Using Quality Factors and Measures to Focus on Customer Satisfaction

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Why Force Developers to Think About Quality, Factors?

- Defining quality factors helps develop understanding of customer needs
- Attending to quality factors results in capturing quality requirements and design goals in the Software Management Plan (e.g., 2167A Software Development Plan) and in the Software Requirements Document
- Using measures for quality factors supports follow up (getting quality engineered into products)
  - o Where are we now? Where do we want to go? Are we getting there?

This presentation reports the experiences of 2 teams

Team Backgrounds

- Team A
  - Participants included Software Manager, Lead Engineers, Software Product Assurance, and SEPG member
  - Project characteristics
    - Onboard software for robotic spaceflight mission with many instruments and many critical events

- Team B
  - Participants included Manager, System Engineer, Test Engineer, Configuration Manager, Software Quality Engineer, SEPG members
  - Project characteristics
    - Ground data system software supporting many missions
    - Large inheritance, multiple platforms over history
    - Greater portability is needed along with new capabilities

Quality Goals of Each Team

- The Team A goal was to pre-rank the quality factors so that the lead engineers could then use the ranked quality factors as criteria in making design trade-off decisions.

- Team B goals were to
  - Improve quality within their budget and schedule
  - Measure current quality
  - Determine how to allocate resources based on current quality
  - Give rewards based on quality factor improvements

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Generic Process

- Assemble the team members with all areas and disciplines represented

- Rank the quality factors

- Propose candidate measures

- Determine cost and values of the supporting measures

- Select the measures
  - o Collect, analyze, and refine the measures
  - o Improve the process
  - o Collect, analyze, and refine the measures based on their costs and values

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Rank the Quality Factors

- Determine the definitions for your customer
  - o Discuss the book definitions (e.g., Deutsch and Willis)
  - o Customize those definitions
  - o Add other quality factors or delete those irrelevant to the customer

- Each individual ranks the quality factors
  - o Sometimes team members bring consensus from their areas back to team
  - o Skipping this step can incline group to follow the leader

- Display the range of votes
  - o Look at the minimum, the maximum, the median, and the modes

