Are We Doing Well, Or Are We Doing Poorly?

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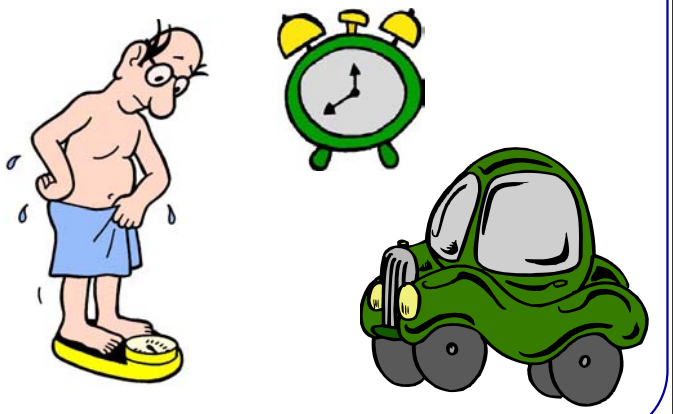
The Westfall Team

Partnering for Excellence in Software

Are We Doing Well or Are We Doing Poorly

Measurement is Common



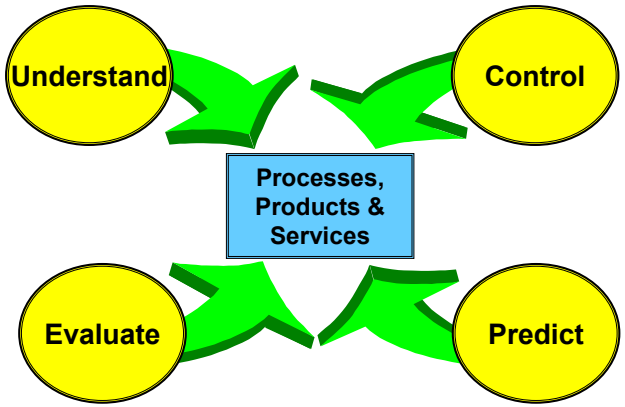
Decision Criteria Defined

According to the ISO/IEC 15939 standard for Software Engineering -- Software Measurement Process:

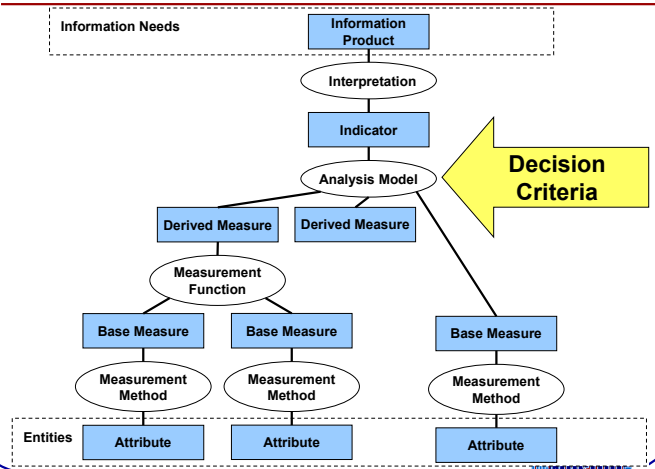
- Decision criteria are the thresholds, targets, or patterns used to:
  - Determine the need for action or further investigation
  - Describe the level of confidence in a given result

[ISO/IEC-15939:2002]

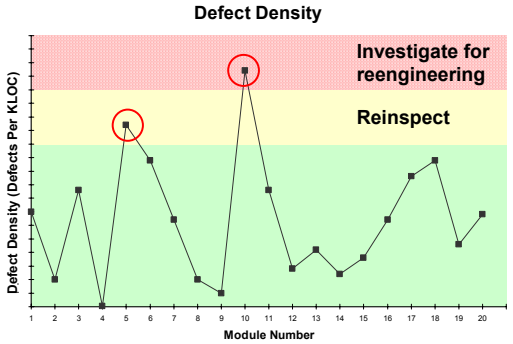
Roles of Measurement



Measurement Information Model

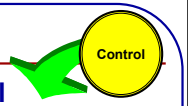


Example – Defect Density Indicator



Decision criteria: Modules in yellow zone are reinspected, modules in red zone are investigated as candidates for reengineering.

