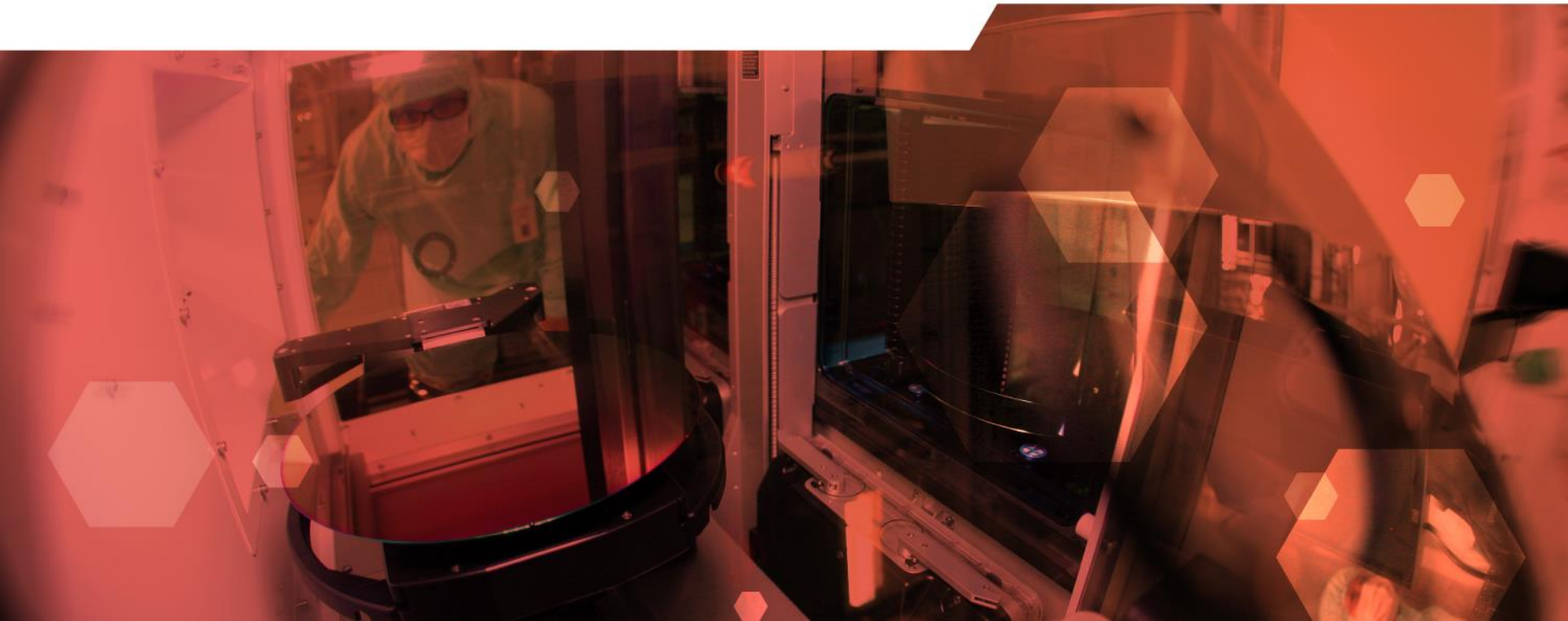


Summary and Discussion of E10

2018/12/13 Mitch Sakamoto

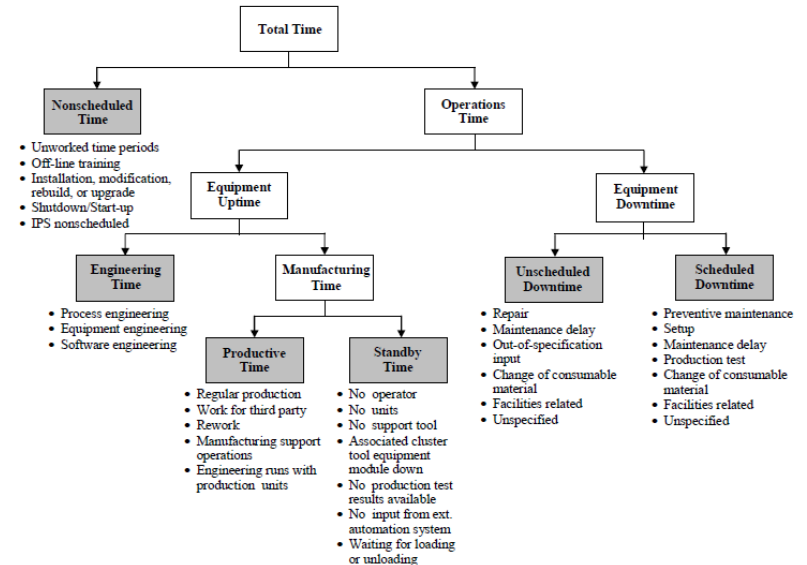
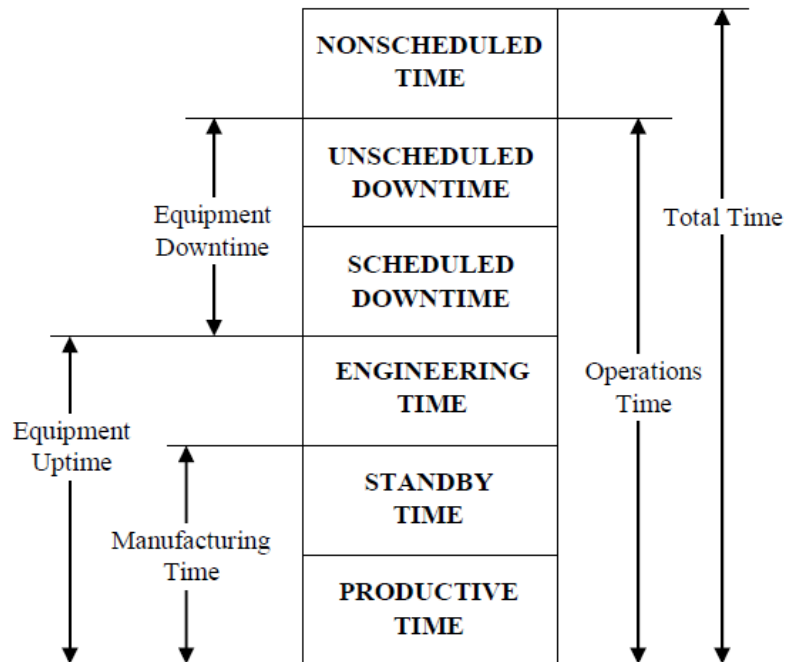


Purpose of E10

Provide the common basis for measurement of the RAM and the Utilization.

Reliability	MTBF
Availability	Uptime (%)
Maintainability	MTTR, MTTPM
Utilization	Productive time (%)

§ 6 Equipment States



Equipment States Summary

Total Time	Nonscheduled Time			
	Operation Time	Equipment Downtime	Unscheduled Downtime	
			Scheduled Downtime	
		Equipment Uptime	Engineering Time	
			Manufacturing Time	Standby Time
				Productive Time

Reliability Metrics

Table 3 Reliability Metrics

<i>Metric</i>	<i>Formula</i>	<i>Paragraph Reference</i>
MTBF _u — Mean uptime time between failures	(uptime) / (# of failures during uptime)	8.2.1.1
MFD _u — Mean failure duration for failures during uptime	(unscheduled downtime for failures during uptime) / (# of failures during uptime)	8.2.1.2
E-MTBF _u — Mean uptime time between equipment-related failures	(uptime) / (# of equipment-related failures during uptime)	8.2.1.3
MTBF _p — Mean productive time between failures	(productive time) / (# of failures during productive time)	8.2.1.4
MFD _p — Mean failure duration for failures during productive time	(unscheduled downtime for failures during productive time) / (# of failures during productive time)	8.2.1.5
E-MTBF _p — Mean productive time between equipment-related failures	(productive time) / (# of equipment-related failures during productive time)	8.2.1.6
MCBF _u — Mean cycles between failures during uptime	(equipment cycles during uptime) / (# of failures during uptime)	8.2.2.1
E-MCBF _u — Mean cycles between equipment-related failures during uptime	(equipment cycles during uptime) / (# of equipment-related failures during uptime)	8.2.2.2
MCBF _p — Mean cycles between failures during productive time	(equipment cycles during productive time) / (# of failures during productive time)	8.2.2.3
E-MCBF _p — Mean cycles between equipment-related failures during productive time	(equipment cycles during productive time) / (# of equipment-related failures during productive time)	8.2.2.4

