Selection of Techniques and Metrics

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Overview

- Criteria for Selecting an Evaluation Technique
- Three Rules of Validation
- Selecting Performance Metrics
- Commonly Used Performance Metrics
- Utility Classification of Metrics
- Setting Performance Requirements

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Criteria for Selecting an Evaluation Technique

Criterion	Analytical Modeling	Simulation	Measurement
1. Stage	Any	Any	Postprototype
2. Time required	Small	Medium	Varies
3. Tools	Analysts	Computer languages	Instrumentation
4. Accuracy[a]	Low	Moderate	Varies
5. Trade-off evaluation	Easy	Moderate	Difficult
6. Cost	Small	Medium	High
7. Saleability	Low	Medium	High

[a] In all cases, result may be misleading or wrong.

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Three Rules of Validation

- **Do not trust the results of a simulation model until they have been validated by analytical modeling or measurements.**
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- **Do not trust the results of a measurement until they have been validated by simulation or analytical modeling.**

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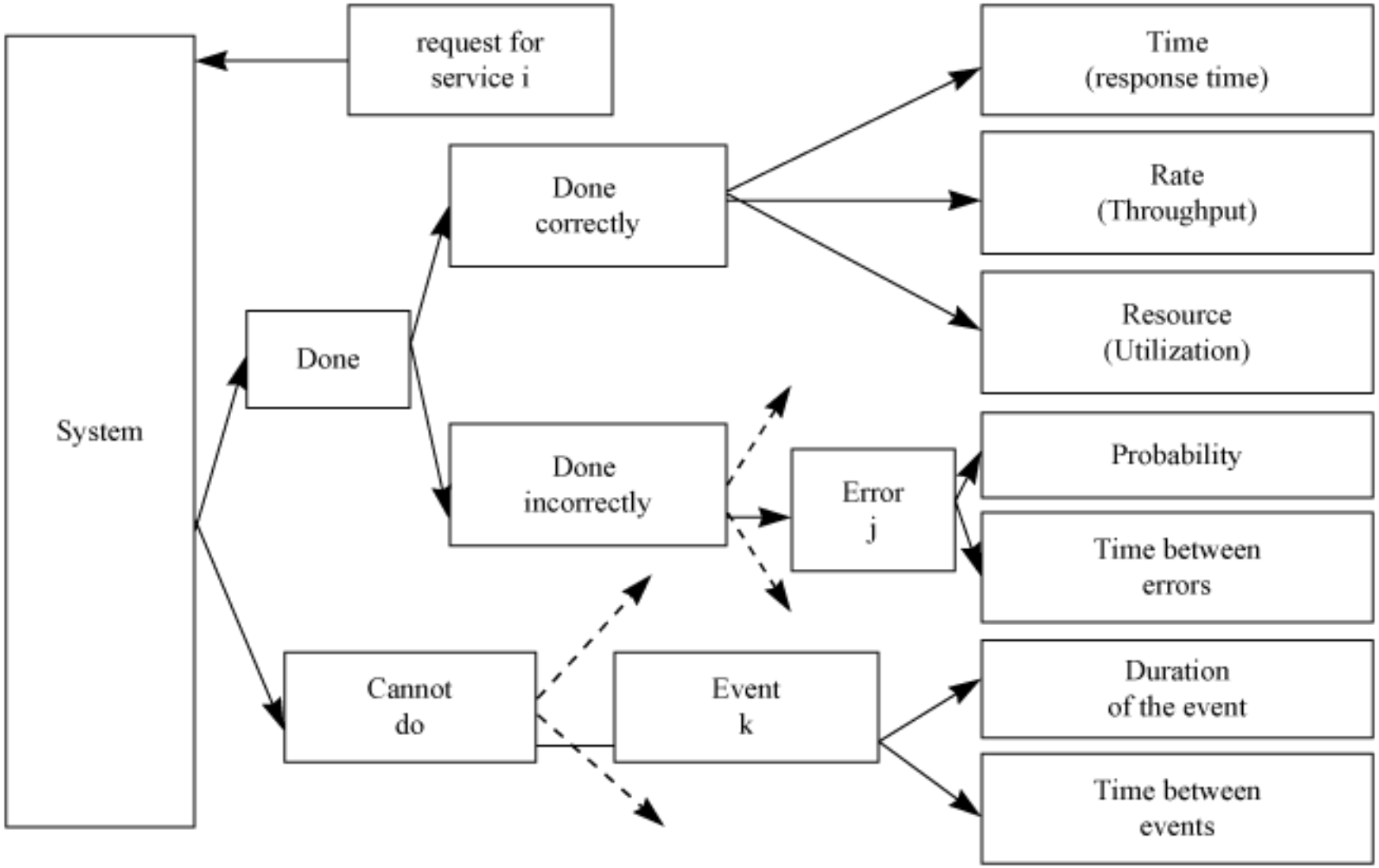
Selecting Performance Metrics