Control Type Metrics



When using software metrics to control processes, products: & services:

- Decision criteria can be established based on:
  - Thresholds
  - Variances
  - Control limits

Thresholds

Control

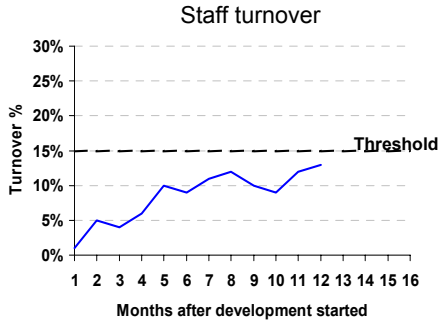
Thresholds are established boundaries that when crossed indicate that action is needed.

Threshold may be established based on:

- Historic data
- Future predictions
- Customer requirements
- Industry standards and/or benchmarks

Thresholds Based on Predictions

Control



Decision criteria: If 15% threshold exceeded; implement staffing & training risk contingency plan

Requirements Based Thresholds

Control

Thresholds can be based on customer requirements for product performance, including:

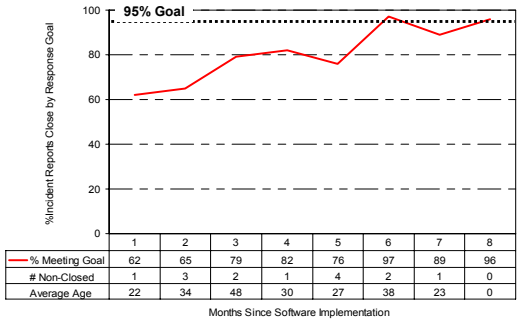
- Capacity
- Throughput
- Response times
- Resource utilization (memory, disk space, bandwidth)
- Accuracy & precision
- Availability
- Reliability
- Quality

Decision criteria: If requirements not met (threshold crossed); open a defect report to investigate need for product design change

Example – Service Level Agreement

Control

Problem Reports Responsiveness

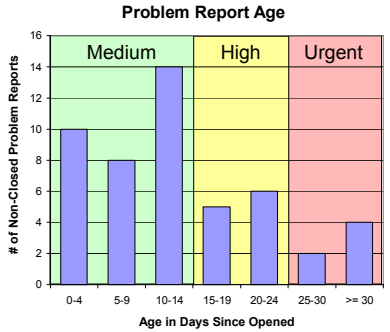


	1	2	3	4	5	6	7	8
% Meeting Goal	62	65	79	82	76	97	89	96
# Non-Closed	1	3	2	1	4	2	1	0
Average Age	22	34	48	30	27	38	23	0

Decision criteria: If under threshold; do better next month

Example – Service Level Agreement

Control



Decision criteria: Prioritize problem resolution based on age

Variances

Control

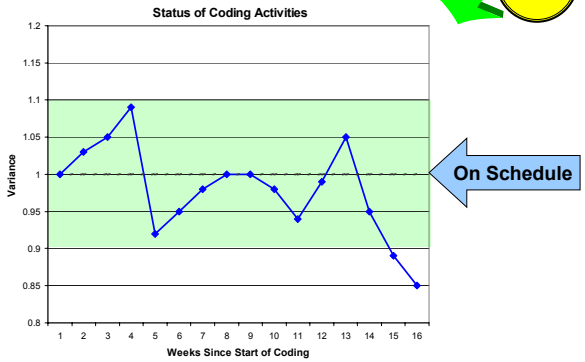
Variances compare actual values with expected values and decisions are based on the magnitude of the difference.

