Quantifying Quality

UiO mandag 23.10, Store auditorium Informatikkbygningen?

Tom@Gilb.com

www.Gilb.com

Version 11.juni 2006

Quantifying Quality

Philolaus on Numbers

- Over four hundred years BC, a Greek by the name of Philolaus of Tarentum said :
- ” Actually, everything that can be known has a Number;
- for it is impossible to grasp anything with the mind or to recognize it without this (number)
- *Best regards (Aug 2005) N.V.Krishna*www.microsensesoftware.com

Quantifying Quality

"You can nearly measure everything but how can you measure style?"
That's Siemens catchphrase for its new S65

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Quantify

Quantifying Quality

How to Quantify any Qualitative Requirement

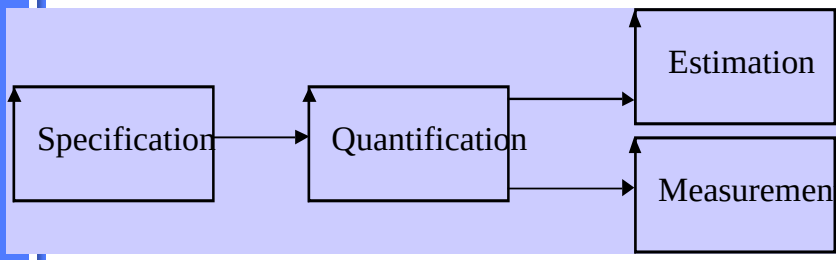


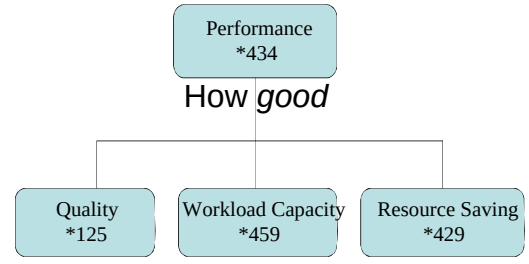
Diagram from 'Competitive Engineering.' book.

Quantifying Quality

Quality: the concept, the noun

Planguage Concept *125, Version: March 20, 2003

A '**quality**' is
- a scalar attribute -|-|-|-|- (Scale symbol)
- reflecting 'how *well*' ------Past Level<---------->
- a system functions. (Fn)------Past Level<-------->



Quantifying Quality

Quality *is characterized by these traits*

1. Quality describes 'how well' a function is done.
2. Quality describes the *partial effectiveness* of a function (as do all other performance attributes).
3. Quality is *valued* to *some* degree by *some* stakeholders of the system
4. *More* quality is generally *valued* by stakeholders; especially if the increase is free, or lower cost, than the value of the increase.
5. Quality attributes can be *articulated* independently of the particular means (designs) used for reaching a specific quality level –
6. even though all quality levels *depend* on the particular designs used to achieve them.
7. A particular quality can be a described in terms of a *complex* concept, consisting of multiple elementary quality concepts.
8. Quality is *variable* (along a definable scale of measure: as are all scalar attributes).
9. Quality levels are capable of being specified *quantitatively* (as are all scalar attributes).
10. Quality levels can be *measured* in practice.
11. Quality levels can be traded off to some degree; with other system attributes valued more by stakeholders.
12. Quality can never be perfect (100%), in the real world.
13. There are some levels of a particular quality that may be outside the state of the art; at a defined time and circumstance.
14. When quality levels increase towards perfection, the resources needed to support those levels tend towards infinity.

8. Quantify

Quantifying Quality

Exercise: Aspects of Love, or Love is a many splendored thing!

- Make inventory of love's many aspects
- Quantify one requirements for love

- Duration: 6 minutes

See note for Sutra

Quantifying Quality

Love Attributes: Brainstormed By Dutch Engineers

- Kissed-ness
- Care
- Sharing
- Respect
- Comfort
- Friendship
- Sex
- Understanding
- **Trust**

- Support
- Attention
- Passion
- Satisfaction
- ...
- ...
- ...