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Selecting Metrics

- Include:
  - Performance Time, Rate, Resource
  - Error rate, probability
  - Time to failure and duration
- Consider including:
  - Mean and variance
  - Individual and Global
- Selection Criteria:
  - Low-variability
  - Non-redundancy
  - Completeness

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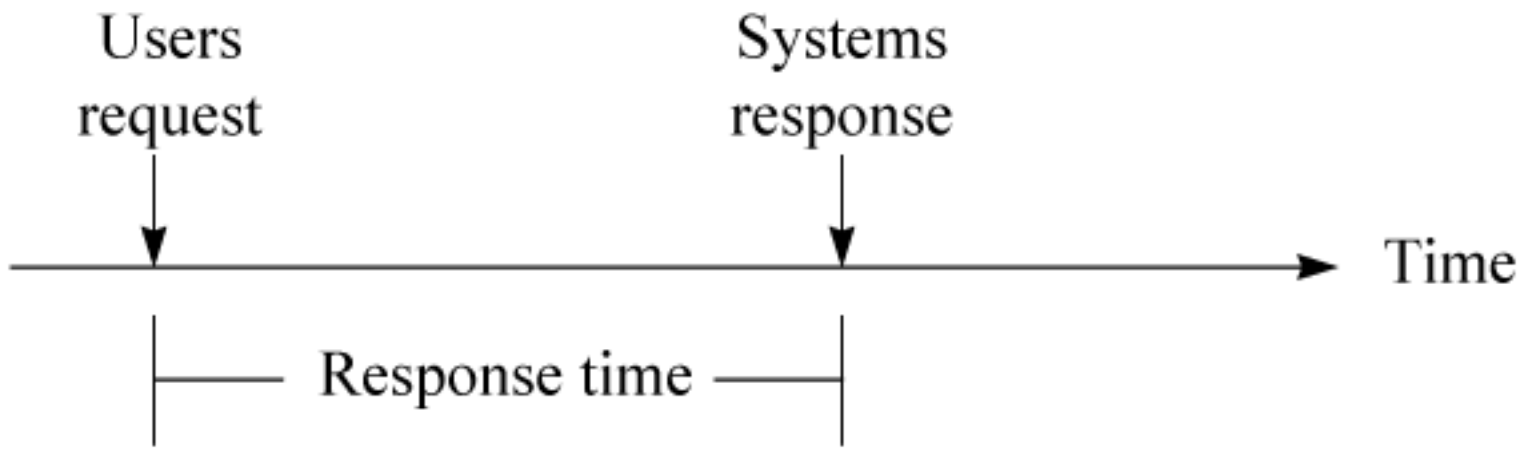
Commonly Used Performance Metrics