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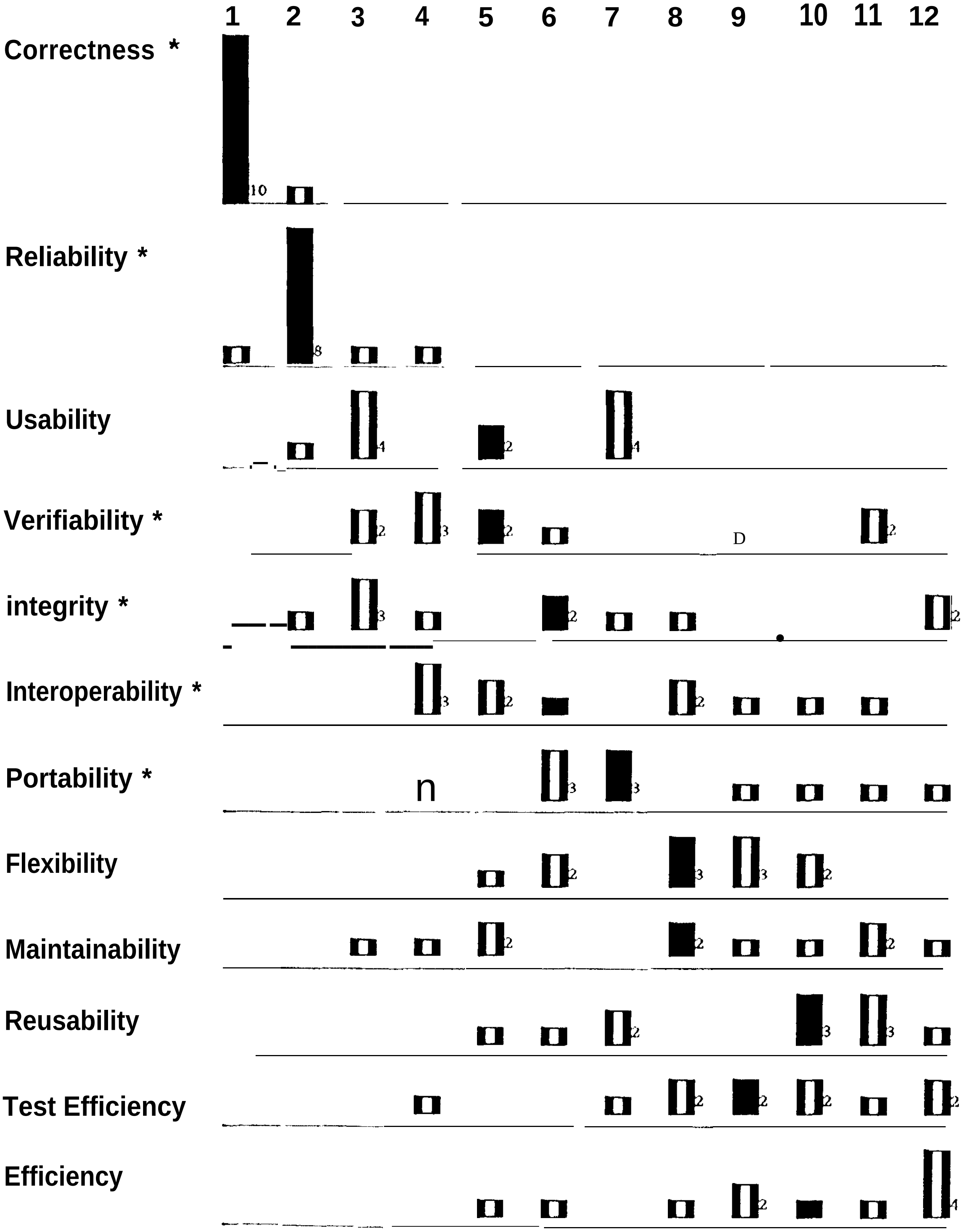
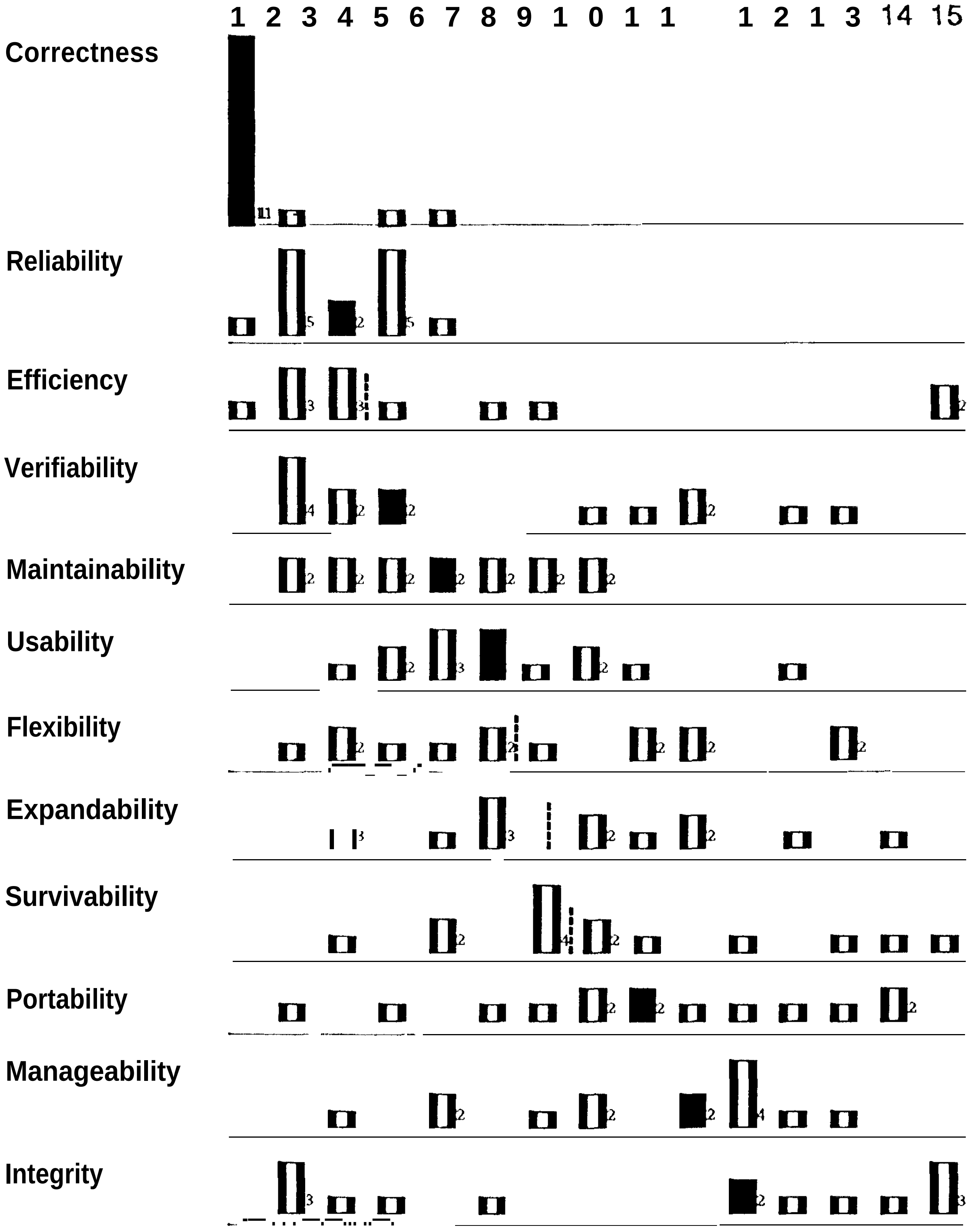
Team B -- Ranking Summary