Variances are typically calculated as:

- Ratio
- Absolute delta

Ratio Type Variance

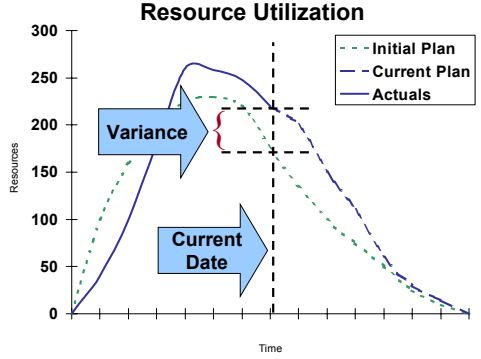
Control



Decision criteria: Resulting ratio should fall between 0.9 and 1.1 to conclude the project is on schedule.

Absolute Delta Type Variance

Control



Decision criteria: Variances of more than 25 should be investigated & corrective action taken.

Decision Criteria for Variances

Control

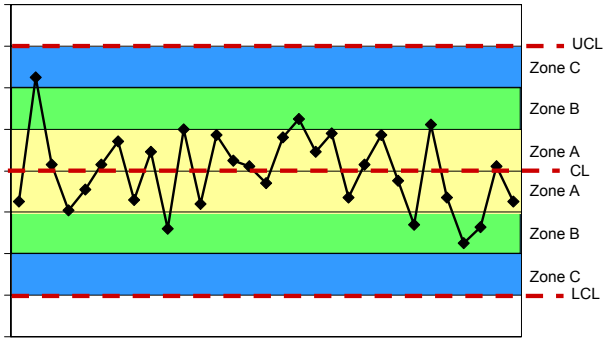
Considerations when establishing decision criteria for a variance:

- Influences of the change in magnitude of the actual & expected values over time
- Historic values – evaluating past variances provide information about:
  - Capabilities of the current estimation/prediction processes
  - What acceptable variances were historically
- Customer, contractual or regulatory requirements
- Best practices & workmanship standards

Control Limits

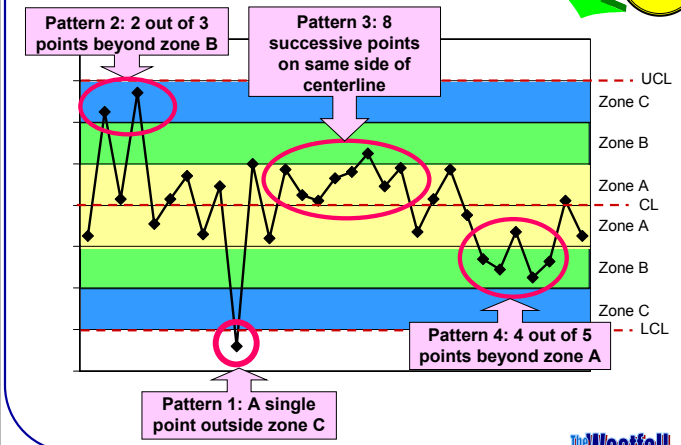
Control

Purpose: To control an attribute of a process over time.



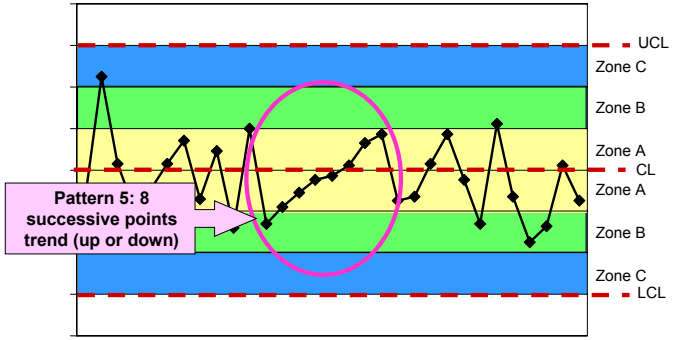
Control Limit Decision Criteria

Control



Control Limit Decision Criteria

Control



Evaluate

Examine & analyze metrics information as a part of our decision-making.