- **Response time and Reaction time**



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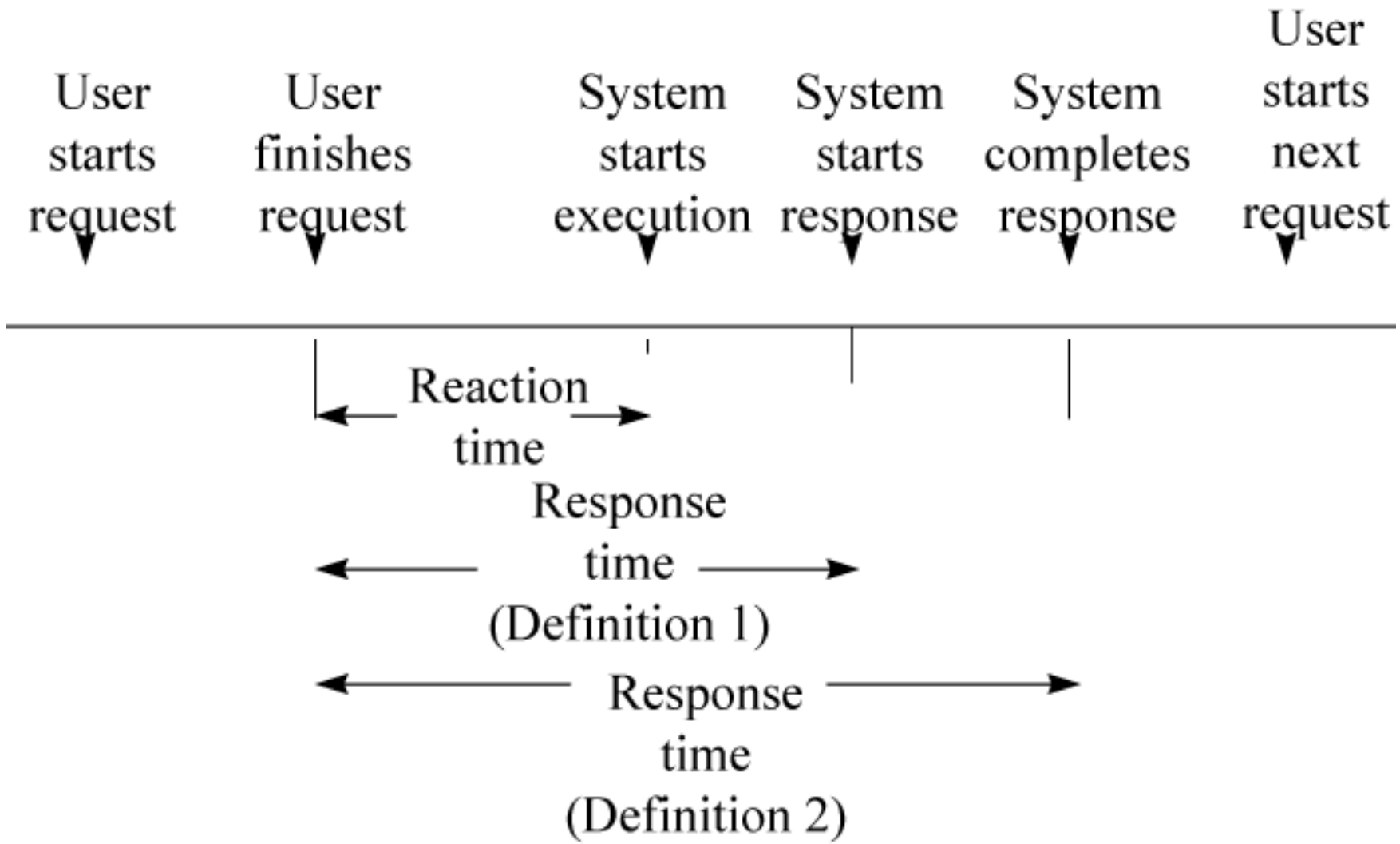
Response Time (Cont)