Quantifying Quality

Trust [Caroline]

- **Love.Trust.Truthfulness**
  - Ambition: No lies.
  - Scale:
    - Average **Black** lies/month from [defined sources].
  - Meter:
    - independent confidential log from sample of the defined sources.
  - Past Lie Level:
    - Past [My Old Mate, 2004] 42 <-Bart
  - Goal
    - [My Current Mate, Year = 2005] Past Lie Level/2
  - **Black**: Defined: Non White Lies

- Other aspects of Trust:
  - **Broken Agreements**
  - **Late Appointments**
  - **Late delivery**
  - **Gossiping to Others**

Quantifying Quality

Camaraderie (Real Case UK)

- Ambition: to maintain an exceptionally high sense of good personal feelings and co-operation amongst all staff: family atmosphere, corporate patriotism. In spite of business change and pressures.
- Scale: **probability that individuals enjoy the working atmosphere so much that they would not move to another company for less than 50% pay rise.**
- Meter: Apparently real offer via CD-S
- Past [September 2001] 60+ % <- R & CD
- Goal [Mid 2002] 10%, [End 2002] <1% <- R & CD
- Rationale:
- maintain staff number, and morale as core of business and business predictability for customers.

Quantifying Quality

Love: Biblical Dimensions < L Day, Boeing

The biblical citation (Book of First Corinthians) I included gives the quantification of the term "love" (agape in Greek). The 'quantification' for love would be as follows:

---------->

QuickTime™ and a decompressor are needed to see this picture.

A person who loves acts the following way toward the person being loved:

1. **suffereth long**
2. **is kind**
3. **envieth not**
4. **vaunteth not itself, vaunteth...:**
   or, is not rash (Vaunt = extravagant self praise)
5. **is not puffed up**
6. **Doth not behave itself unseemly**
7. **seeketh not her own**
8. **is not easily provoked**
9. **thinketh no evil**
10. **Rejoiceth not in iniquity (=an unjust act)**
11. **rejoiceth in the truth**
12. **Beareth all things**
13. **believeth all things**
14. **hopeth all things**
15. **endureth all things**
16. **never faileth**

Quantifying Quality

What can we do *better* (or 'at all'), if we **quantify** quality ideas?

- Evaluation solutions/designs/architectures against the quantified quality requirements (Impact Estimation)
- Test and measure the degree to which solutions meet quality and cost expectations (when they were chosen)
- **Measure** evolutionary **project progress** towards quality goals
  - And get early & continuous improved estimates for time to completion
- Communicate quality goals much better to all parties (users, customers, developers, testers, lawyers)
- **Contract** for results
  - Pay for results only (not effort expended)
- **Reward** teams for results achieved
- **Motivate** technical people to focus on real business results
- Simplify requirements (the top few quantified- everything else is design)
- Collect numeric data about designs, processes, organizational structures, to learn and use in future.
- Permits systematic corporate or academic research of a development environment

Quantifying Quality

Real Examples of (BAD)Requirements (Oct 2004)
37 Page **Detailed Functional Requirement**

Projected benefits of this include
- reduced time lost in planning,
- quicker identification of actual and potential operational problems-
- reduced time in vehicle tracking for customers and internal purposes,
- better matching of operational costs and effort to sales contracts,
- better information for future contract negotiations & renegotiation
- ----------

The perceived benefits of better planning and management of high & heavy cargo are:
- reduced manual effort in planning movements,
- better performance to target delivery dates for high & heavy,
- better terminal planning for the cargo,
- better terminal operation from better information about handling,
- better customer management from better information on progress.

