-2	1/8	1.25	1/16	.73

Work Cycle Standard Data

- A SDS that uses normal times for the entire task rather than dividing the task into work elements and determining element normal times
- When appropriate:
  - Work elements of task are highly variable
  - Elements are difficult to separate or identify
  - Task consists of many elements
  - Many elements are similar
  - Time standard will not be used for wage incentive purposes

Work Cycle Standard Data

- Examples:
  - Checkout of customers at supermarket counter
    - Simpler to determine time per customer than to break the time into elements
  - Prepare legal document for client
    - Start with standard document form (e.g., will) and edit for specific needs of client
  - Proofreading a document
    - Time estimate based on the number of pages to proofread

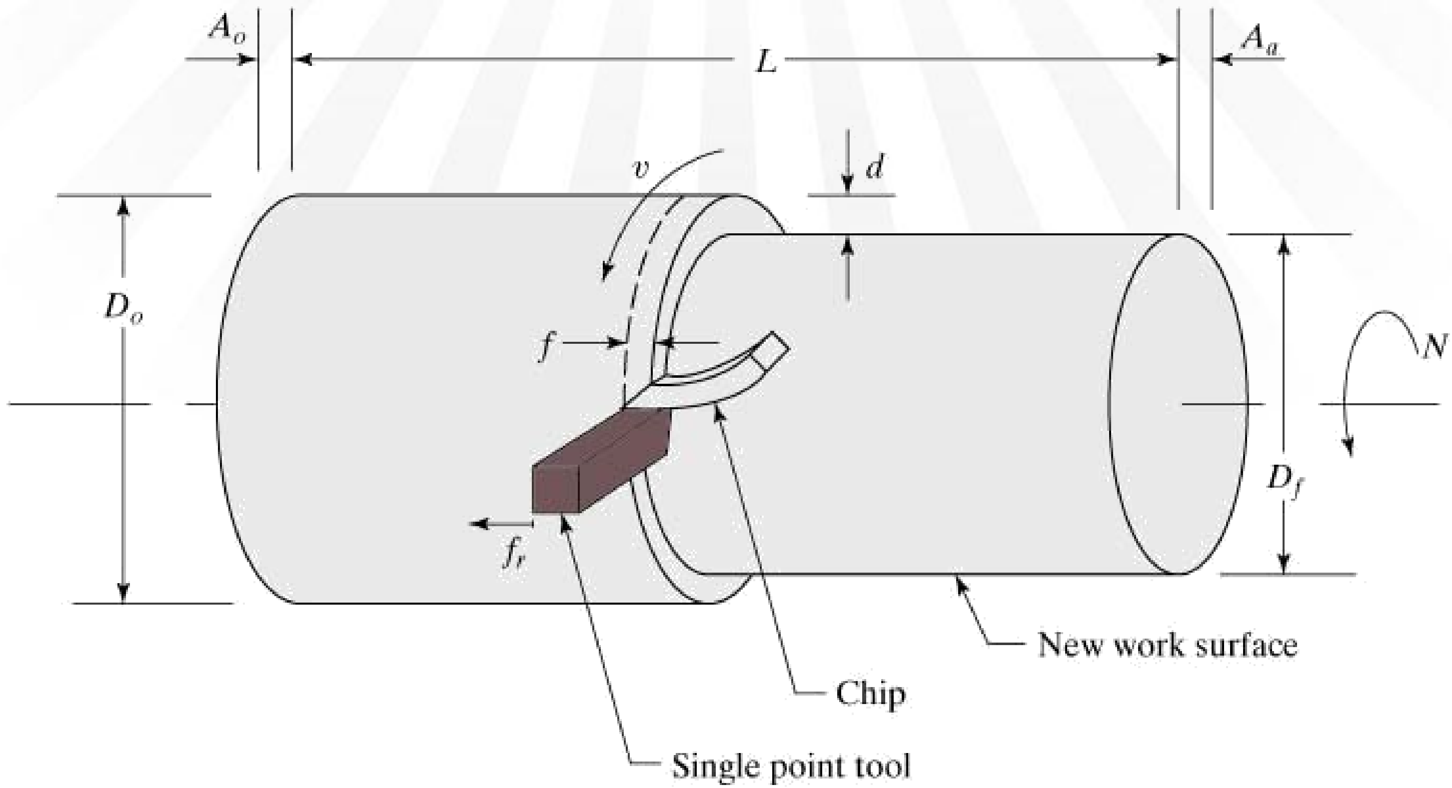
Machine-Controlled Elements

- Examples:
  - Power feed motion of a machine tool
    - Once activated by worker, machine time depends on feed and speed settings and dimensions of work piece
  - Semiautomatic cycle of a machine
    - Machine cycle operates under computer numerical control (CNC)
  - Fully automated cycle
    - Operator periodically attends machine

Machine Times for Machining

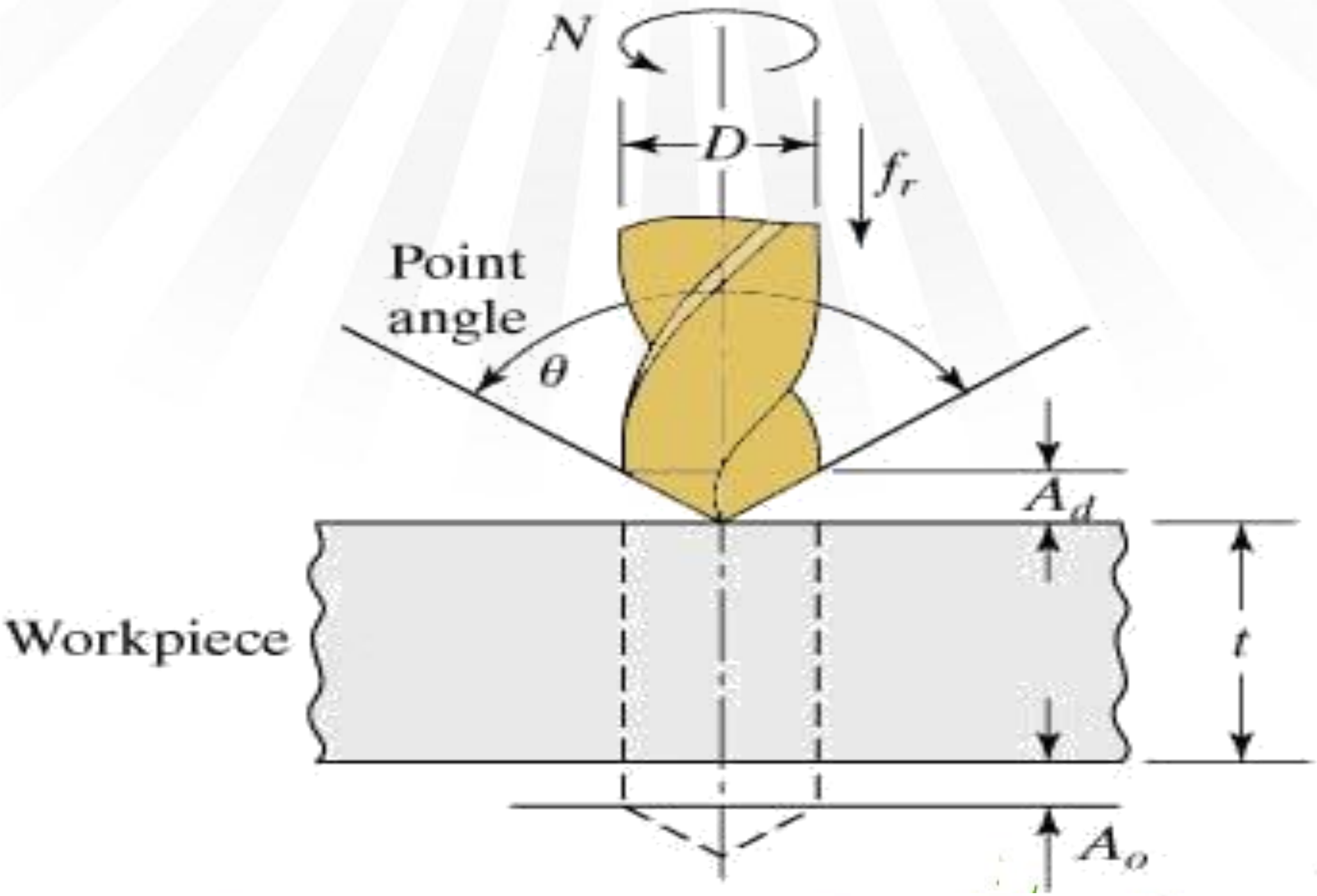
- Machining - family of processes in which excess material is removed from a starting work piece by a sharp cutting tool so the remaining part has the desired geometry
  - Common machining operations:
    - Turning
    - Drilling
    - Milling
- Machining times can be calculated or measured with great accuracy, given the machine settings (feeds and speeds) and part dimensions