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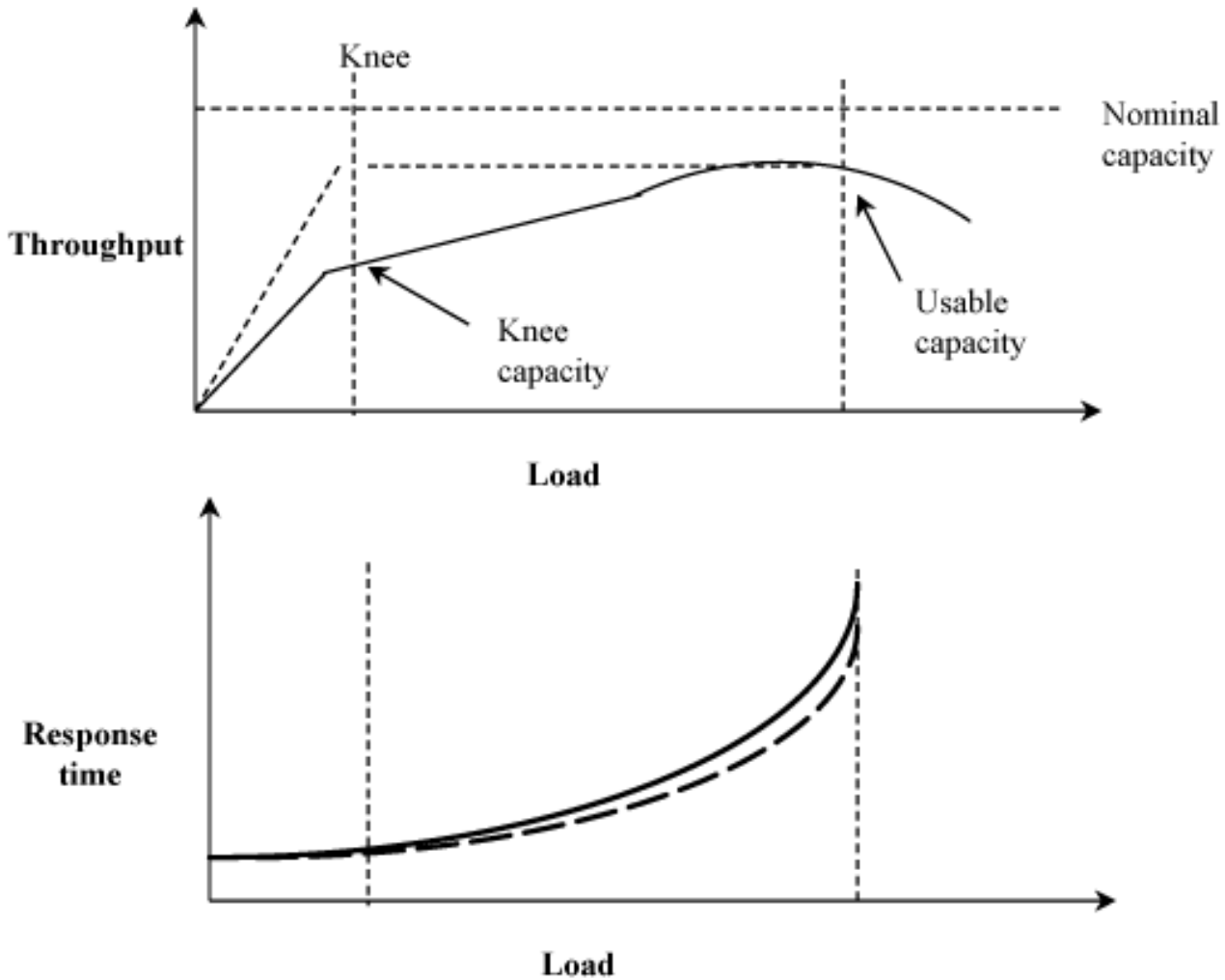
Capacity



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Common Performance Metrics (Cont)

- **Nominal Capacity**: Maximum achievable throughput under ideal workload conditions. E.g., bandwidth in bits per second. The response time at maximum throughput is too high.
- **Usable capacity**: Maximum throughput achievable without exceeding a pre-specified response-time limit
- **Knee Capacity**: Knee = Low response time and High throughput

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Common Performance Metrics (cont)

- **Turnaround time** = the time between the submission of a batch job and the completion of its output.
- **Stretch Factor**: The ratio of the response time with multiprogramming to that without multiprogramming.
- **Throughput**: Rate (requests per unit of time) Examples:
  - Jobs per second
  - Requests per second
  - Millions of Instructions Per Second (MIPS)
  - Millions of Floating Point Operations Per Second (MFLOPS)
  - Packets Per Second (PPS)
  - Bits per second (bps)

