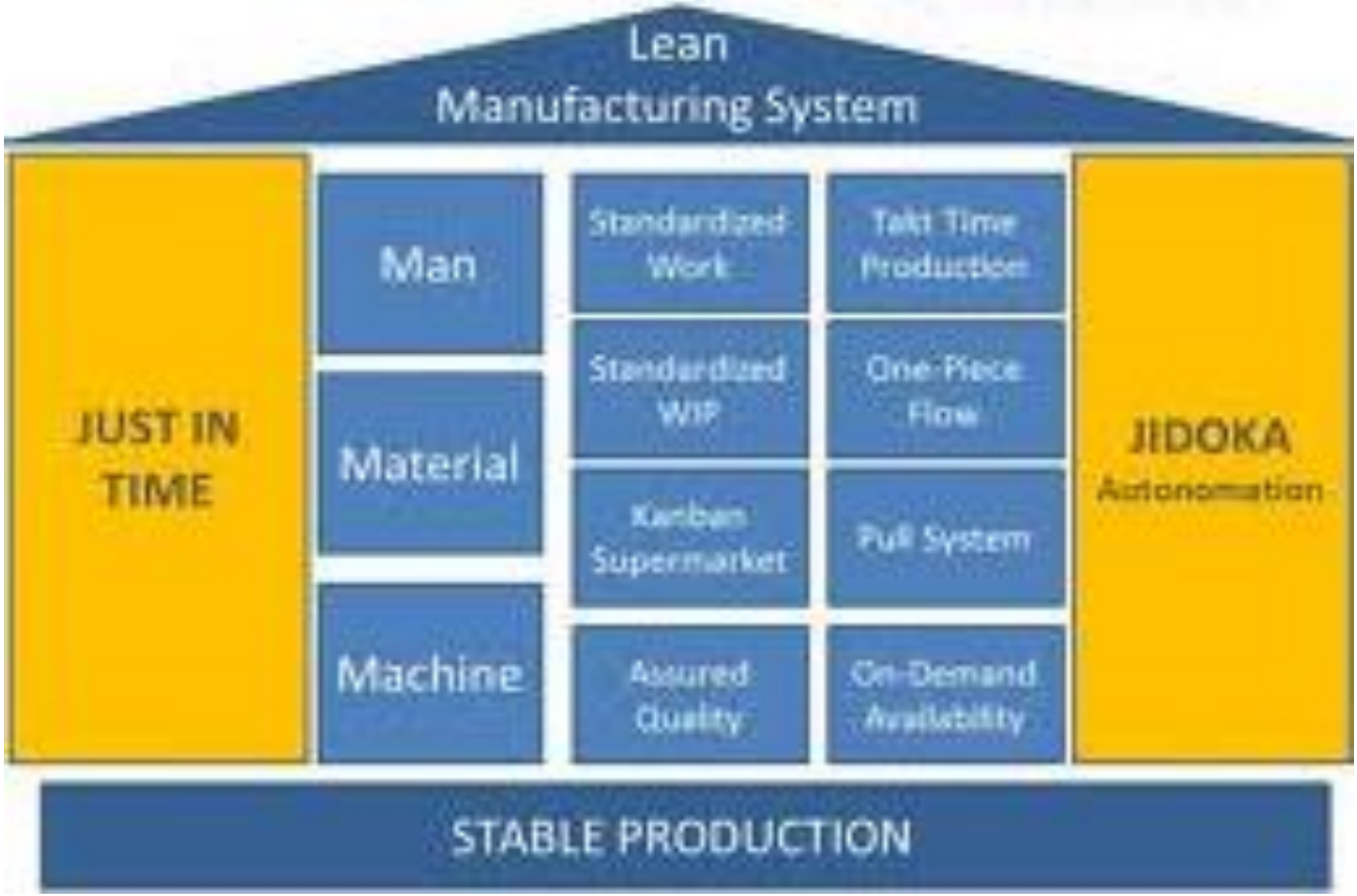
Basic Time Study

AICE PROGRAM – MALAYSIA AUTOMOTIVE INSTITUTE

Topics Outline

- Overview of standardized work
- Introduction to standardized work
- Objective of standardized work
- Elements of standardized work
    - Takt time
    - Cycle time
    - Standard time
- Time Study on Continuous Observation