Solid bars and dotted lines represent medians. * indicates required quality factor,

Diverse Students -- No Discussion



Solid bars and dotted lines represent medians. * indicates required quality factor,

Use Patterns to Focus Discussion

- Arrange counts for each quality factor by decreasing medians to see patterns

- Is apparent agreement real? (e.g., Correctness)

- Why did people hold split views? (e.g., Usability)

  o Are different people using different definitions?

- Why were views so distributed? (e.g., Maintainability)

  o Is same definition applied differently by different people to the project?

- Do close "averages" mean equally important factors?

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  0 Are some quality factors requirements and others are design goals?

Propose Candidate Measures: Some Examples

- #Errs. In. Interface.Test = Number of errors found during interface testing
- #Errs.by.Phase.Found = Number of errors by phase found
- #Extrnl.Interfcs.to. Test = Number of external interfaces to test
- #Failure. Reports = Number of failure reports (FRs) per time period (e.g., month or delivery)
- #FRs.Call.Cockpit.Errs = Number of failure reports called cockpit errors
- #Unt.W/NStd.Lang. Feat = Number of units using non-standard language features

Example Scales for Determining Cost and Value

- cost
  - o □ LOW if it is something we already have or do
  - o ⬓ MEDIUM if is something not done now, but easy and well understood
  - o ■ HIGH if it is something new or something hard to do

- Value scales roughly with the strength of the correlation between the quality factor and the measure
  - o ■ HIGH if the measure is directly related to the quality factor
  - o ⬓ MEDIUM if it is one degree removed from the quality factor (e.g., Complexity correlates with Reliability)
  - o □ LOW if it is more than one degree removed from the quality factor

Determine Costs and Values

- Assess COSTS before VALUES
    - It is easier and gives an established scale to work against

- Pre-Assess VALUES
    - Discuss the meanings of the values with whole team
    - Two people each make an initial assessment of the values, then discuss the values with each other
    - Adjust the values and record differences of opinion (e.g., HIGH/MED)

- Re-Assess VALUES
    - Present preliminary values and their reasons to the group
    - Discuss and modify the pre-assessed values
    - Iterate as many times as it takes to reach consensus

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Some Costs and Values According to Team B