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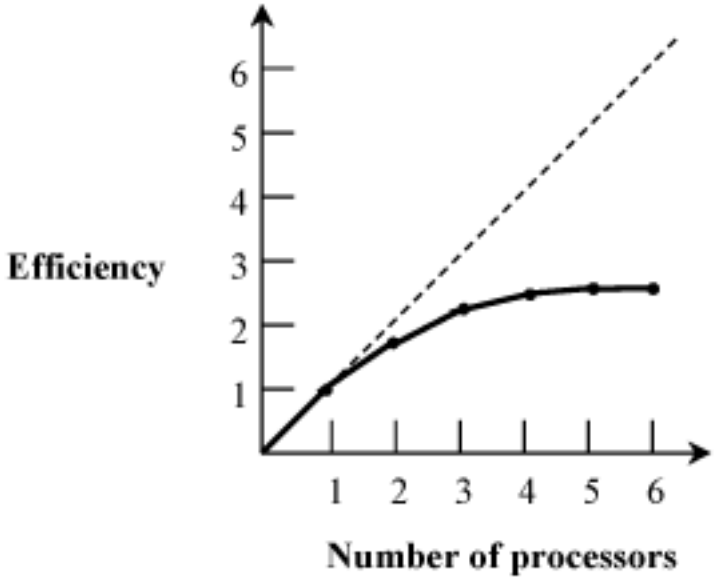
Common Performance Metrics (Cont)

- **Efficiency**: Ratio usable capacity to nominal capacity. Or, the ratio of the performance of an *n*-processor system to that of a one-processor system is its efficiency.
- **Utilization**: The fraction of time the resource is busy servicing requests. Average fraction used for memory.



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Common Performance Metrics (Cont)

- **Reliability**:
  - Probability of errors
  - Mean time between errors (error-free seconds).
- **Availability**:
  - Mean Time to Failure (MTTF)
  - Mean Time to Repair (MTTR)
  - MTTF/(MTTF+MTTR)

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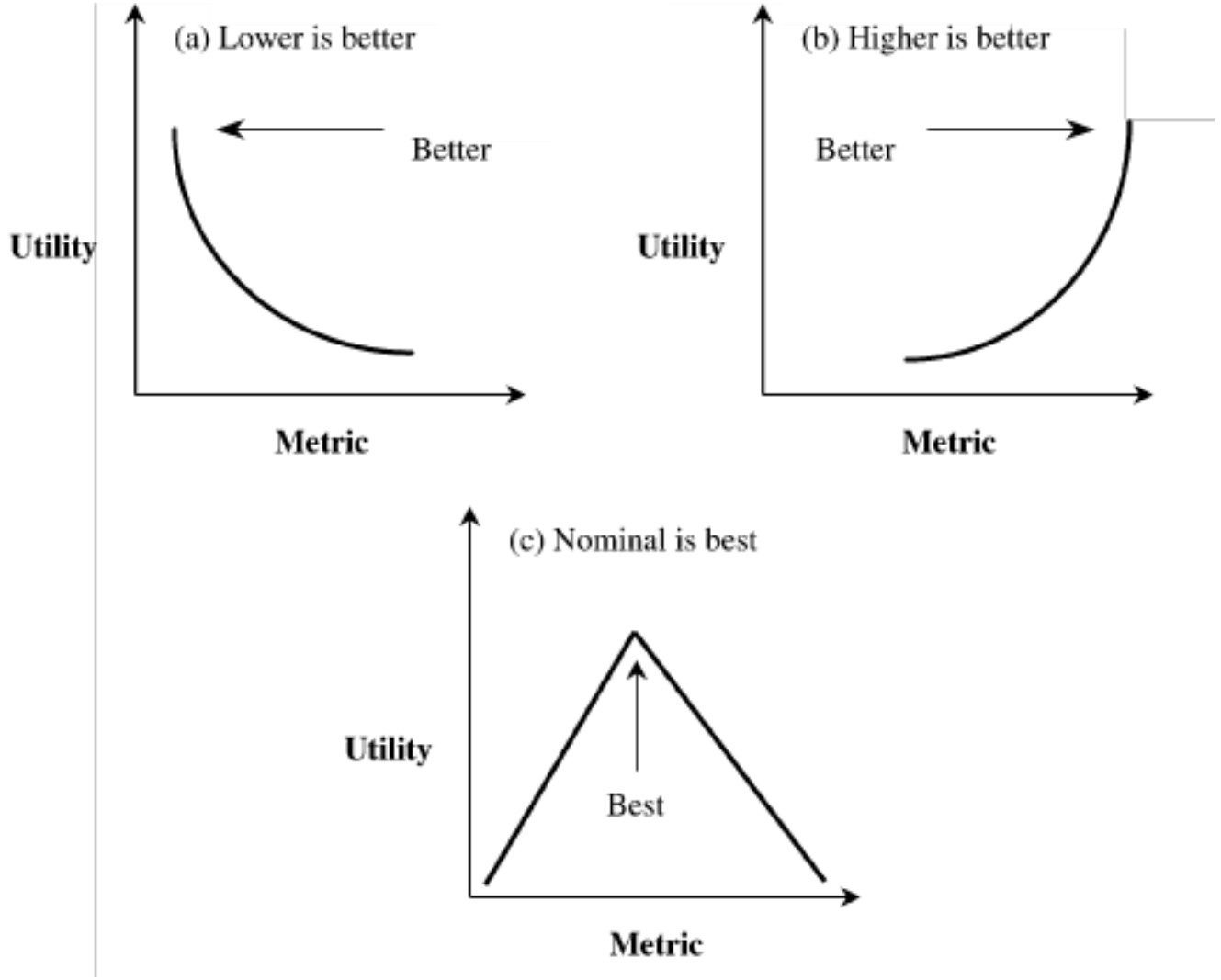
Utility Classification of Metrics