Turning Operation

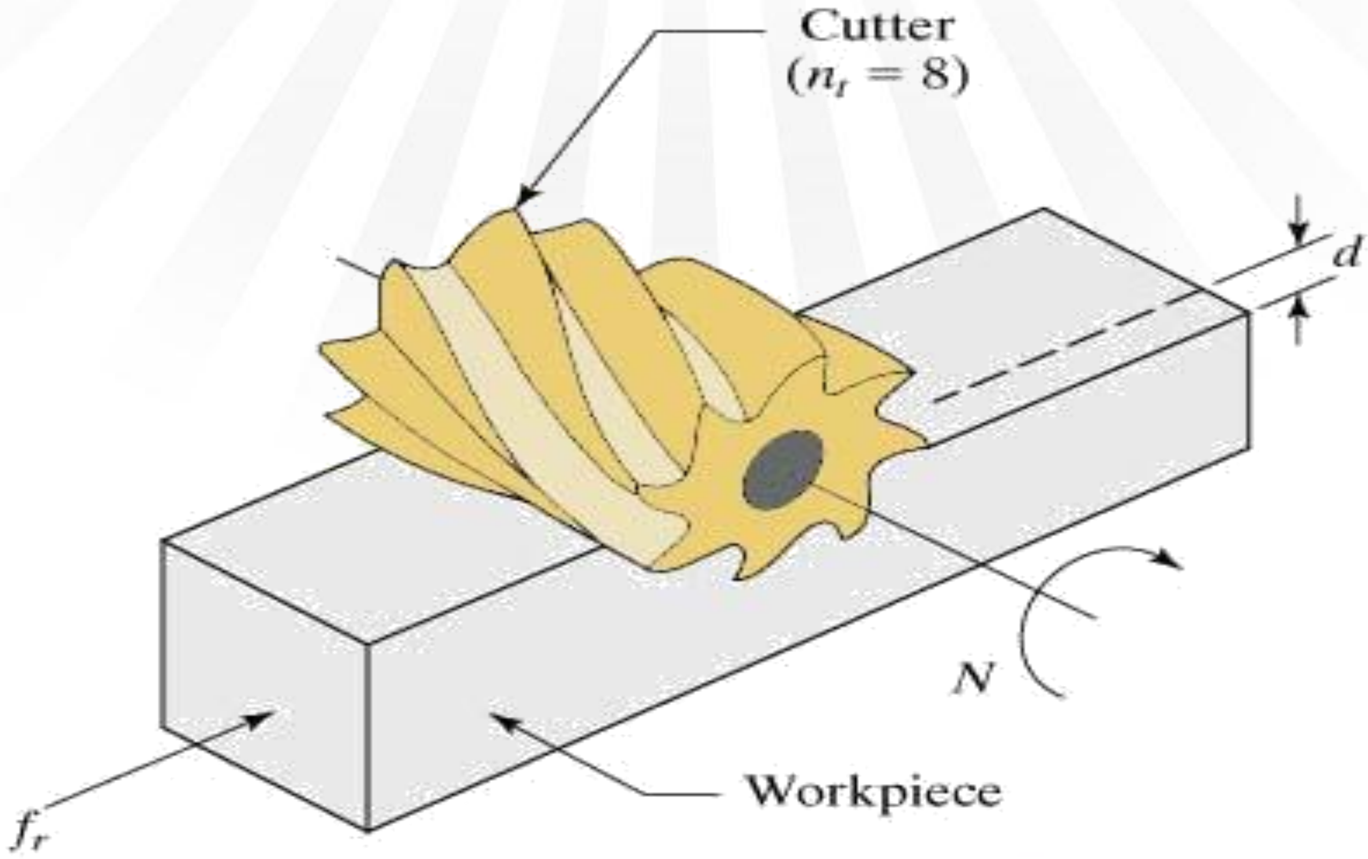


Key: D_o = staring diameter, D_f = final diameter, L = length, v = cutting speed, f = feed, d = depth of cut, f_r = feed rate, N = rotational speed, A = approach allowance, and A_o = overtravel allowance.