The perceived benefits of better planning and management of high & heavy cargo are:
- reduced manual effort in planning movements,
- better performance to target delivery dates for high & heavy,
- better terminal planning for the cargo,
- better terminal operation from better information about handling,
- better customer management from better information on progress.
- ==========

Consolidated, consistent and timely planning information will:
- reduce the incidence of wrong booking and loading of cargo,
- reduce double handling and recording of information,
- give visibility of planning data along the full distribution chain,
- allow marketing to give more accurate information to customers,
- increase utilization of COMPANY's own transport, and
- -reduce the amount of emergency third party charter.

Quantifying Quality

What is *wrong* with this (previous slide) picture?

Some more detail in the same 'functional' requirements: (is this a design?)

1. **It must be possible to select any cargo, including High & Heavy and MAFI, based on any of:**
   - **VIN (either complete or a subset, typically the last 5, 6, 8 or 10 characters)**
   - **tracking number**
   - **serial number**
   - **multiple VINs (eg cut & paste input),**
   - **movement,**
   - **customer's batch number,**
   - **transport ID (rail wagon no or MAFI, lorry, vessel),**
   - **customer code**
   - **customer's sales order number**
   - **customer's manufacturing order no (also called Commission or ED no)**
   - **at location on date (by destination)**
   - **dealer code**
   - **model type & make**

- **No *identification* of the main benefits (just bullet points)**
- **No definition of the *quantification* (no 'Scale' specification)**
- **No *benchmark* to help define 'better'.**
- **No *target* to define 'better'**
- **No dates to define *when* 'better'**
- **No *evidence* that the 'designs' in the requirements will give any of the cited results**
- **No specification of the *long term value or costs* of the suggested designs (in the requirements)**
- **AND MANY MORE PROBLEMS**
  - **Sources**
  - **Authority**
  - **Risks**
  - **Priorities**

FIRM as Presentation
Trond Johnsen

Tom Gilb Version

May 7 2005

Customer Successes in Corporate Sector

FIRM R&D department

- Developers (13)
- Management/(CSO) (2)
- Tech Support NY (1)
- Microsoft .NET framework, SQL
- SEPG group (3) with responsibility of process improvement and quality assurance (QA).
  - Configuration Management, setup
  - Testing
  - Software Process Improvement (SP

Requirements - 3, Real Example of Spec

Usability.Productivity *(taken from Confirmit 8.5 development)*

Scale for quantification: Time in minutes to set up a typical specified Market Research-report

Past Level [Release 8.0]: 65 mins.,

Tolerable Limit [Release 8.5]: 35 mins.,

Goal [Release 8.5]: 25 mins.

Note: end result was actually 20 minutes ☺

Trond Johansen

Meter [Weekly Step]: Candidates with Reportal experience, and with knowledge of MR-specific reporting features, performed a set of predefined steps, to produce a standard MR Report.

- Our new focus is on the **day-to-day operations** of our Market Research users,
  - not a list of features that they might or might not like. 50% never used!
  - We KNOW that increased efficiency, which leads to more profit, will please them.
  - The '45 minutes actually saved x thousands of customer reports'
    - = big $$$ saved
- After **one week** we had defined more or less all the requirements for the next version (8.5) of Confirmit.