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Setting Performance Requirements

- **Examples**:
  - " The system should be both processing and memory efficient. It should not create excessive overhead"
  - " There should be an extremely low probability that the network will duplicate a packet, deliver a packet to the wrong destination, or change the data in a packet."
- **Problems**:

  Non-Specific

  Non-Measurable

  Non-Acceptable

  Non-Realizable

  Non-Thorough

  $\Rightarrow$ SMART

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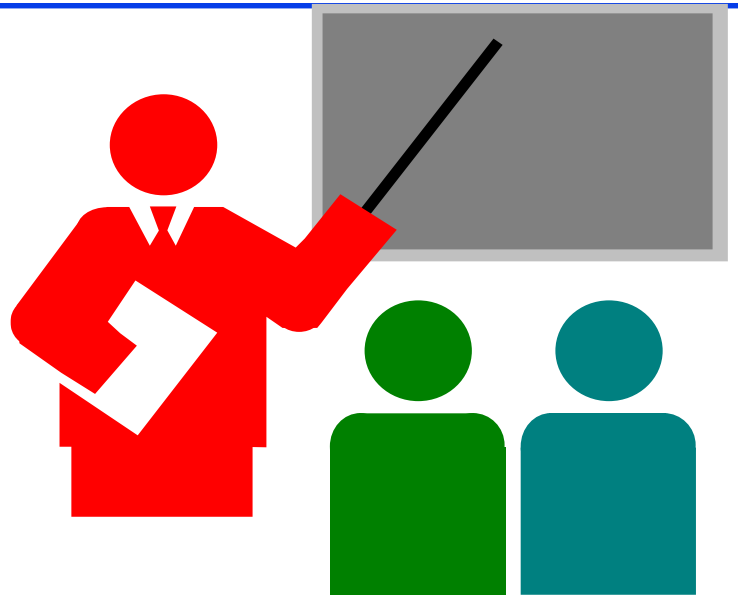

Summary of Part I

- **Systematic Approach**: Define the system, list its services, metrics, parameters, decide factors, evaluation technique, workload, experimental design, analyze the data, and present results
- **Selecting Evaluation Technique**: The life-cycle stage is the key. Other considerations are: time available, tools available, accuracy required, trade-offs to be evaluated, cost, and saleability of results.

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Summary (Cont)

- **Selecting Metrics**:
  - For each service list time, rate, and resource consumption
  - For each undesirable outcome, measure the frequency and duration of the outcome
  - Check for low-variability, non-redundancy, and completeness.
- **Performance requirements**: Should be SMART. Specific, measurable, acceptable, realizable, and thorough.

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