Malaysia Automotive Institute



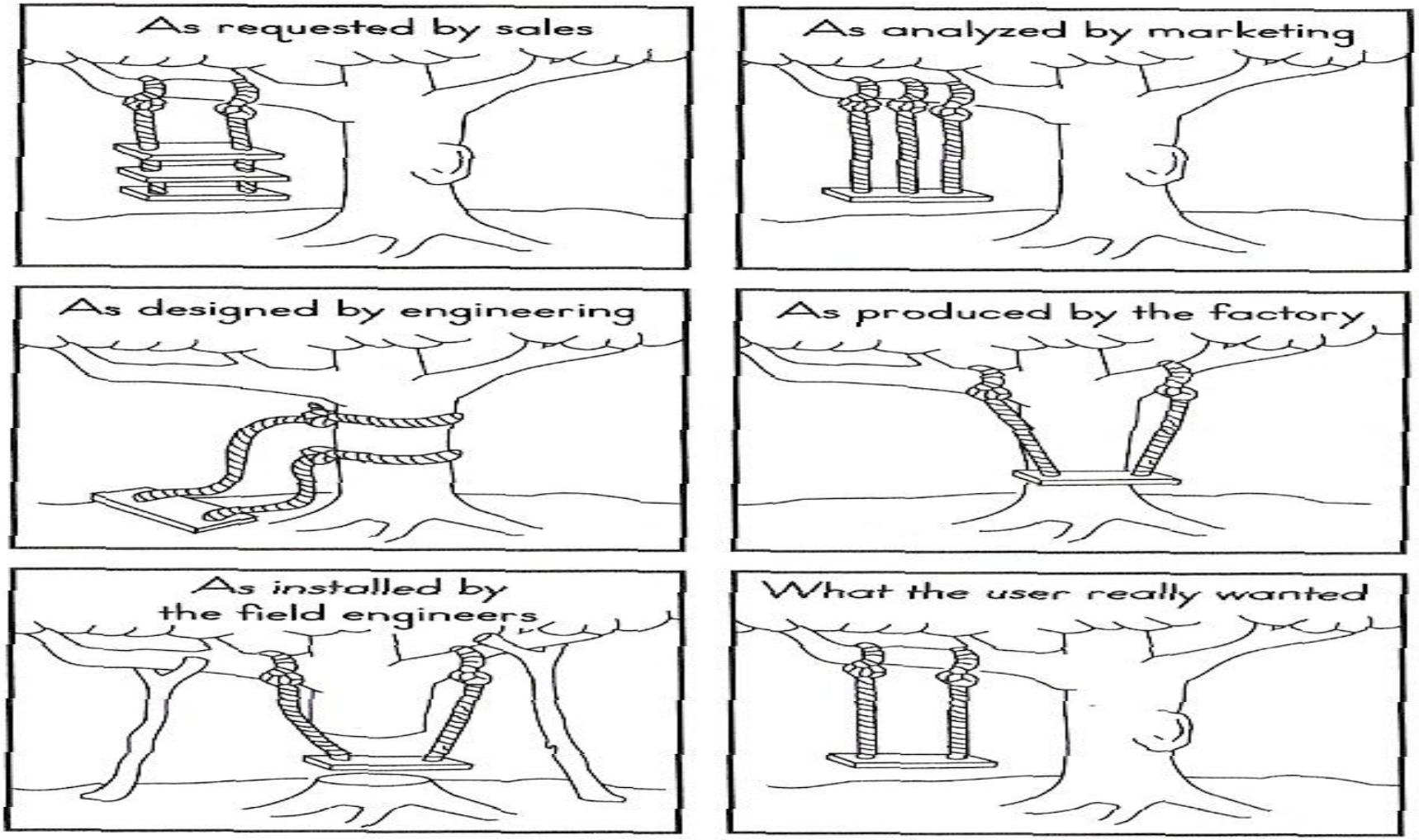
Overview of Standardized Work

Introduction to Standardized Work

Standardized work is the foundation for consistent and stable quality.

This consistency and stability is the first step towards Continuous Improvement (Kaizen)

Introduction to Standardized Work



Essence of Quality

Introduction to Standardized Work

Why Standardized Work ?

….to maintain the safety at work place.

….to guarantees quality for the customer.

….to achieve better production performance.

….to create efficient production sequence with less waste

The system which can be easily understood

... the most efficient combination of person, machine, and material.

Introduction to Standardized Work

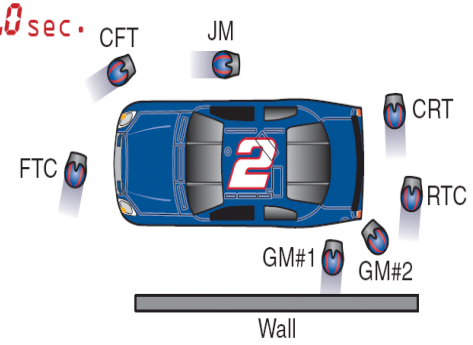
Case : Rusty Wallace's NASCAR Racing Team

- NASCAR racing became very popular in the 1990s with huge sponsorship and prize money
- High performance pit crews are a key element of a successful race team
- Pit crew members can earn $100,000 per year – for changing tires!
- Each position has very specific work standards
- Pit crews are highly organized and go though rigorous physical training
- Pit stops are videotaped to look for improvements

Introduction to Standardized Work

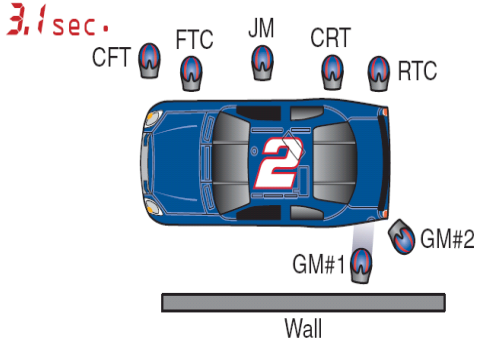
1 Wallace's car pulls into the pit; the crew rushes to the right side of the car to begin service.

0.0 sec.



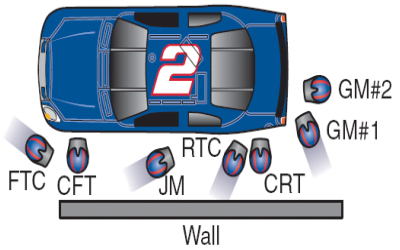
2 Right side is jacked up, tire starts to come off; gas man is emptying his first can.

3.1 sec.



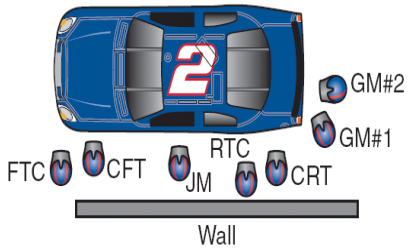
3 Action shifts to driver's side of the car; gas man carries second can of gas in.

8.9 sec.



