
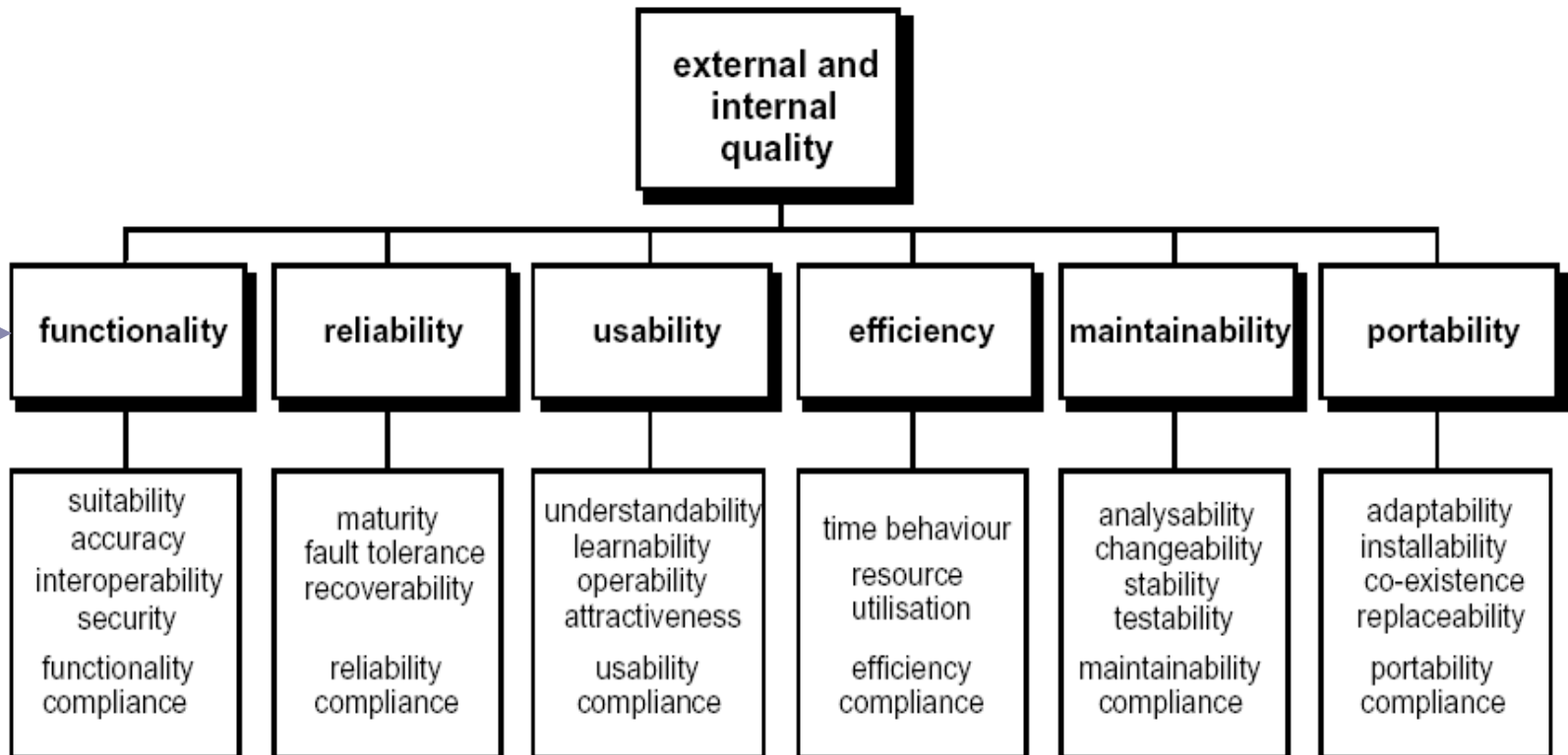


What does a programmer
need to think about?