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

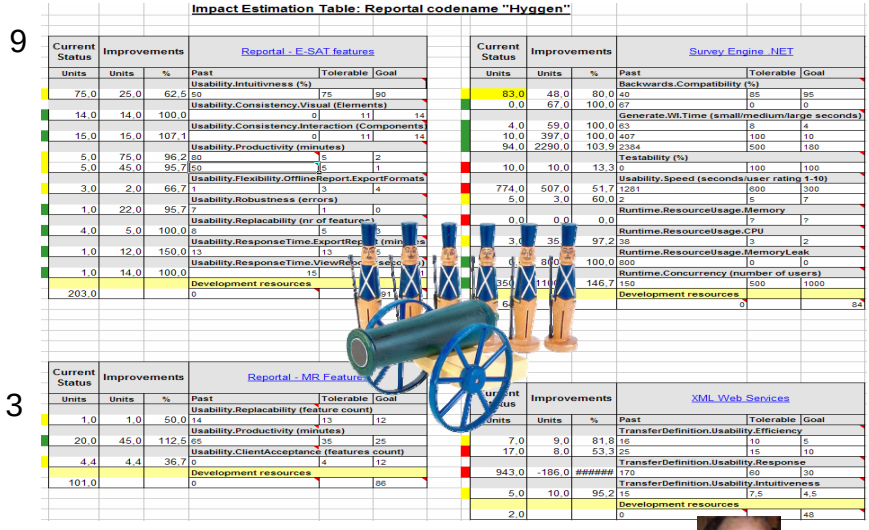
Trond Johansen

- IET for MR Project – Confirmit (<-FIRM Product Brand) 8.5
- **Solution:** Recoding
  - Make it possible to recode variable on the fly from Reportal.
  - Estimated effort: 4 days
  - **Estimated** Productivity Improvement: 20 minutes (50% way to Goal)
  - actual result 38 minutes (95% progress towards Goal)

		Current Status	Improvements		Goals			Step9 Recoding			
								Estimated impact		Actual impact	
		Units	Units	%	Past	Tolerable	Goal	Units	%	Units	%
					Usability.Replacability (feature count)						
		1,00	1,0	50,0	2	1	0				
					Usability.Speed.NewFeaturesImpact (%)						
		5,00	5,0	100,0	0	15	5				
		10,00	10,0	200,0	0	15	5				
		0,00	0,0	0,0	0	30	10				
					Usability.Intuitiveness (%)						
		0,00	0,0	0,0	0	60	80				
					Usability.Productivity (minutes)						
		20,00	45,0	112,5	65	35	25	20,00	50,00	38,00	95,00
					Development resources						
			101,0	91,8	0		110	4,00	3,64	4,00	3,64

EVO Plan Confirmit 8.5

4 product areas were attacked in all: 25 Qualities concurrently, one quarter of a year. Total development staff = 13



Trond Johansen

FIRM EVO-week cycle

	Development Team	Users (PMT, Pros, Doc writer, other)	CTO (Sys Arch, Process Mgr)	QA (Configuration Manager & Test Manager)
Friday	✓ PM: Send Version N detail plan to CTO + prior to Project Mgmt meeting ✓ PM: Attend Project Mgmt meeting: 12.00-15.00 ✓ Developers: Focus on genereal maintenance work, documentation.		✓ Approve/reject design & Step N ✓ Attend Project Mgmt meeting: 12-15	✓ Run final build and create setup for Version N-1. ✓ Install setup on test servers (external and internal) ✓ Perform initial crash test and then release Version N-1
Monday	✓ Develop test code & code for Version N	✓ Use Version N-1		✓ Follow up CI ✓ Review test plans, tests
Tuesday	✓ Develop Test Code & Code for Version N ✓ Meet with users to Discuss Action Taken Regarding Feedback From Version N-1	✓ Meet with developers to give Feedback and Discuss Action Taken from previous actions	✓ System Architect to review code and test code	✓ Follow up CI ✓ Review test plans, tests
Wednesday	✓ Develop test code & code for Version N			✓ Review test plans, tests ✓ Follow up CI
Thursday	✓ Complete Test Code & Code for Version N ✓ Complete GUI tests for Version N-2			✓ Review test plans, tests ✓ Follow up CI

Code quality – ”green” week

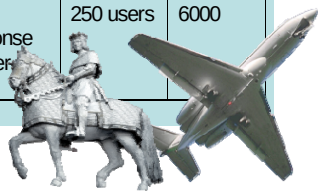
- In these ”green” weeks, some of the deliverables will be less visible for the end users, but more visible for our QA department.
- We manage code quality through an Impact Estimation table.