4 The second can of gas is being emptied; driver's side tires are being changed.

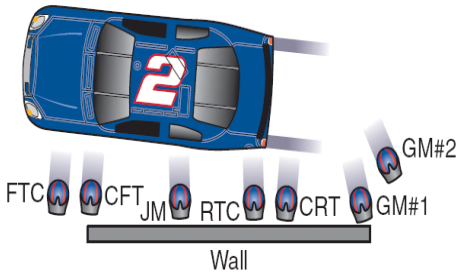
13.7 sec.



5 Service is complete. The jackman drops the car, which is the signal to the Wallace driver to exit the pit.

15.4 sec.

A good pit stop will take about 16 seconds.



Movement of the pit crew members who go over the wall...

JM = Jackman

FTC = Front tire carrier

CFT = Changer front tire

RTC = Rear tire carrier

CRT = Changer rear tire

GM#1 = Gas man #1

GM#2 = Gas man #2

Introduction to Standardized Work

Objective of Standardized Work

Performing standardized work allow clear and visible ‘standard’ operation. Deviation from standardized work indicates an abnormality, which is then an opportunity for improvement.

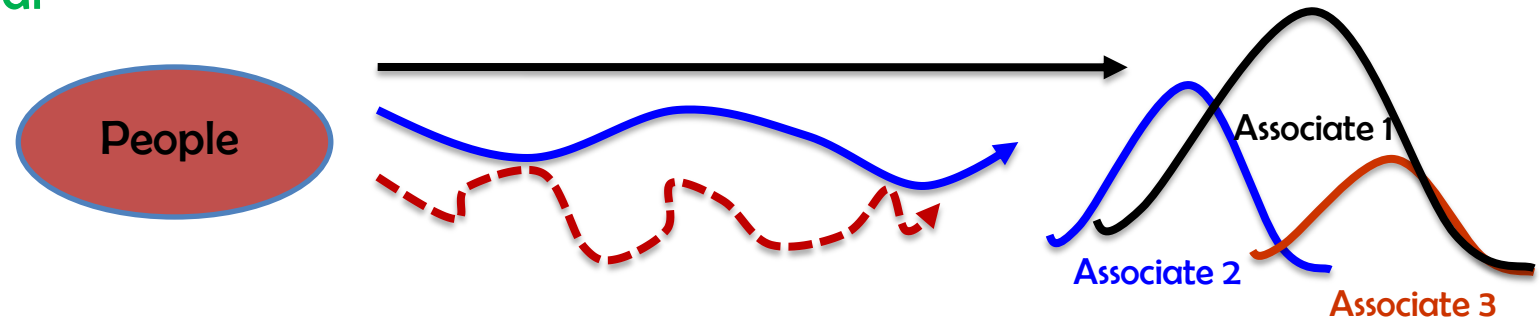
The system enable everyone to find problems.

Standardized Work
vs.
Work Standards???