ISO 9126 Quality Model



Measures (see ISO9126-2, ISO9126-3, ISO9126-4)

ISO 9126 – Software Product Characteristics or Customer needs

- Lets have a quick look at an example.
- Lets imagine we are building an Internet-based banking system.
- What do those criteria or sub-characteristics mean?

Functionality

Sub-characteristic	Definition	Applicability to Internet Banking
Suitability	Attributes of software that bear on the presence and appropriateness of a set of functions for specified tasks.	The software can transact deposits, withdrawals, transfers, and bill payments.
Accuracy	Attributes of software that bear on the provision of correct or agreed results or effects.	The software can correctly calculate and display interest payments.
Interoperability	Attributes of software that bear on its ability to interact with specified systems.	The software can work on client PCs using different Windows operating systems (2000, XP, Vista).
Compliance	Attributes of software that make the software adhere to application related standards or conventions or regulations in laws and similar prescriptions.	The software can forward transaction information to the appropriate clearinghouse for reconciliation.
Security	Attributes of software that bear on its ability to prevent unauthorized access, whether accidental or deliberate, to programs or data.	The software can secure customer information according to established protocols.

Reliability

Sub-characteristic	Definition	Applicability to Internet Banking
Maturity	Attributes of software that bear on the frequency of failure by faults in the software	The software can complete the entire transaction cycle without runtime errors.
Fault Tolerance	Attributes of software that bear on its ability to maintain a specified level of performance in the presence of software faults.	The software continues to operate if data is missing or incorrectly interpreted, without a critical failure event.
Recoverability	Attributes of software that bear on the capability to re-establish its level of performance and recover the data directly affected by a failure, and on the time and effort needed for it.	The software can resume a partially completed loan application after disconnection from a power outage.

The Patriot Missile Failure

- On February 25, 1991, during the Gulf War, an American Patriot Missile battery in Dhahran, Saudi Arabia, failed to track and intercept an incoming Iraqi Scud missile.
- The Scud struck an American Army barracks, killing 28 soldiers and injuring around 100 other people

Cause

It turns out that the cause was an inaccurate calculation of the time since boot due to computer arithmetic errors.

Specifically,

- The time in tenths of second as measured by the system's internal clock was multiplied by $1/10$ to produce the time in seconds.
- This calculation was performed using a 24 bit fixed point register.
- The small chopping error, when multiplied by the large number giving the time in tenths of a second, led to a significant error.
- Indeed, the Patriot battery had been up around 100 hours, and an easy calculation shows that the resulting time error due to the magnified chopping error was about 0.34 seconds.

Specifically, ...and Technically

- [illegible]

Which implies

- A Scud travels at about 1,676 meters per second, and so travels more than half a kilometer in this time.
- A Scud travels at about 1,676 meters per second, and so travels more than half a kilometer in this time.
- *Ironically, the fact that the bad time calculation had been improved in some parts of the code, but not all, contributed to the problem, since it meant that the inaccuracies did not cancel.*

Usability

Sub-characteristic	Definition	Applicability to Internet Banking
Understandability	Attributes of software that bear on the users' efforts in recognizing logical concepts presented by the application.	The customer to understands the systems purpose after participating in 20-minute online tutorial.
Learnability	Attributes of software that bear on the users' effort for learning its application.	Software provides tips or assistance to product functions.
Operability	Attributes of software that bear on the users' effort to customise or control the application.	Software can provide users with ability to configure privilege setting to restrict functions (i.e. so teenage children can't withdraw family savings to purchase a sports car).

It looks like you're writing a letter.

Would you like help?

- Get help with writing the letter
 - Just type the letter without help
- ☐ Don't show me this tip again



Clippy is sad.

Are you sure you want to kill off the Clippy?