Values Corresponding to Quality Factors

cost	Measure	CORR	RELI	USA	VERIF	INTEG	INTROP	PORT	FLEX	EXPAN	MAINT	REUSE
		▼	▼	v	▼	▼	▼	▼	▼	▼	▼	▼
❑	* #Errs. In. interface.Test	❑	■		⬓	.	■			❑	□	□
❑	#Errs. by. Phase. Found	■	■	.	.	.	.	.	.	.	□	□
■	#Errs. by. Phase. Injected	■	■	.	.	.	.	.	.	□/⬓	□/⬓	□/⬓
❑	* #Extrnl.Interfcs.to. Test	■	■	⬓	■	❑	❑		.	❑	⬓	❑
I - I	* #Failure. Reports	■	■	⬓	□	.	❑			|	.	|
□/⬓	* #FRs.Call.Cockpit. Errors	.	□	■	⬓	.	.	.	.	⬓	⬓	⬓
■	McCabe. Complexity/Unit	❑	⬓	.	■	.	.	.	n ⬓	⬓	■	⬓
❑	* %Reqs.Dmd.Testabl	■	.		■	.	•1	.	.	❑	⬓	❑
❑	* %Reqs.Wi.Tst.Cases	■	□	❑	■	❑	ı	.	□	❑	■	□

Costs and Values According to Team B

Values Corresponding to Quality Factors

		CORR	RELI	USA	VERIF	INTEG	INTROP	PORT	FLEX	EXPAN	MAINT	REUSE
Cost	Measure	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼
❑☛	%Comments/Unit	.	.	.	❑	.	.	□	❑	❑	■	■
❑	#Errs. Fnd/WF?by.Phs.Fnd	■	■	.	.		.		.	.	❑	❑
■	#Errs. Fnd/WP.by.Phs.Inj	■	■	.		.			.	□/⬓	□/⬓	□/⬓
⬓/■	#Errs. Forecast. Tot	.	■	.	⬓		.	.		.	.	
❑ *	#Errs.in.interface.Test	■	■		⬓		■		.	□	❑	□
❑ *	#Externi.interfaces. to.Test	■	■	⬓	■	❑	❑		.	❑	⬓	❑
❑ *	#Failure. Reports	■	■	❑	u	.	❑	.	.	.	.	.
□/⬓*	#FRs.Call.Cockpit. Errors	\	□	■	⬓	.		.	.	❑	⬓	W
❑	#Internl.interfaces.to. Test	■	■	.	■		.	.	.	□	❑	❑
■	McCabe. Complxty/Unit	❑	⬓	.	■	.	.	.	❑	⬓	■	⬓
u *	#NonPortablty. Msgs/Unit		.	.		.	□	■	❑	❑	⬓	❑
❑	#NSLOC/Unit	❑	□	.	❑		.	ı	❑	□	⬓	❑
•1	#NSLOC/Program	ı	□	.	❑	.	.	ı	.	❑	❑	⬓
U	Operator. Actions/Task	ı	□	■	⬓	.	⬓		.	ı	❑	
□	#Progs.In.Mixed. Langs	ı	.	.	⬓	.	□	■	⬓	❑	■	⬓
❑ *	%Reqs.Dmd.Testabl	■	.	.	■	.	❑	ı	.	❑	❑	⬓
❑ *	%Reqs.Wi.Tst.Cases	■	□	❑	❑	❑	.	ı	•1	❑	■	❑
□	#Units/Program	ı	□	.	W	.	.	ı	❑	⬓	⬓	⬓
□	#Unts.Over.NSLOC. UCL	❑	□	.	⬓	.	.	ı	.	⬓	⬓	❑
□ *	#Unts.Wi.NStd.Lang. Feat	ı	.	.	❑	.	⬓	■	❑	⬓	■	■

For Cost: ■ (HIGH), ❑ (Meal), or ❑ (low) represents the cost of obtaining the measurement.
For Value: ■ (HIGH), ⬓ (Meal), or ❑ (low) indicates the value of how strongly the measure supports the quality factor.
"." indicates no recommended value of measure. "/" shows range. "*" indicates selected measures.

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In Conclusion

- Defining quality factors and measures helped the teams understand their customers' needs and make better trade-off decisions

"You Can't Achieve ≤uality ... Unless You Specify It!"

--Michael Deutsch and Ronald Willis in "Software Quality Engineering", Pg. 8

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