Introduction to Standardized Work

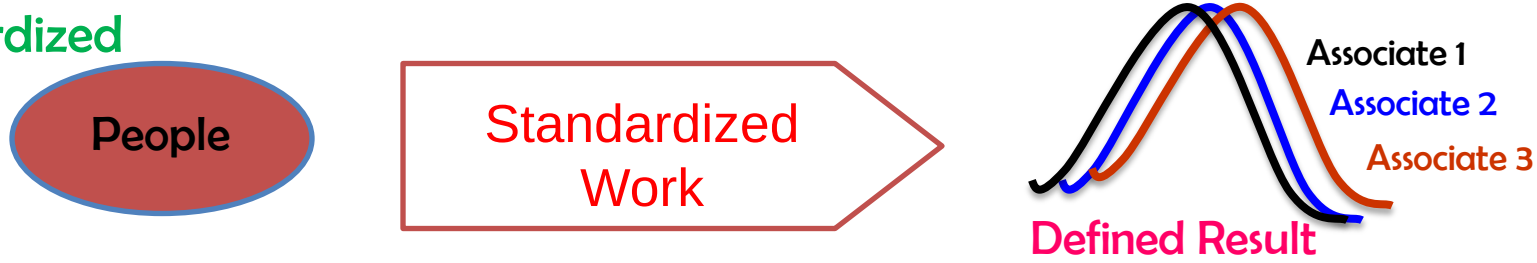
Reduce variation in the process

Traditional Method



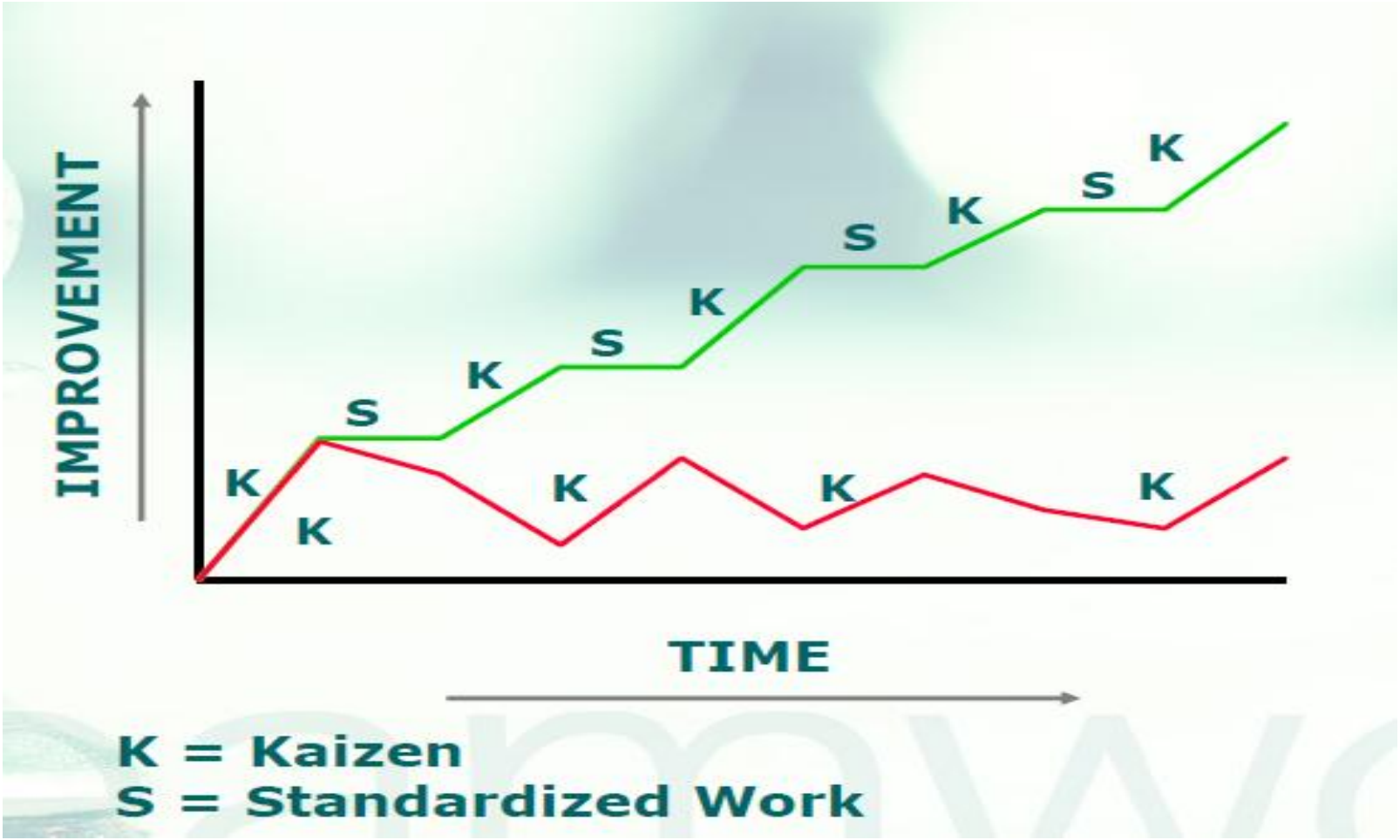
People using different processes and get different result

Standardized Work



People using standardized processes and get defined result

Introduction to Standardized Work



Standardized Sustain Result

Elements of Standardized Work

- Takt Time
- Work Sequence
- Standardized Work in Process (SWIP)

Takt Time

Definition

- From the German word Taktzeit (clock cycle), takt refers to the measure, meter or beat of movement.
- For the Lean enterprise, takt time is the pace at which items need to be produced in order to satisfy customer demand. It is the heartbeat of the market and the drumbeat of production.

$$\text{Takt Time} = \frac{\text{Available Time (Total work time available)}}{\text{Daily Demand (Units required)}}$$

Takt Time vs Cycle Time

Takt Time	Cycle Time
The heartbeat of the process and the voice of the customer	The voice of the process
The time interval at which a finished product MUST come off the line to meet the customer's needs	The time between two consecutive parts produced in a particular process

Remark:

- Takt time (TT) and Cycle time (CT) are NOT the same.
  - ✓ TT is driven by the customer; CT by the process.

- CT is not the same as Processing Time.
  For example, we might have multiple parts processed simultaneously – e.g. painting process : Each enters and exits the process every "x" seconds while the Processing Time for each part is longer.

Takt Time

Example 1:

Time Available (per shift)

510 min (8.5 hr x 60 min/hr)
- 30 min (Lunch)
- 20 min (2 - 10 min breaks)
- 15 min (Ergonomic stretch)
- 15 min (5S)

430 min/day

Customer Demand

160 trucks/week
= 32 trucks/day

$$\text{Takt Time} = \frac{430 \text{ min/day}}{32 \text{ trucks/day}} = 13.4 \text{ min/truck}$$

Takt Time

Example 2:

- Work Unit 3000 (Two shift operation)
- Customer demand = 1504 / per day
- Available work time = 16 hours = 960 min/day
- Less 4 breaks per day @ 10 min. each = 40 min
- Total Available Time = 920 min

Solution

✓ 920 minutes X 60 seconds = 55,200 seconds

✓ Takt Time = 55,200sec / 1504 units = 36.7 seconds

✓ We need to net 1 unit every 36.7 seconds

Time Studies

- Involves timing a sample of a worker's performance and using it to set a standard
- Requires trained and experienced observers
- Cannot be set before the work is performed

Questions

What if CT is greater than TT… is this an issue?

What if CT is less than TT?

Time Studies

1. Define the task to be studied
2. Divide the task into precise elements
3. Decide how many times to measure the task
4. Time and record element times and rating of performance
5. Compute average observed time

$$\text{Average observed time} = \frac{\left(\text{Sum of the times recorded to perform each element}\right)}{\text{Number of observations}}$$

Time Studies

6. Determine performance rating and normal time

$$\text{Normal time} = \left(\text{Average observed time}\right) \times \left(\text{Performance rating factor}\right)$$

7. Add the normal times for each element to develop the total normal time for the task

8. Compute the standard time

$$\text{Standard time} = \frac{\text{Total normal time}}{1 - \text{Allowance factor}}$$

Rest Allowances

- Personal time allowance
  - 4% - 7% of total time for use of restroom, water fountain, etc.
- Delay allowance
  - Based upon actual delays that occur
- Fatigue allowance
  - Based on our knowledge of human energy expenditure

Rest Allowances

1. Constant allowance
   - (A) Personal allowance 5
   - (B) Basic fatigue allowance 4

2. Variable allowances:
   - (A) Standing allowance 2
   - (B) Abnormal position
     - (i) Awkward (bending) 2
     - (ii) Very awkward (lying, stretching) 7