Yes

No



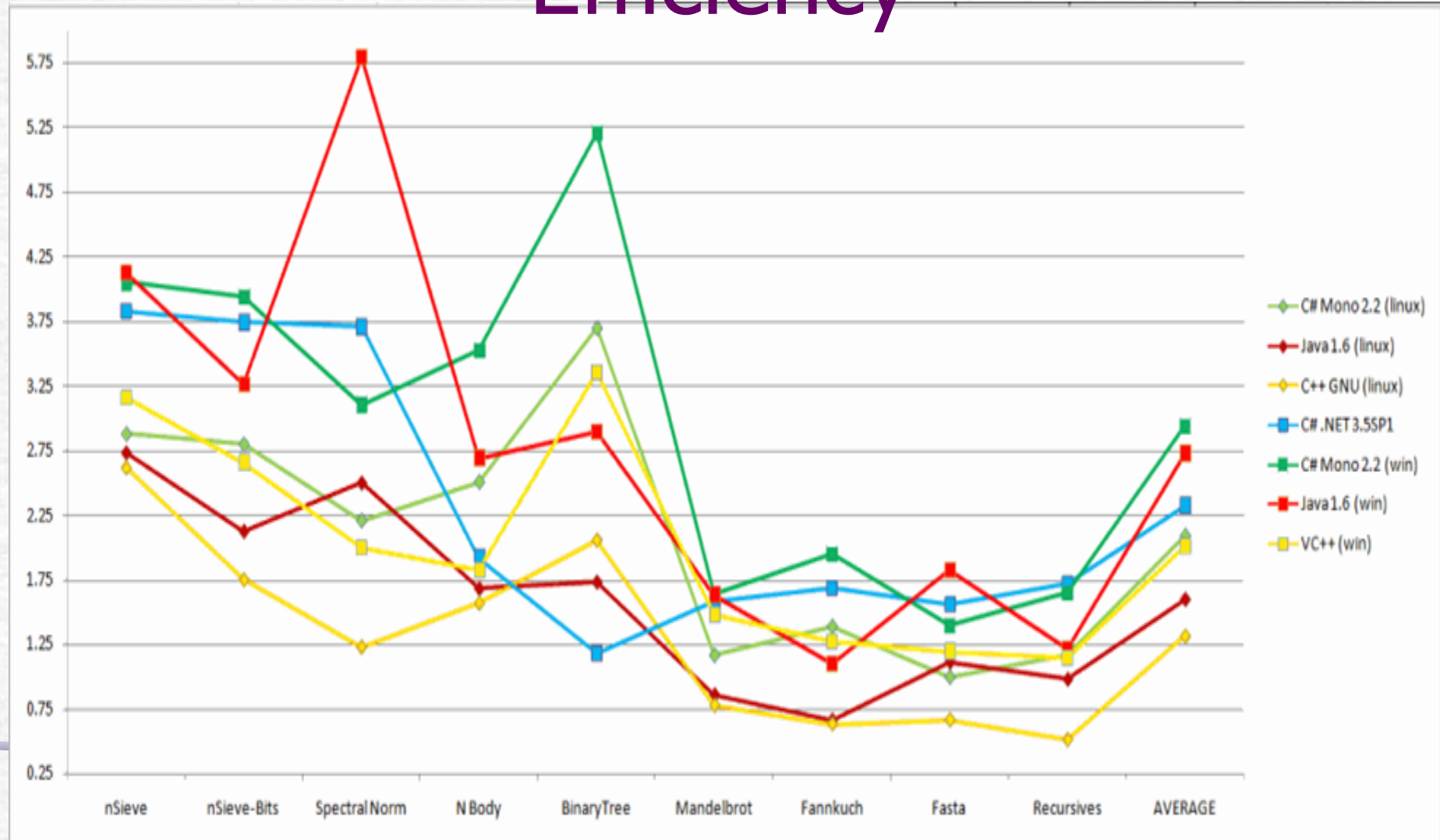
The much-reviled Microsoft Office Paperclip.