e.g., $MTBF_u = (\text{uptime}) / (\text{\#failures})$

Availability Metrics

Table 4 Availability Metrics

<i>Metric</i>	<i>Formula</i>	<i>Paragraph Reference</i>
total uptime (%)	$(\text{uptime} \times 100) / (\text{total time})$	8.3.1
operational uptime (%)	$(\text{uptime} \times 100) / (\text{operations time})$	8.3.2
equipment-dependent uptime (%)	$(\text{uptime} \times 100) / (\text{equipment-dependent operations time})$	8.3.3.1
equipment-dependent scheduled downtime (%)	$(\text{equipment-dependent scheduled downtime} \times 100) / (\text{equipment-dependent operations time})$	8.3.3.2
equipment-dependent unscheduled downtime (%)	$(\text{equipment-dependent unscheduled downtime} \times 100) / (\text{equipment-dependent operations time})$	8.3.3.3
supplier-dependent uptime (%)	$(\text{uptime} \times 100) / (\text{supplier-dependent operations time})$	8.3.4.1
supplier-dependent scheduled downtime (%)	$(\text{supplier-dependent scheduled downtime} \times 100) / (\text{supplier-dependent operations time})$	8.3.4.2
supplier-dependent unscheduled downtime (%)	$(\text{supplier-dependent unscheduled downtime} \times 100) / (\text{supplier-dependent operations time})$	8.3.4.3

e.g., Operational uptime (%)
= $(\text{uptime} \times 100) / (\text{operation time})$

Maintainability Metrics

Table 5 Maintainability Metrics, Aggregate Denominator

<i>Metric</i>	<i>Formula</i>	<i>Paragraph Reference</i>
MTTPM — Mean time to [perform] preventive maintenance (PM)	(SDT preventive maintenance) / (# of PM events)	8.4.1.1
MTTR — Mean time to repair	(UDT repair, equipment-related + UDT repair, nonequipment-related) / (# of equipment-related repair events + # of nonequipment-related repair events)	8.4.1.2
E-MTTR — Mean time to repair during equipment-related failures	(UDT repair, equipment-related) / (# of equipment-related repair events)	8.4.1.3
MTOL — Mean time off-line	(scheduled downtime + unscheduled downtime) / (# of continuous downtime events)	8.4.1.4

e.g., $MTTR \cong (UDT \text{ time}) / (\# \text{repair event})$

Utilization Metrics

Table 7 Utilization Metrics

<i>Metric</i>	<i>Formula</i>	<i>Paragraph Reference</i>
total utilization (%)	$(\text{productive time} \times 100) / (\text{total time})$	8.5.1
operational utilization (%)	$(\text{productive time} \times 100) / (\text{operations time})$	8.5.2