Rest Allowances

(C) Use of force or muscular energy in lifting, pulling, pushing

Weight lifted (pounds)

20 3

40..... 9

60..... 17

(D) Bad light:

(i) Well below recommended…. 2

(ii) Quite inadequate……. 5

Rest Allowances

(E) Atmospheric conditions (heat and humidity) ……	0-10
(F) Close attention:	
(i) Fine or exacting……..	2
(ii) Very fine or very exacting……	5
(G) Noise level:	
(i) Intermittent—loud……..	2
(ii) Intermittent—very loud or high-pitched……..	5

Rest Allowances

(H)	Mental strain:	
	(i) Complex or wide span of attention……..	4
	(ii) Very complex……..	8
(I)	Tediousness:	
	(i) Tedious…….……	2
	(ii) Very tedious……	5

Time Study Example 1

Average observed time = 4.0 minutes
Worker rating = 85%
Allowance factor = 13%

Normal time = (Average observed time) x (Rating factor)

= (4.0)(.85)

= 3.4 minutes

$$\text{Standard time} = \frac{\text{Normal time}}{1 - \text{Allowance factor}} = \frac{3.4}{1 - .13} = \frac{3.4}{.87}$$

= 3.9 minutes

Time Study Example 2

Allowance factor = 15%

Job Element	Cycle Observed (in minutes) 1	2	3	4	5	Performance Rating
(A) Compose and type letter	8	10	9	21*	11	120%
(B) Type envelope address	2	3	2	1	3	105%
(C) Stuff, stamp, seal, and sort envelopes	2	1	5*	2	1	110%

1. Delete unusual or nonrecurring observations (marked with *)
2. Compute average times for each element

Average time for A = (8 + 10 + 9 + 11)/4 = 9.5 minutes

Average time for B = (2 + 3 + 2 + 1 + 3)/5 = 2.2 minutes

Average time for C = (2 + 1 + 2 + 1)/4 = 1.5 minutes

3. **Compute the normal time for each element**

Normal time = (Average observed time) x (Rating)

Normal time for A = (9.5)(1.2) = 11.4 minutes
Normal time for B = (2.2)(1.05) = 2.31 minutes
Normal time for C = (1.5)(1.10) = 1.65 minutes

4. **Add the normal times to find the total normal time**

Total normal time = 11.40 + 2.31 + 1.65 = 15.36 minutes

5. **Compute the standard time for the job**

$$\text{Standard time} = \frac{\text{Total normal time}}{1 - \text{Allowance factor}}$$

$$= \frac{15.36}{1 - 0.15} = 18.07 \text{ minutes}$$

Question

The data in the following table represent time-study observations on a new operation with three work elements. On the basis of these observations, find the standard time for the process. Assume a 15% allowance factor.

Element	Performance Rating	Observations (times in seconds)			
		1	2	3	4
1	120%	90.3	91.5	92.4	90.2
2	100%	30.5	32.3	29.6	31.1
3	105%	130.5	128.9	132.0	130.5

Time Study

Example of Process Study Sheet (作業分析の例)

Process Study	Process: Final Assembly #7	Product: DV-020332	Observer: Benny	Date/Time: April 18, 2007 14:00	Page 1/3

Process Steps	Work Element	OPERATOR Observed Times 1	2	3	4	5	6	7	8	9	10	Repeatable	MACHINE Cycle Time	Notes
Assembly 1	Get base & put into fixture	4	5	6	3	4	4	4	4	5	4	4		Base far away
	Get pin & put into fixture	6	8	10	15	9	10	10	7	11	10	10		Fixture unstable
	Put fixture into machine	2	2	1	2	2	3	2				2		
	Machine cycle	1	1	1								1	6	Operator waiting
	Remove	2	2	2	1	2	2					2		
	Check appearance & place	8	11	8	20	7	8	9	9	9	8	8		Checking unstable
	Subtotal											27		
Assembly 2	Get lower case													
	Get work piece													
	Put into lower cas													Insertion unstable
	Get upper case &													
	Put into forming m													Machine gate far away
	...													
	...													

Timing Tips

- Collect real times at the process.
- Position yourself so you can see the operator's hand motions.
- Time each work element separately.
- Time several cycles of each work element.
- Observe an operator who is qualified to perform the job.
- Always separate operator time and machine time.
- Select the lowest repeatable time for each element.
- Remember shop floor courtesy.

Time Study Analysis

Time Analysis Classification

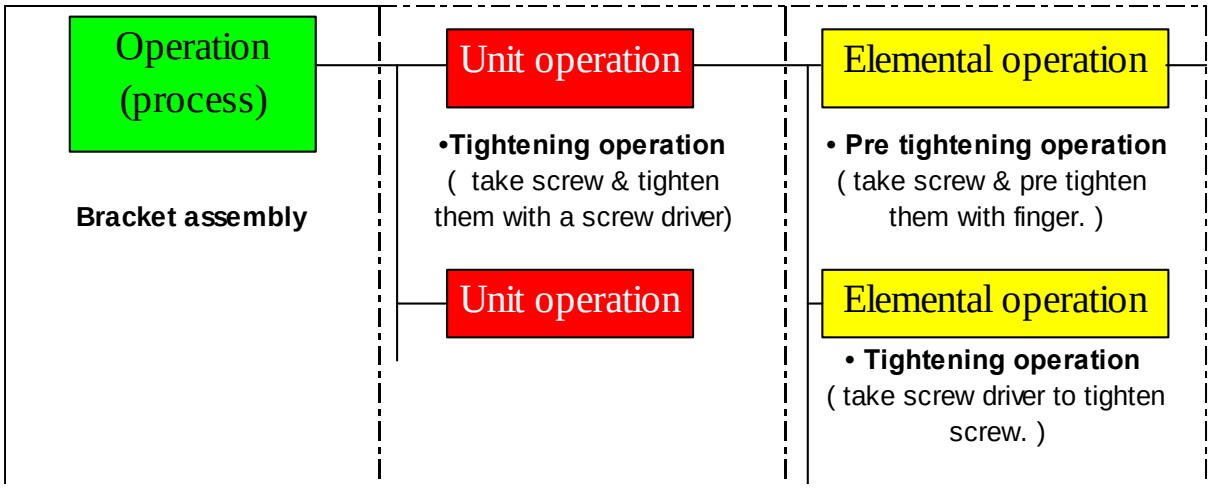
Elemental operation time analysis	It's used to observe highly repetitive, relatively regular & short duration motion (in line operation)
Continuous observation	It's used to observe less repetitive but long duration motion (set-up, off line operation & etc)
Slight motion analysis	It's used to observe highly repetitive but short duration cycle operation. Generally VTR are used.