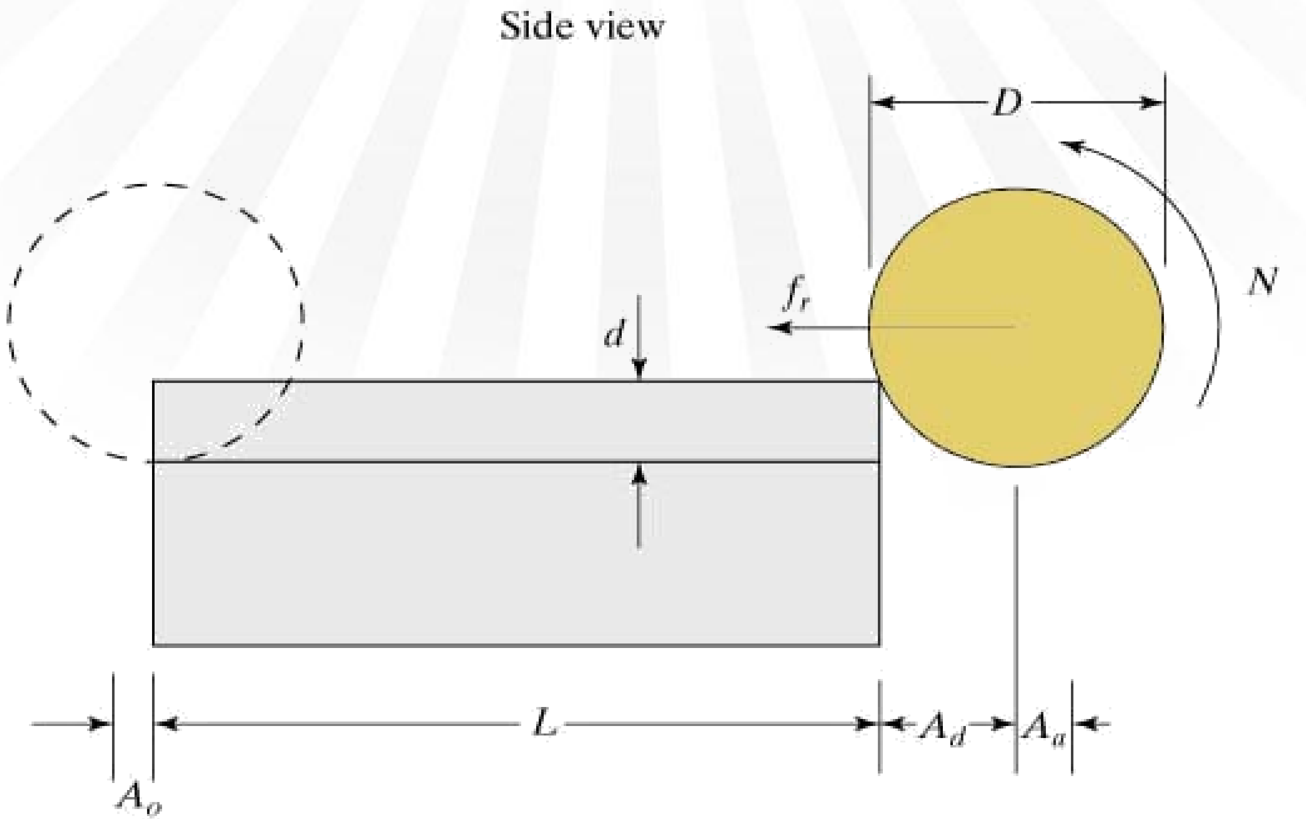
Drilling Operation: Through Hole



Milling Operation: Peripheral Milling

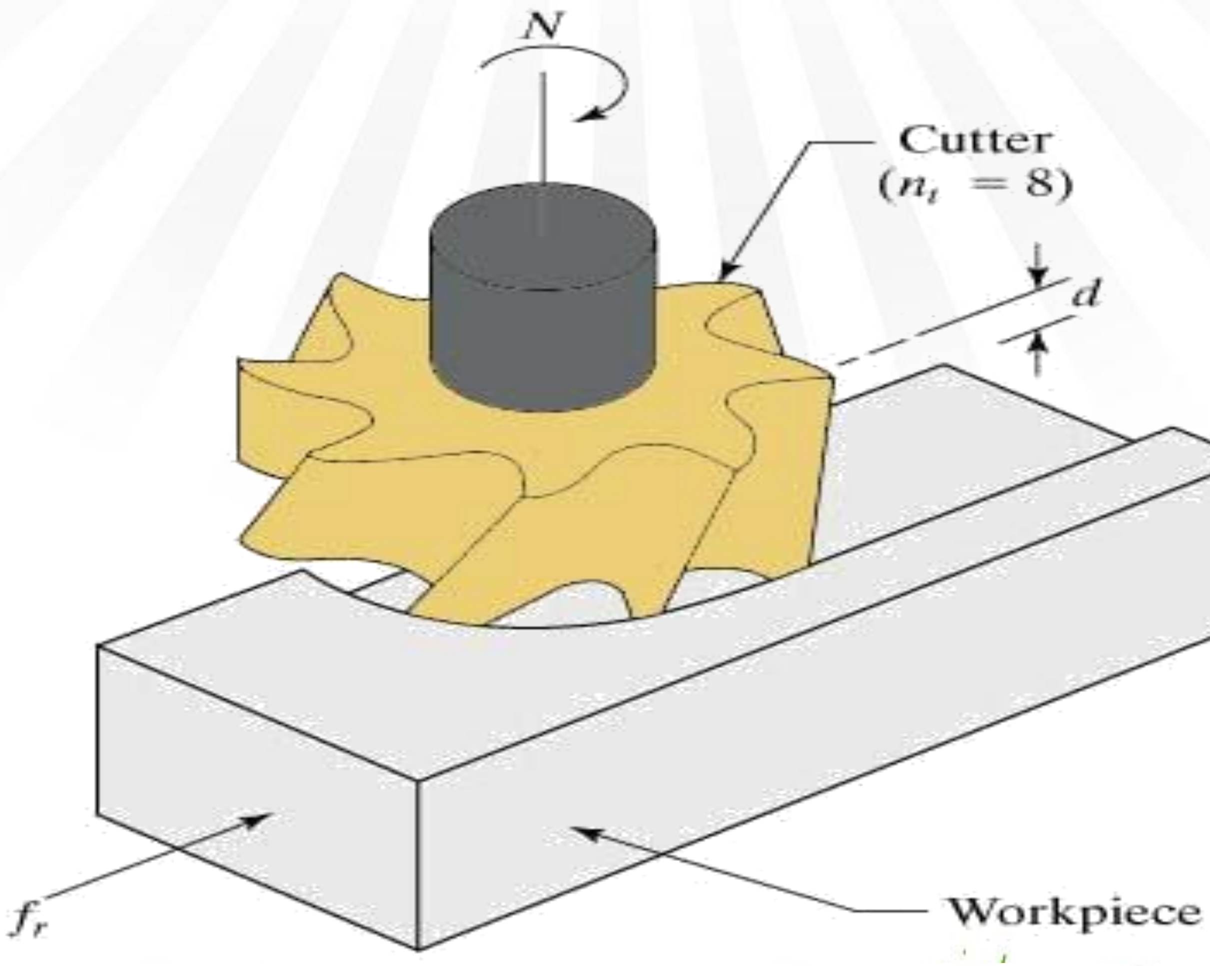


Peripheral Milling: Approach Distance

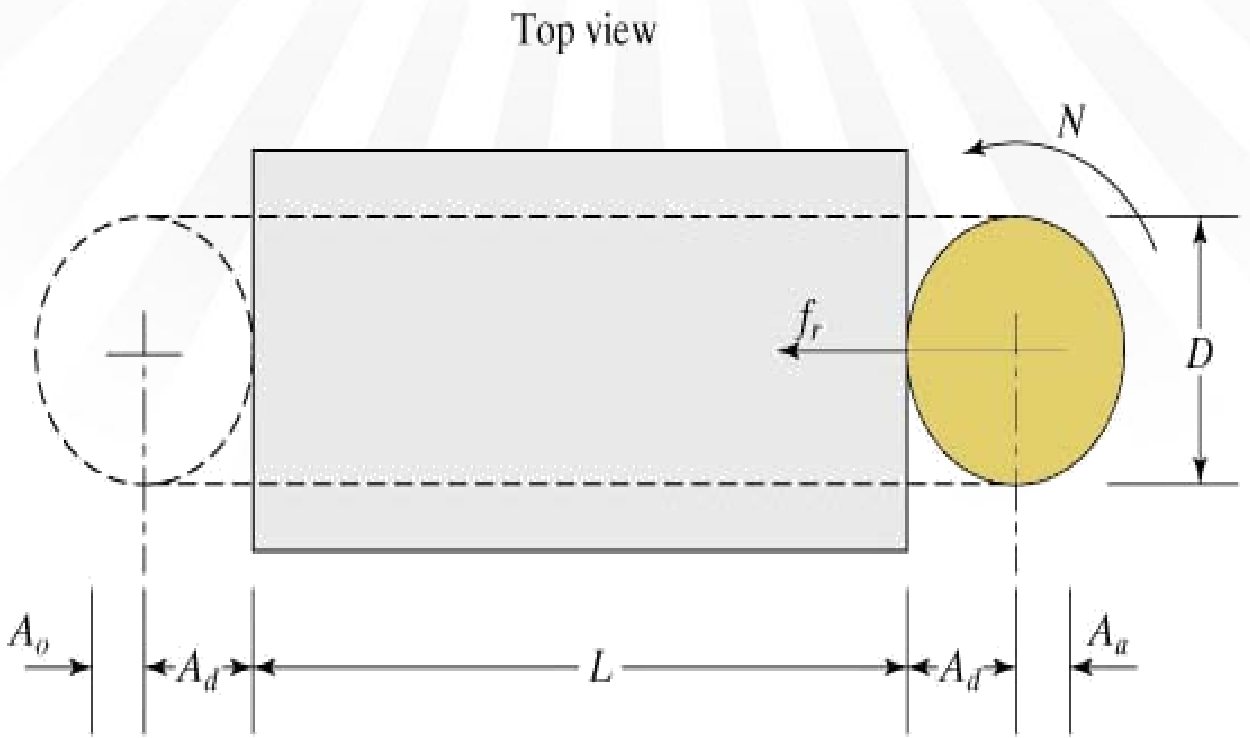


Key: D = cutter diameter, N = cutter rotational speed, f_r = feed rate,
L = workpiece length, d = depth of cut, A_d = distance to reach full depth,
A_a = approach allowance, and A_o = overtravel allowance.