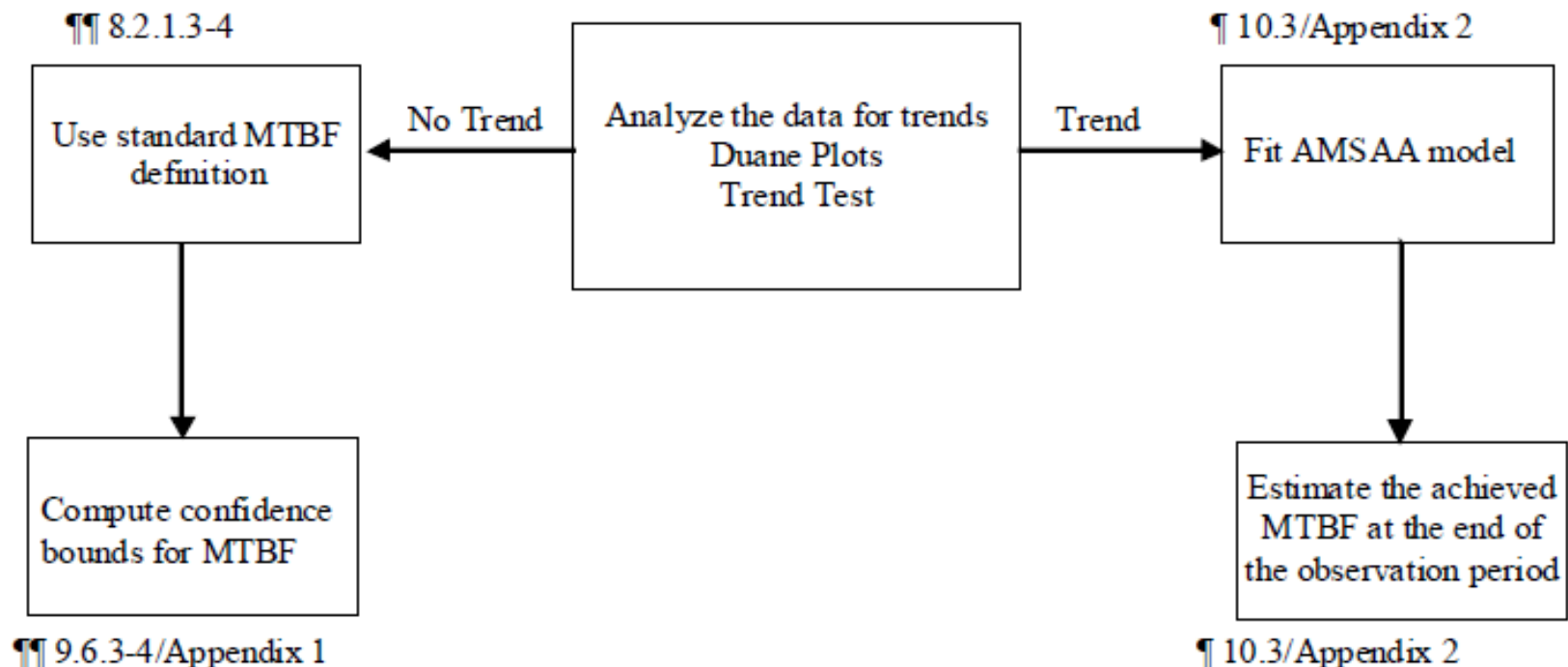
e.g., Operational utilization
= (PRD time x 100)/(operation time)

§ 9 Uncertainty Measurements

- Precision calculation

- 信頼区間 Confidence Interval (CI)
 - 信頼下限 Lower Confidence Bound (LCB)
 - 信頼上限 Upper Confidence Bound (UCB)