Taking Elemental Operation : Time Analysis Procedure.

1. **Observation frequency.**
   - Between 10 ~ 20 times data sampling.
   - If fluctuation of material, part dimension or time value are big, increase observation frequency
2. **Observation position & posture.**
   - Observer's position should provide a good view of operation.
   - Observer's position must not interrupt associate movement.
   - The observer posture should be in such way that the associate, stop watch & observer's eye were align.
3. **During observation, give a full attention to operator movement.**
4. **Abnormal operation.**
   - Part dropping, equipment faulty (short m/c down & etc), NG occurrence, repair, talking & etc should be consider abnormal. Circle the entered time data with explanatory notes.
5. **Determine dividing line for elemental operation**.
   - It's more helpful to utilize signals such as light, buzzer & etc.
6. **Exclude intermission time & synchronizing m/c time**.
   - If waiting knowing in advance, write down in elemental operation work column
7. **Interval operation time such as container replacement, quality check, should be entered for every operation**.

Taking Continuous Observation : Time Analysis Procedure.

1. Study current operation earlier.
2. Fill up Operation Analysis Chart.
3. Make enough copies of the chart.
4. Start analysis & make sure :
    a. Observation position & posture.
        - Stand in a position where overall operation can be seen well. (move if required)
        - Stand in a position that didn't disturb associate operation.
    b. While observation, give a full attention to the operation.
    c. Divide the operation into unit operation which is one level higher than elemental operation.



Time Study : Exercise

Watch writing characters on the whiteboard operation and perform time analysis.

Points

1) Watch carefully the operation content and memorize it.
2) Divide motions (sort into element operations)
3) Enter the element operations in the analysis sheet.
4) Measure time with stopwatch, keeping the dividing point of motion in mind.
5) Start observation after you get used to operation.

Time Study Through VTR : Exercise

(Ex) Timing when pressing stopwatch button

Motion	Observation Point	Element Operation
	The moment you stand up	
Stand up from the chair	The moment you stood up	
Walk	The moment you reached the board	
Take a piece of marker	The moment you took a piece of chalk	
Write characters on the board	The moment you finished writing characters on the board.	
Put on the markers cap	The moment you replaced chalk.	
Walk	The moment you returned to the chair.	
Sit on the chair	The moment you sat down.	
Rest		

Preparation to Make Time Study

It's the best condition if we can take all part number time study. But due to some model are slow moving, it's very difficult for us to take all of it. At this stage, we used PQ Analysis Chart to determine which part number are more priority.

Production Quantity Analysis Chart				Approved	Checked	Written						
[PQ Chart]				Department : LEGO Manufacturing								
Month :				Line name : HVAC								
Working Day :				Date :								
No.	Part no.	Product	Monthly units	Needed* units per day	Needed units per day							Accumulation %
1	MA446850-962DOR	D73A	5921									
2	MA446850-972DOR	D74A	4646									
3	MA446850-982DOR	D75A	4123									
4	MA446850-992DOR	D76A	3465									
5	MA446850-0310OT	Myvi	3006									
6	MA446850-0310OT	Myvi	2122									
7	MA446850-0210OT	Alza	1784									
8	MA446850-0220OT	Alza	1234									
9	MA446850-0131OT	Vios	947									
10	MA446850-0141OT	Vios	756									
11	MA446850-0441OT	Camry	648									
12	MA446850-0451OT	Camry	541									
13	MA446850-6580OP	Exora	446									
14	MA446850-6570OP	Exora	312									
15	MA446850-5580OP	BLM	254									
16	MA446850-5570OP	BLM	212									
17	MA446850-5580OP	Waja	178									
18	MA446850-5590OP	Waja	136									
19												
Total												

1 - Fill in the column of Month , Working day, Department , Line Name and Date.

2 - Sum all the monthly quantity

3 - Convert to daily quantity (Monthly / working day)

4 - Draw the horizontal bar graft base daily quantity

5 - Calculate the percentage accumulation

Each model / total x 100% add to previous value)

Production Analysis Board

Supervisor signs hourly

Line/Cell Name:	Team Leader:	Date:
Final Assembly #7	Benny Li	April 07
Quantity Required: 690 p	**Takt Time:** 40 sec./p	**Shift:** A
		Num of Operator: 16

Time	Hourly Plan Actual	Cumulative Plan Actual	Problem Causes	Sign-off
06:00–07:00	90 / 90	90 / 90		Sharon
07:00–08:00	90 / 88	180 / 178	Tester Mixer Stoppage	Sharon
08:00–09:00	90 / 90	270 / 268		Sharon
09:10–10:10	90 / 85	360 / 353	Defects (Appearance)	Sharon
10:10–11:10	90 / 90	450 / 443		Roy
11:40–12:40	90 / 90	540 / 533		Sharon
12:40–13:40	90 / 86	630 / 619	Defects (Bad Parts)	Sharon
13:50–14:30	60 / 60	690 / 679		Sharon
O.T.	11 / 11	690 / 690		Roy