Current Status		Improvement	Goals			Step 6 (week 14)		Step 7 (week 15)	
	Units		Past	Tolerable	Goal	Estimated Impact	Actual Impact	Estimated Impact	Actual Impact
	100.0	100.0	0	80	100			100	100
Speed									
	100.0	100.0	0	80	100	100	100		
Maintainability.Doc.Code									
	100.0	100.0	0	80	100	100	100		
InterviewerConsole									
NUnitTests									
	0.0	0.0	0	90	100				
PeerTests									
	100.0	100.0	0	90	100			100	100
FxCop									
	0.0	10.0	10	0	0				
TestDirectorTests									
	100.0	100.0	0	90	100			100	100
Robustness.Correctness									
	2.0	2.0	0	1	2	2	2		
Robustness.BoundaryConditions									
	0.0	0.0	0	90	100				
Speed									
	0.0	0.0	0	80	100				
ResourceUsage.CPU									
	100.0	0.0	100	80	70	70			
Maintainability.Doc.Code									
	100.0	100.0	0	80	100	100	100		
SynchronizationStatus									
NUnitTests									

Evo's impact on Confirmit product qualities - 2

- Only highlights of the impacts are listed here

Description of requirement/work task	Past	Status
Usability.Productivity: Time for the system to generate a survey	7200 sec	15 sec
Usability.Productivity: Time to set up a typical specified Market Research-report (MR)	65 min	20 min
Usability.Productivity: Time to grant a set of End-users access to a Report set and distribute report login info.	80 min	5 min
Usability.Intuitiveness: The time in minutes it takes a medium experienced programmer to define a complete and correct data transfer definition with Confirmit Web Services without any user documentation or any other aid	15 min	5 min
Performance.Runtime.Concurrency: Maximum number of simultaneous respondents executing a survey with a click rate of 20 sec and an response time<500 ms, given a defined [Survey-Complexity] and a defined [Server-Configuration, Typical]	250 users	6000



QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.

Initial Experiences and conclusions

- We launched our first major release based on Evo in May 2004 (Rel. 8.5)
  - and we have already gotten feedback from users on some of the leaps in product qualities.
  - E.g. the time for the system to generate a complex survey has gone **from 2 hours (=wait for the system to do work) to 15 seconds!**
- EVO has resulted in
  - increased **motivation and**
  - **enthusiasm** amongst developers,
  - it opens up for empowered creativity
- Developers
  - **embraced the method** and
  - **saw the value of using it**,
  - even though they found parts of Evo difficult to understand and execute
- Project leaders feel:
  - Defining good requirements can be hard.
  - It was hard to find meters which were practical to use, and at the same time measure real product qualities.
  - Sometimes we would like to spend more than a day on designs, but this was not right according to our understanding of Evo. (Concept of backroom activity was new to us)
  - Sometimes it takes more than a week to deliver something of value to the client. (Concept of backroom activity was new to us)

QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.

Trond Johansen

Experiences and conclusions – 2

- Team members (developers)
  - "Sometimes it felt like we were rushing to the next weekly step, before we had finished the current step"
  - Testing was sometimes 'postponed'
    - in order to start next step,
    - some of these test delays were <u>not</u> compensated for, in later testing.

Evo's impact on product qualities - 1

- The impact described is based on:
  - Internal usability test, productivity tests ++
  - Performance tests carried out at Microsoft Windows ISV laboratory in Redmond USA
  - Direct customer feedback
    - *"I just wanted to let you know how appreciative we are of the new "entire report" export functionality you recently incorporated into the Reportal.*
    - *It produces a fantastic looking report, and the table of contents is a wonderful feature.*
    - *It is also* ***a HUGE time saver." <- Customer***
  - "These leaps in product qualities would not have been achieved without Evo". <- TJ

Trond Johansen

Conclusions - 1

- The method's **positive impact** on Confirmit product qualities has convinced us that
  - Evo is a better suited development process than our former waterfall process, and
  - we will continue to use Evo in the future.
- What **surprised** us the most was
  - the method's **power of focusing on delivering value** for clients versus cost of implementation.
  - Evo enables you to **re-prioritize** the next development-steps based on the weekly feedback.
  - What seemed important
    - at the start of the project
    - may be replaced by other solutions
    - based on knowledge gained from previous steps.
- The method has
  - high focus on **measurable product qualities**, and
    - defining these clearly and testably, requires training and maturity.
  - It is important to ***believe* that everything can be measured**
    - and to seek guidance if it seems impossible.