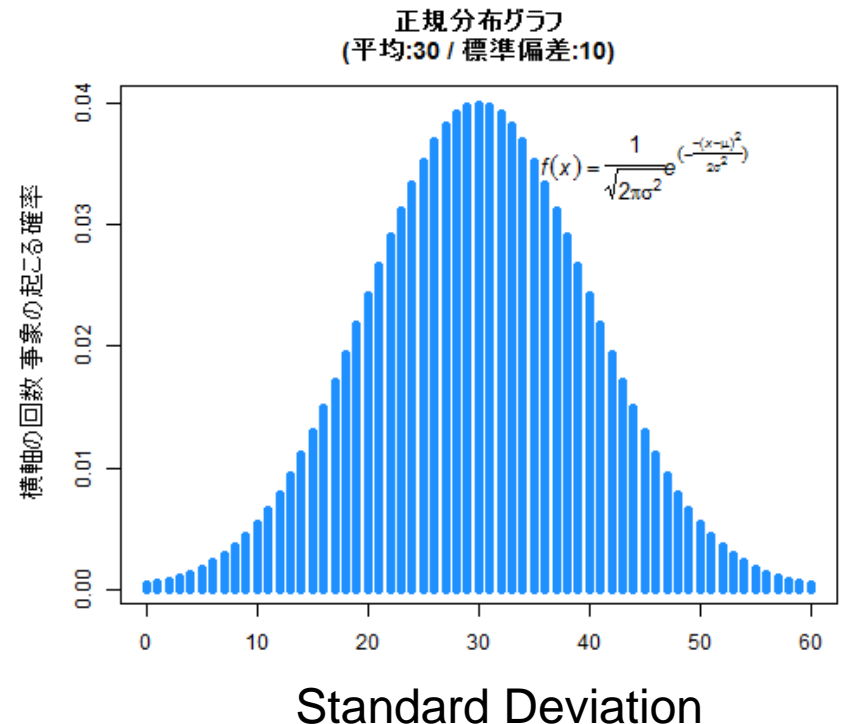
§ 10 Reliability Growth/Degrade



Discussion of Data Reliability

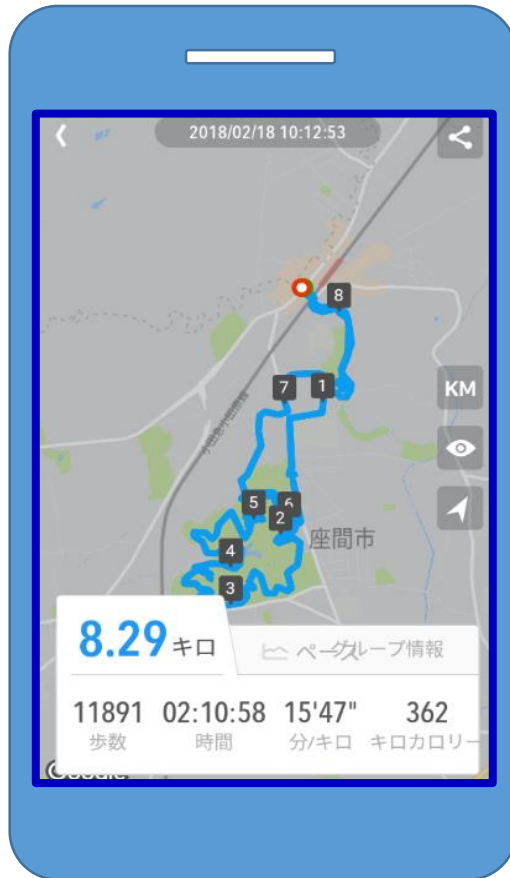
NOTE

- “Reliability”
- E.g., measured RF data
- Characteristic value
- Standard Deviation
- Data Quality
- Repeatability
- Reproducibility