Milling Operation: Face Milling



Face Milling: Approach and Over Travel



Key: D = cutter diameter, N = cutter rotational speed, f_r = feed rate, L = workpiece length,
A_d = allowance distance to reach full diameter (equal to overtravel distance),
A_a = approach allowance, and A_o = overtravel allowance.

Calculation of Machining Times

- Basic approach to calculate machining times:
  - **Determine the length of the cut**

    $$L = \text{mm or inch}$$

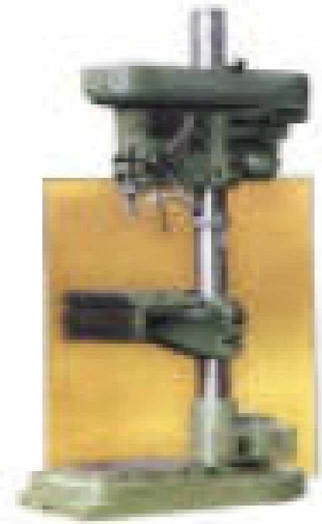
    - Add allowances for approach and over travel if applicable
  - **Divide by feed rate**, which is the travel speed of the cutting tool in the direction of the length

    $$f_r = \text{mm/min or inch/min}$$

- Thus, machining time $T_m = L/f_r$

Constant Element Data

(Elemental Time Data for Sensitive Drills)