Trond Johansen

Conclusions - 2

- A pre-requisite related to the method for using Evo is an ***open architecture*.**
- Another pre-requisite is ***management support*** for changing the work process, and this is important in any software process improvement initiative.

- The concept of **Continuous Integration (CI)/daily builds**
  - was valuable
  - with respect to delivering new versions of the software every week.

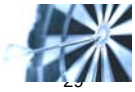
- Evo,
  - as most other software processes,
  - requires continuous focus
  - and learning about the methodology.

The way ahead - after Release 8.5

Trond Johansen

- Overall, the whole organization has embraced EVO.
- We all think it has great potential,
  - and we will work hard to utilize it to the full.
- In June 2004
  - we had Tom and Kai Gilb for a 4 days course for the whole R&D department and related resources

- The next version of Confirmit, Confirmit 9.0, will prove whether we have matured in our understanding and execution of EVO
- Confirmit 9.0 is due to be released Q4 2004, here is a sneak preview…



www.Gilb.com

29

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Confirmit 9.0 and product qualities part way

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

- Theme for 9.0:
  - Extend usage in large corporations,
    - hence focus on **usability**, **intuitiveness**, **easy to learn**
  - Market Research:
    - Support for large panels, up to 200 000 panellists.
    - Improve productivity in general for those who work with such large panels
  - Improve throughput
    - for users that receive reports with more than 1 000 000 responses
      - (important for large corporations; HP, Microsoft, Accenture etc)

Description of requirement/work task	Past	Status 11.09	Goal
Usability.Intuitiveness: Probability that a defined User can intuitively figure out how to do a defined Task correctly (without any errors needing correction)	30%	45%	80%
Panel.Scalability: Maximum number of panelists that the system can support within a timeframe of 120 seconds for creating a sample of 50 000, with all components of the panel system performing acceptably.	30,000	500,000	200,000
Performance.DataVolume: Numbers of survey responses that can be handled by Reportal. Tables should be generated within 5 seconds.	20,000	500,000	500,000

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

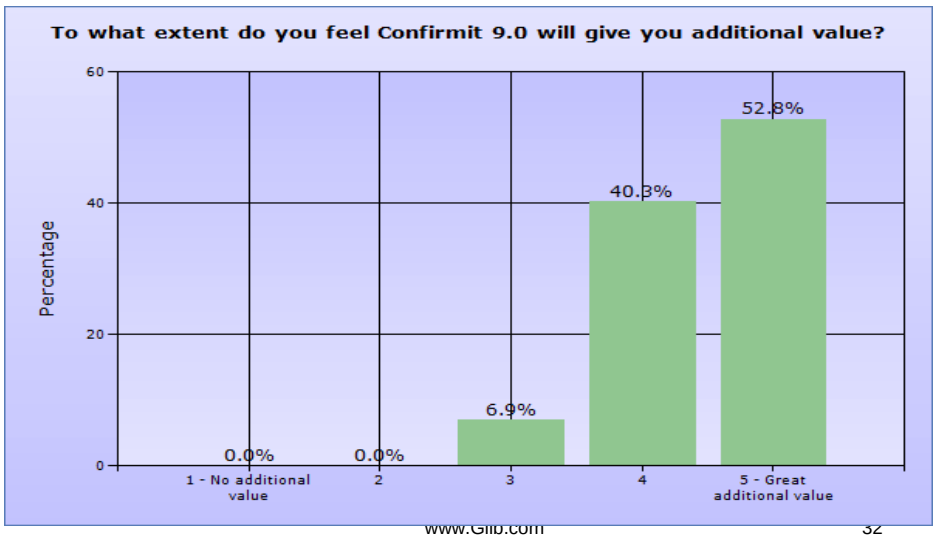
30

Initial Customer Feedback on the new Confirmit 9.0

November 24th, 2004

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Initial perceived value of the new release (Base 73 people)