Metrics Example of Walking

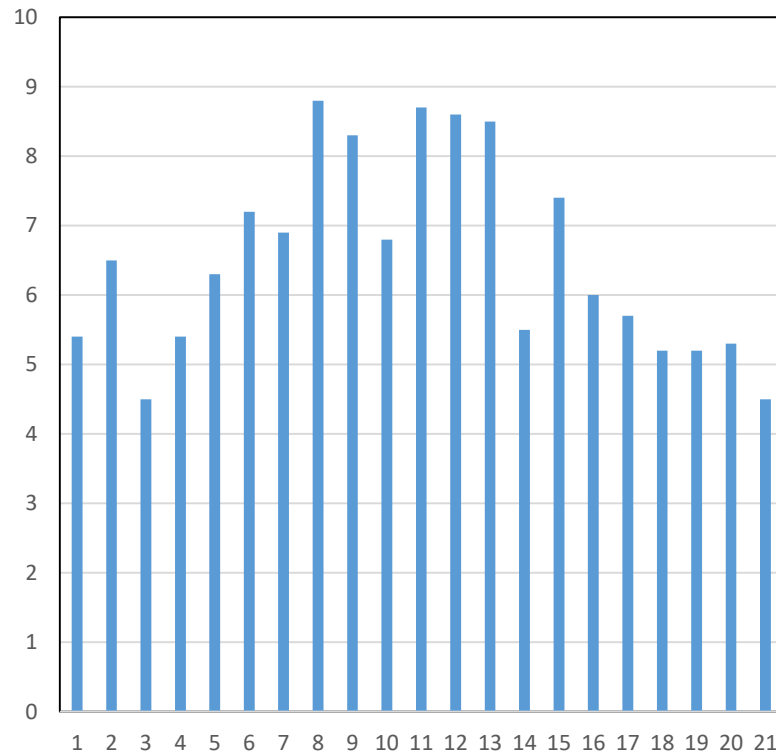
NOTE



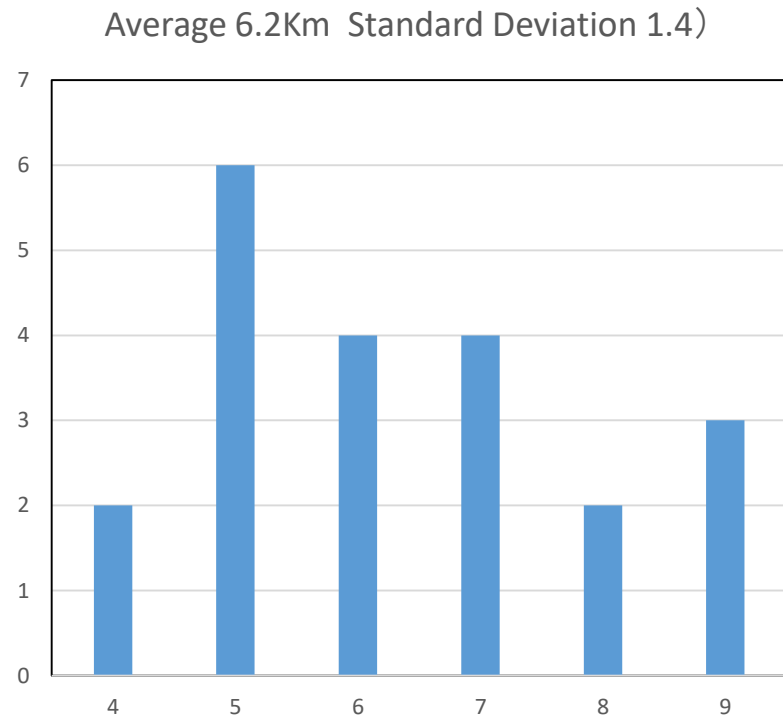
Measurement

Walking Statistics

NOTE



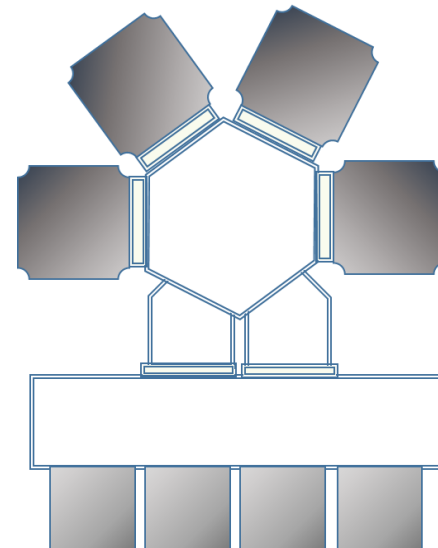
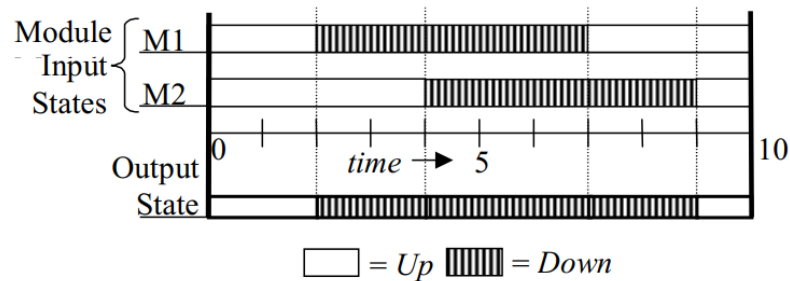
Collection