Remember breaks

Area Manager signs at lunch and end of shift

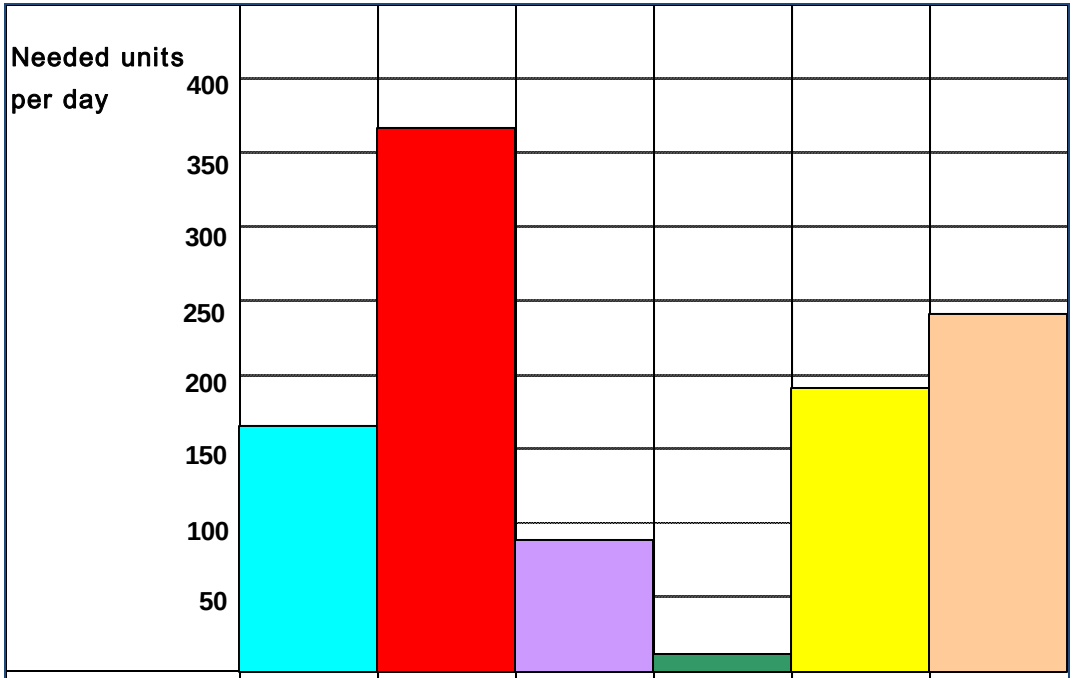
Just keeping visibility is not our real objective. Problems must be linked to corrective action!

Example of Process Capacity Sheet (工程別能力表の例)

Process Capacity Sheet	Approved by: R. Quan	Part # 25-59001	Application JN-01	Entered by: Wayne Xi	Date May 08, 2007
		Part name Base Unit	Number of parts 1	Line Machine Shop #2	

Step	Step name	Machine #	BASIC TIME			TOOL CHANGE		PROCESSING CAPACITY/SHIFT	Remarks
			MANUAL	AUTO	COMPLETION	CHANGE	TIME		
1	Cut	C100	6	32	38	500	2 min.	720 p	
2	Rough Grind	GR100	7	12	19	1,000	5 min.	1,440 p	
3	Fine Grind	GR200	7	30	37	200	5 min.	724 p	
4	Measure Diameter	TS100	8	4	12	—	—	2,325 p	
		Total	28						

Production Quantity Analysis Chart



Product type	MA162500	MA282500	MA282500	MA282500	MA282500	MA162500
Typical part No.	-19206N	-10706N	-1230	-1330	-0230	-3260
Needed units per day	162	352	96	1	199	246
Ratio %	15.34	33.34	9.09	0.09	18.84	23.3

In this chart, data from capacity planning was transform into bar graph. The data shown are calculate base on daily needed quantity.