- Perform cost/benefit analysis
- Analyze & prioritize choices
- Perform analysis to determine if a process is ready to start or end (entry & exit criteria)

Cost/Benefit Analysis

Cost/benefit analysis is used to:

- Determine whether the predicted return on investment (RIO) is sufficient
- Select between alternative projects or actions

Example costs:

- People
- Materials
- Methods & tools
- Capital equipment
- Infrastructure
- Risks

Example benefits:

- Revenue
- Market share
- Technical leadership
- Increased capability or capacity
- Reduced risk

Cost/Benefit Analysis

Risk Reduction Leverage (RRL) = $\frac{(RE_{before} - RE_{after})}{\text{Risk Reduction Cost}}$

Risk #	Prob(UO) before	Loss (UO) before	RE before
143	25%	$300K	$75K

Alternative	Prob(UO) after	Loss(UO) after	RE after	Cost	RRL
1	5%	$300K	$15K	$65K	0.9
2	25%	$160K	$40K	$25K	1.4
3	20%	$300K	$60K	$2K	7.5

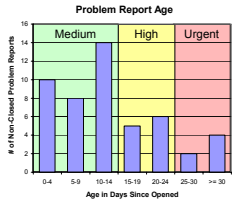
Decision Criteria:

- Risk Reduction Leverage (RRL) > 1.15
- Risk Exposure after risk reduction (RE_{after}) < $50K

Analyze & Prioritize Choices

Measurements are used to rank items by priority. We have already had two examples:

- Prioritizing problem report resolution by age



- Prioritizing the selection of risk reduction activities by RRL

Risk #	Prob(UO) before	Loss (UO) before	RE before
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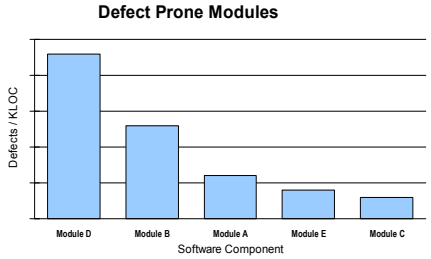
Pareto Chart

Evaluate

Purpose: To help identify areas that are causing the most problems.



Decision criteria: Analyze & prioritize the most error prone modules for reengineering or additional defect detection effort.

Example – Supplier Scorecards

Evaluate

Scorecard for Ranking Potential Suppliers

Attribute	Max Score	Supplier 1	Supplier 2	Supplier 3
Ability to deliver by date needed	10	10	7	8
Purchase price / licensing costs	10	7	5	10
Licensing restrictions	5	5	4	5
Operating costs	15	12	15	5
Maintenance costs	10	5	10	7
Process capability	10	10	8	5
Product functionality matches needs	20	18	16	8
Product quality	20	20	15	15
Ease of integration with existing systems	5	3	5	3
Ease of integration with our business processes	10	10	7	10
Ability to customize product	5	5	4	5
Technical support	5	5	3	2
Training availability	10	10	5	5
Total Score	135	120	104	88

Ability to deliver by date needed = 10 points minus one point for each week past needed date

Product functionality meets needs = (# requirements met / Total requirements) x 20

Decision Criteria: Choose the supplier with the highest score

Entry/Exit Criteria

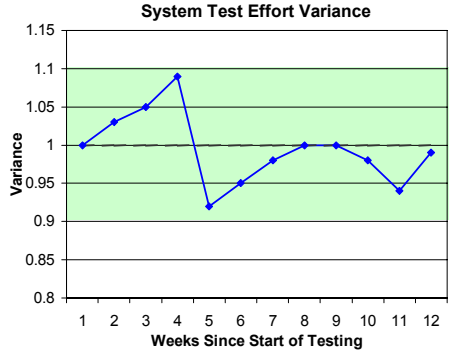
Evaluate

Entry/exit criteria are specific, measurable conditions that must be met before the process can be started/completed.

- Decision criteria for multiple metrics might be used.
- For example, as exit criteria for system test we might look at decision criteria for:
  - System test effort variance
  - System test activity status
  - Problem report arrival rate
  - Non-closed problem report counts

System Test Exit Criteria

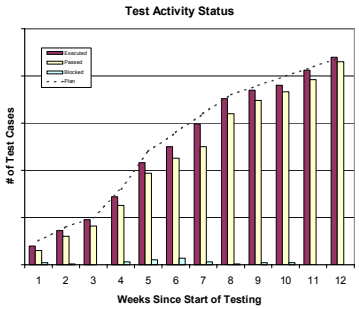
Evaluate



Decision Criteria: Cumulative system test effort rate matches plan within a 10% variance.