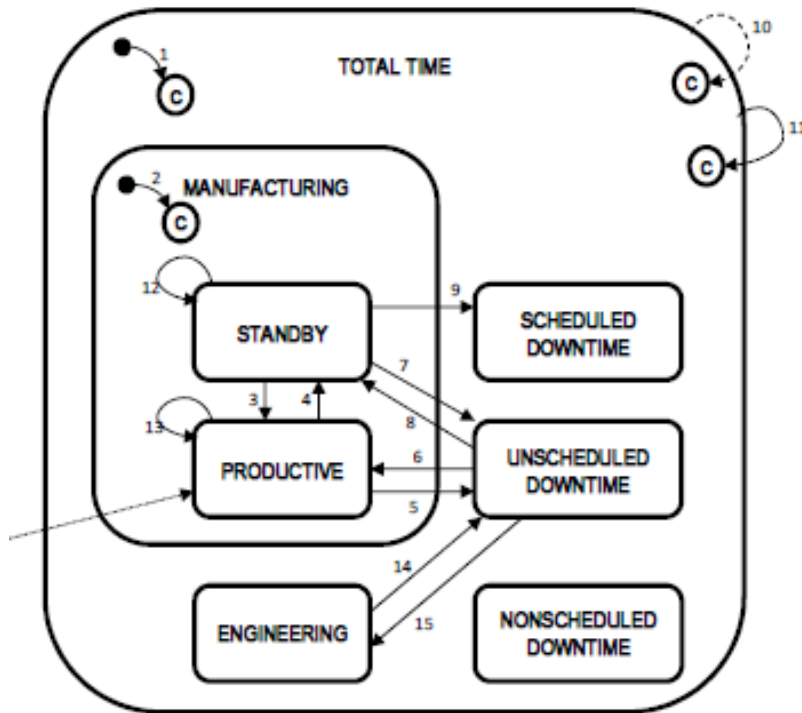
Analysis

E10 for Cluster Tool

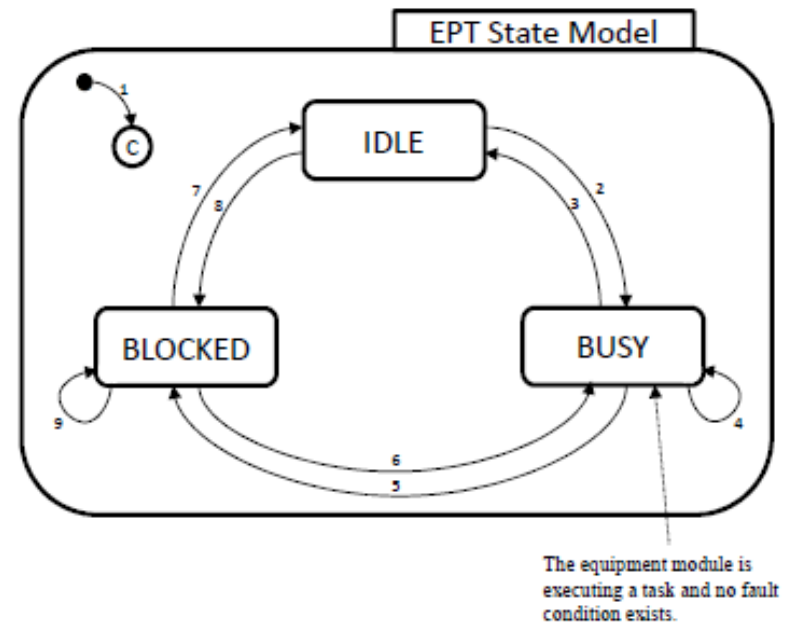
- SPCT: Single-Path Cluster Tool
- MPCT: Multi-Path Cluster Tool
- IPS: Intended Process Set
- K: Key group



Software Standards for E10



E58 ARAMS



E116 EPT

END