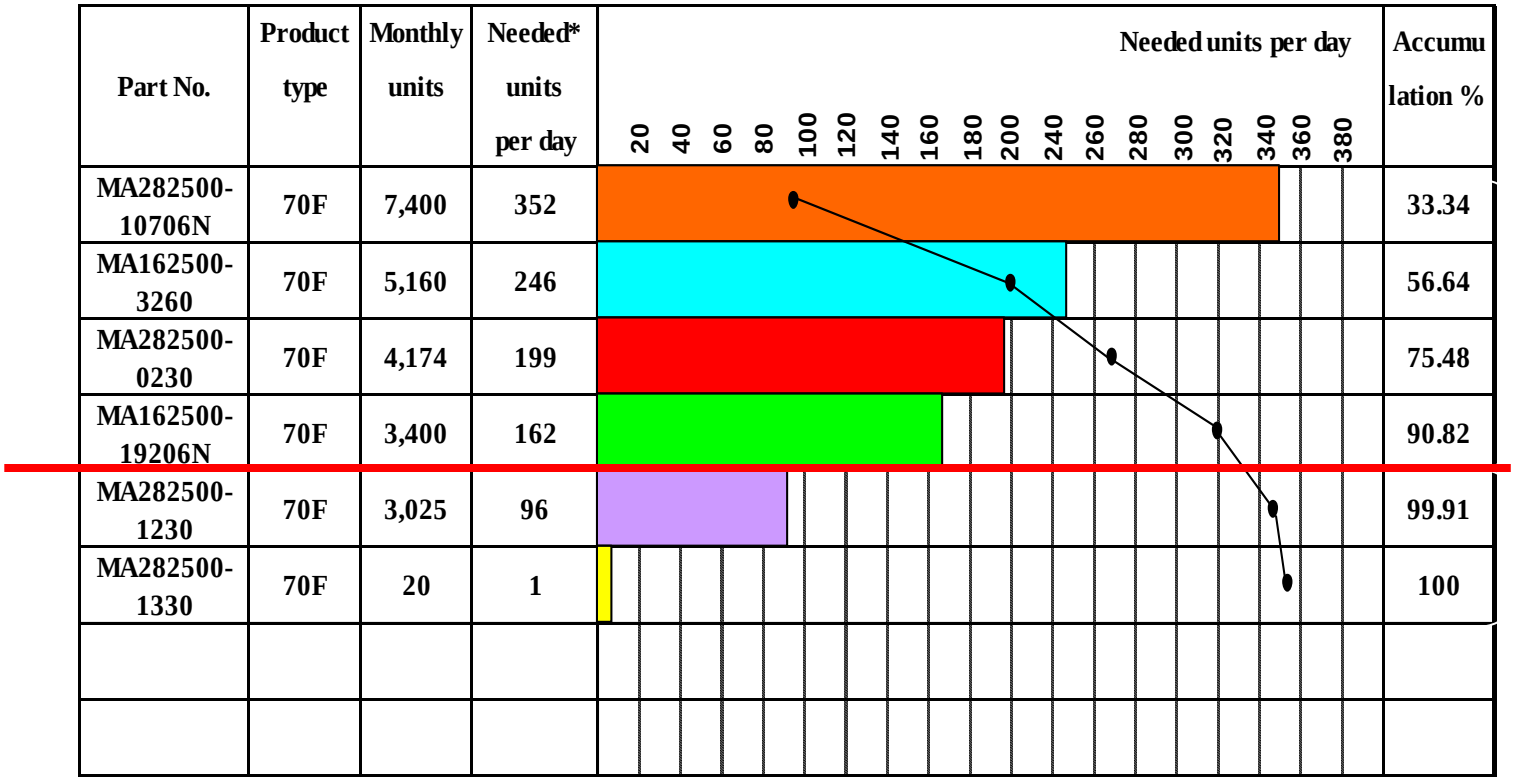
Product No.

Monthly vol./working day.

Percentage against daily vol..

Production Quantity Analysis Chart

Part No.	Product type	Monthly units	Needed* units per day	Needed units per day (20 40 60 80 100 120 140 160 180 200 240 260 280 300 320 340 360 380)	Accumulation %
MA282500-10706N	70F	7,400	352		33.34
MA162500-3260	70F	5,160	246		56.64
MA282500-0230	70F	4,174	199		75.48
MA162500-19206N	70F	3,400	162		90.82
MA282500-1230	70F	3,025	96		99.91
MA282500-1330	70F	20	1		100



Must make Standardized Work

At least must have total net time

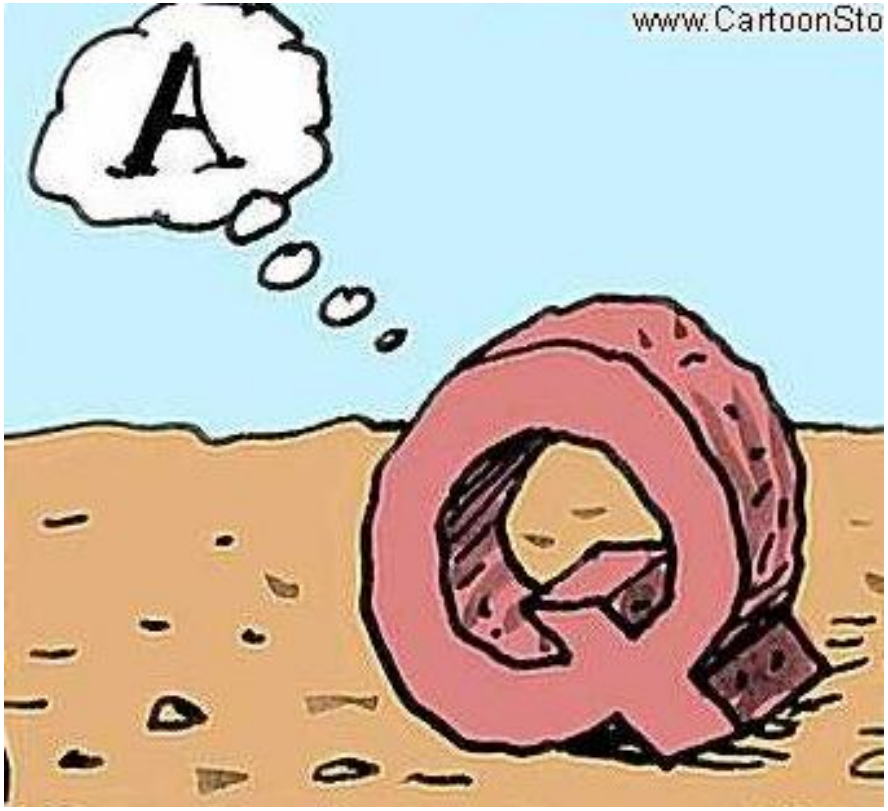
This PQ Chart shows distribution of product volume / day & their percentage.

Our target is to make time study for all model in the respective production line.

Commonly use is to make time study for model that contributes between 0% ~ 90% in line volume.

This to make initial standardize work for the line. For the balance 10%, we should have at least their total net time for reference. Once the analysis completed, best we make time study for all model for overall standardization.

Thank You !



...to be continue