System Test Exit Criteria

Evaluate

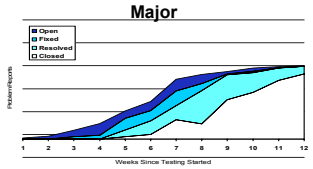


Decision Criteria:

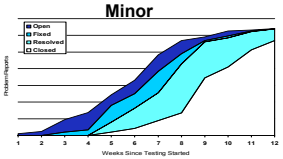
- 95% of all planned test cases executed
- No blocked test cases
- 95% of all test cases executed were passed

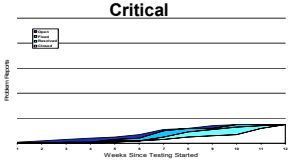
System Test Exit Criteria

Evaluate



Cumulative Problem Report Arrival Rates by Status





Decision criteria:

- Problem arrival rate
- Non-closed defect counts

Understand

Understand

Gather metrics to learn about our current products, processes & capabilities.

- How much are we spending on software development? On testing?
- Where do we allocate & use resources throughout the life cycle?
- How many errors & of what types are typical in our software products? How much do they cost us?
- What are our current productivity levels?

Understand (cont.)

Understand

This information can be used to:

- Establish baselines, standards & goals
- Derive models of our software processes
- Examine relationships among process parameters
- Target process & product improvement efforts
- Better estimate project effort, costs & schedules

Decision Criteria: What is our confidence level in the measures we are using as a basis for our understanding?

Predict

Use metrics to estimate future values.

- How much will it cost? (Budget)
- How long will it take? (Schedule)
- How much effort will it take? (Staffing)
- What other resources will it take? (Resources)
- What is the probability that something will go wrong? And what will it cost if it does? (Risk)
- How many errors will it have? (Quality)
- How will those errors impact operations? (Reliability)

Decision Criteria

Decision criteria are the "thresholds, targets, or patterns used to determine the need for action or further investigation, or to describe the **level of confidence in a given result"**

Decision criteria for Understand & Predict type metrics

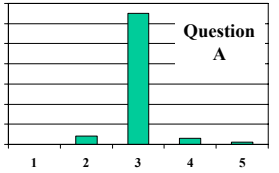
Confidence Level

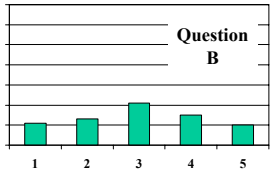
Considerations when determining our confidence level in a given result include:

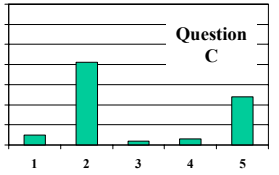
- How complete is the data used?
- Is the data used subjective or objective?
- What is the integrity and accuracy of the data?
- How stable is the product, process or service being measured?
- What is the variation within the data set?

Customer Satisfaction

Question Response Distribution Report for Current Satisfaction Levels





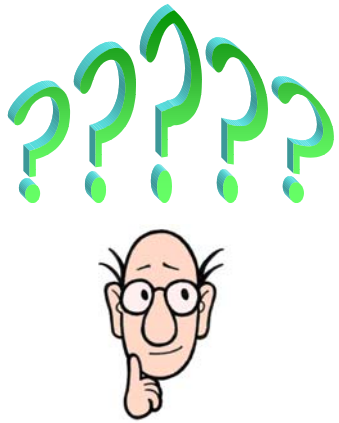


Conclusions

I believe that having clearly defined & appropriate decision criteria is important in ensuring that our measurement indicators are correctly interpreted & applied.

- ISO/IEC 15939 provides decision criteria definition & examples but little guidance to help us establish them for our metrics
- This papers is a starting point
- More discussion & definition is needed

Questions?



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