Machine Manipulation Time

Classes :

A. Drilling, one drill and no bushing
B. Drilling, placing and removing bushing
C. Drilling, placing and removing drill
D. Drilling, placing, removing drill and bushing

Elements	Time (x 0.01 menit)			
	A	B	C	D
1. Place bushing in jig	---	6	---	6
2. Place drill in chuck	---	---	4	4
3. Advance drill to work	4	4	4	4
4. Raise drill from hole	3	3	3	3
5. Remove bushing from jig	---	5	---	5
6. Remove drill from chuck	---	---	3	3
Total :	7	18	14	25

Catatan :

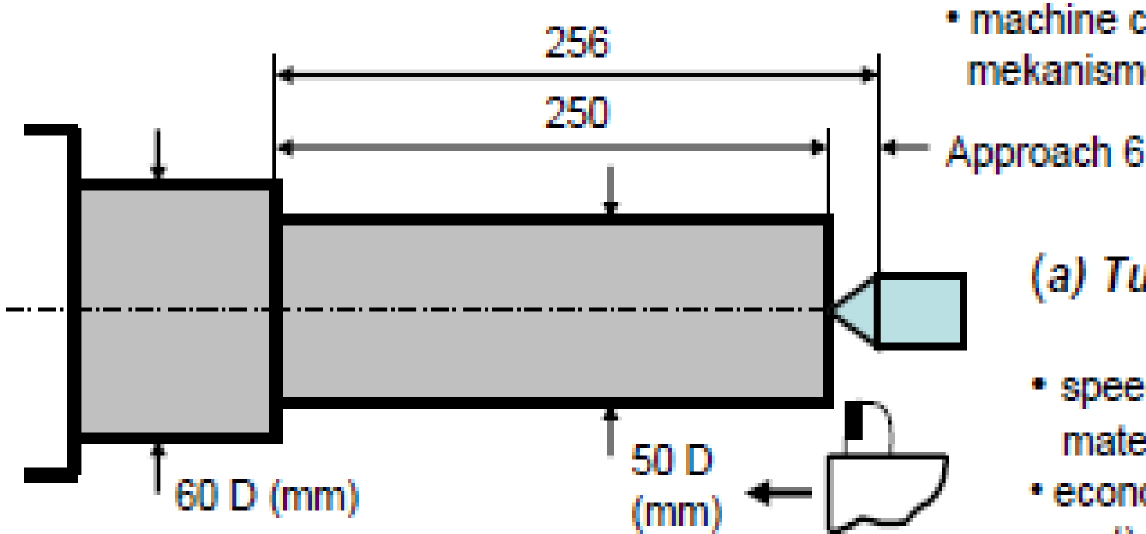
- Tambahkan 0.15' bila "quick change chuck" tidak digunakan (kasus B dan C)
- Tambahkan 0.05' bila drill memerlukan lubrication setiap siklus kerja berlangsung.

Variable Element Times

Waktu diekspresikan dalam bentuk rumus
atau grafik yang diperoleh secara teoritis atau eksperimen

(1) Teoritical Derivation of Element Times

- element is machine controlled
- machine cycle dikendalikan melalui sebuah mekanisme khusus