- Clippy was a well-intentioned effort to solve a real usability problem. Users don't read the manual, don't use the online help, and don't know how to find the answers to their problems. Clippy tries to suggest answers to the problem it thinks you're having.
- Unfortunately it's often wrong, often intrusive, and often annoying. The subjective quality of your interface matters too.

Efficiency

Sub-characteristic	Definition	Applicability to Internet Banking
Time Behaviour	Attributes of software that bear on response and processing times and on throughput rates.	Software can complete a withdrawal or deposit transaction within 3 minutes from origination to confirmation.
Resource Behaviour	Attributes of software that bear on the amount of resource used and the duration of such use in performing its function.	Software can be used in client system with less than 5% available memory without disruption of other processes or operations.

Efficiency



Maintainability

Sub-characteristic	Definition	Applicability to Internet Banking
Analyzability	Attributes of software that bear on the effort needed for diagnosis of deficiencies or causes of failures, or for identification of parts to be modified.	Software malfunctions by incorrectly calculating year-end totals resulting in integrity errors. Software should reveal how calculations occurred, dependencies, and effects.
Changeability	Attributes of software that bear on the effort needed for modification, fault removal or for environmental change.	Software can take on international banking functions (i.e. offshore accounts with different tax requirements).
Stability	Attributes of software that bear on the risk of unexpected effect of modifications.	Software can be adapted to work with wireless devices, but smaller screen size changes display characteristics.
Testability	Attributes of software that bear on the effort needed for validating the modified software.	Software can be tested to ensure sustained functionality under conditions of load and stress.

Year	Development Personnel	Maintenance Personnel	Total Personnel	Maintenance Percent
1950	1,000	100	1,100	9.09%
1955	2,500	250	2,750	9.09%
1960	20,000	2,000	22,000	9.09%
1965	50,000	10,000	60,000	16.67%
1970	125,000	25,000	150,000	16.67%
1975	350,000	75,000	425,000	17.65%
1980	600,000	300,000	900,000	33.33%
1985	750,000	500,000	1,250,000	40.00%
1990	900,000	800,000	1,700,000	47.06%
1995	1,000,000	1,100,000	2,100,000	52.38%
2000	750,000	2,000,000	2,750,000	72.73%
2005	775,000	2,500,000	3,275,000	76.34%
2010	800,000	3,000,000	3,800,000	78.95%
2015	1,000,000	3,500,000	4,500,000	77.78%
2020	1,100,000	3,750,000	4,850,000	77.32%
2025	1,250,000	4,250,000	5,500,000	77.27%

Portability

Sub-characteristic	Definition	Applicability to Internet Banking
Adaptability	Attributes of software that bear on the opportunity for its adaptation to different environments or situations.	Software can work in conjunction with third party applications for Check Ordering, Bill Payments, Loan Decisions, and Data Aggregation.
Installability	Attributes of software that bear on the effort needed to install the software in a specified environment.	Software can be installed as part of a distributed system or as a stand-alone application.
Conformance	Attributes of software that make the software adhere to standards or conventions relating to portability.	Software permits health insurance transactions in a manner that complies with Health Information Portability and Accountability Act (HIPAA).
Replaceability	Attributes of software that bear on opportunity and effort using it in the place of other software.	Software can effectively replace the legacy systems installed on mainframe computers 20 years ago without disrupting operations.

The Explosion of the Ariane 5



The Explosion of the Ariane 5

- On June 4, 1996 an unmanned Ariane 5 rocket launched by the European Space Agency exploded just forty seconds after its lift-off from Kourou, French Guiana.
- The rocket was on its first voyage, after a decade of development costing \$7 billion. The destroyed rocket and its cargo were valued at \$500 million.

Cause

- It turned out that the cause of the failure was a software error in the inertial reference system.
- Specifically a 64 bit floating point number relating to the horizontal velocity of the rocket with respect to the platform was converted to a 16 bit signed integer.
- The number was larger than 32,767, the largest integer storable in a 16 bit signed integer, and thus the conversion failed

Solution



Java

JVM