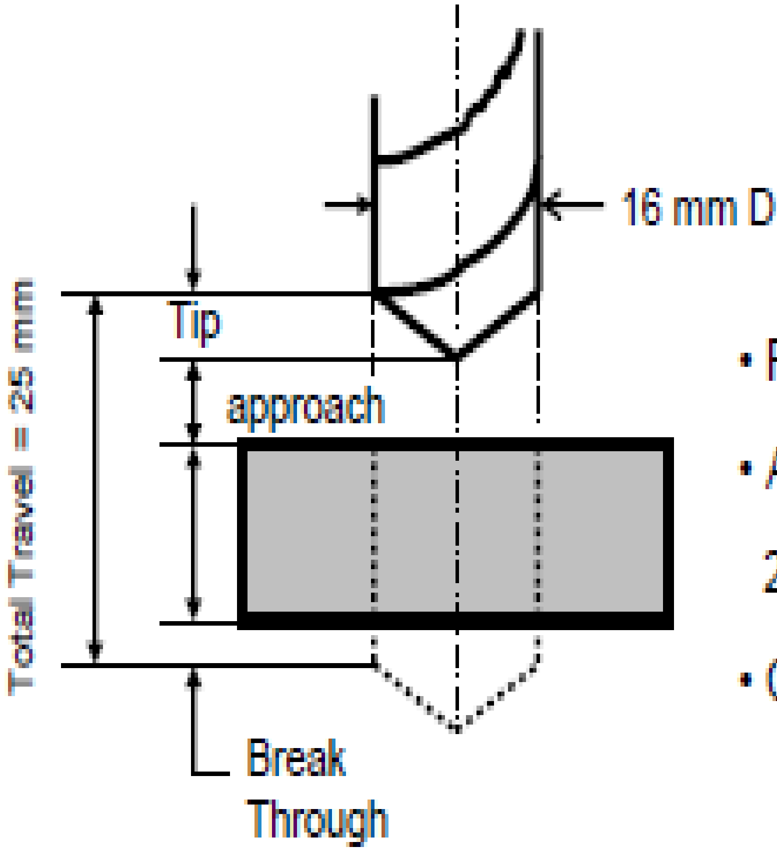


(a) Turning a length on a shaft

- speed atau feed harus sesuai dengan material yang dipotong.
- economical speed (machine cost, labor cost)

- speed ↑ ; machine/labor cost ↓ ; tool cost ↑ (more rapid tool wear)
- feed ↑ (tool of movement per revolution of work); excessive tool forces; poor surface finish; and more power
- feed rate (s) ≈ 0.38 mm/rev (basis of minimum acceptable finish)

(b) Drilling a hole through a steel plate.



- Feed 0.30m mm/re
- Available spindle speeds : 100; 200, 400 dan 800 rpm
- Cutting speed 50 m/min (at OD)

- Berapa lama waktu pemotongan yang diperlukan untuk proses tersebut diatas ?

Variable Element Times

Waktu diekspresikan dalam bentuk rumus
atau grafik yang diperoleh secara teoritis atau eksperimen

2) Experimental Determination of Formulae

- Sering dijumpai bahwa variable element merupakan fungsi dari sebuah variable tertentu. Contoh (proses pengelasan/penyoderan) :

Barnes : $T = 0.014\ L$; dimana T = solder a seam (menit), L = panjang *seam* (inches)

Formula dikembangkan dari micro-motion studies yang dilaksanakan terhadap berbagai operasi penyoderan (soldering) untuk berbagai macam panjang solderan (seams). Disini cukup menggunakan fungsi *straight line* dan ternyata cukup layak untuk menunjukkan hu bungan antara T (waktu) dan L (panjang *seams*).

- Proses *arc-welding* (Niebel) :

$Y = 0.08\ (13)^X$; dimana X = size of weld,
T = Time (minute) per inches

- Penetapan model matematis terhadap curva yang me- nunjukkan hubungan antar variabel dg analisa regresi

SDS Advantages

- **Increased productivity in setting standards**
  - Associated costs savings
- **Capability to set standards before production**
- **Avoids need for performance rating**
  - Controversial step in direct time study
- **Consistency in the standards**
  - Based on averaging of much DTS data
- **Inputs to other information systems**
  - Product cost estimating, computer-assisted process planning, MRP

SDS Disadvantages and Limitations

- **High investment cost**
  - Developing a SDS requires considerable time and cost
- **Source of data**
  - Large file of previous DTS data must exist
- **Methods descriptions**
  - Documentation still required
- **Risk of improper applications**
  - Attempting to set standard for tasks not covered by SDS

“Knowing exactly what you want to do, and then seeing that they do it the best and cheapest way.”

- Frederick W. Taylor-

Thank you