Evo's impact on Confirmit 9.0 product qualities

Product quality	Description	Customer value
Intuitiveness	Probability that an inexperienced user can intuitively figure out how to set up a defined Simple Survey correctly.	Probability increased by 175%
Productivity	Time in minutes for a defined advanced user, with full knowledge of 9.0 functionality, to set up a defined advanced survey correctly.	Time reduced by 38%

Product quality	Description	Customer value
Productivity	Time (in minutes) to test a defined survey and identify 4 inserted script errors, starting from when the questionnaire is finished to the time testing is complete and is ready for production. (Defined Survey: Complex survey, 60 questions, comprehensive JScripting.)	Time reduced by 83% and error tracking increased by 25%

Evo's impact on Confirmit 9.0 product qualities

Product quality	Description	Customer value
Performance	Max number of panelists that the system can support without exceeding a defined time for the defined task, with all components of the panel system performing acceptable.	Number of panelists increased by 1500%
Scalability	Ability to accomplish a bulk-update of X panelists within a timeframe of Z second	Number of panelists increased by 700%
Performance	Number of responses a database can contain if the generation of a defined table should be run in 5 seconds.	Number of responses increased by 1400%

Initial qualitative feedback on the new release

" ... keep up the good work."

"It looks like you have listened to the people that actually use the software daily and aimed to make it easier for them ... "

“I was very impressed with the version 9.0”

- Seminar observations
  - On several occasions, customers gave spontaneous "WOWs" and applauses!
  - The training room in London was literally packed with people eager to test the new version.
  - Several clients asked if they could access the test server from home as well.
  - Great participation rate; 95% of all registered people showed up.

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

35

004-11-29: Press Release from FIRM

New version of Confirmit increases user productivity up to 80 percent NOVEMBER 29th, 2004

- : FIRM, the worldÌs leading provider of online survey & reporting software, today announced the release of a new version of Confirmit delivering substantial value to customers including increased user productivity of up to 83 percent.
- FIRM is using **Evolutionary (EVO) development to ensure the highest focus on customer value through early and continuous feedback from stakeholders.** A key component in EVO is **measuring** the **effect** new and improved product **qualities** have on customer **value**. Increased customer value in Confirmit 9.0 includes:·
  - Up to 175 percent more intuitive user interface.
  - Up to 80 percent increased user productivity in questionnaire design and testing.
  - Up to 1500 percent increased performance in Reportal and Panel Management*Features delivering increased customer value include:
  - A completely new and state-of-the-art user interface.
  - Random Data Generator enabling automated testing of questionnaires·
  - Real-time Script Checker for on-the-fly script validation·
  - Block Randomization of questions to avoid respondent bias·
  - Reportal BitStream for fast online tabulation on high volume of responses-
  - We are very pleased to see major improvements in Confirmit 9.0, including updates to both the user interface and survey engine. We plan to deploy this new version when it becomes available to server customers, stated Alex Grinberg, Greenfield Online's Chief Information Officer. -
    - We believe the improvements in Confirmit 9.0 will benefit Greenfield Online's survey programming, data collection and data delivery capabilities, helping us to bring even more value to our clients.
  - FIRMÌs VP of Marketing, Kjell Øksendal, comments; - FIRM, through evolutionary development, is able to substantially increase customer value by focusing on key product qualities important for clients and by continuously asking for their feedback throughout the development period.
  - Confirmit is used by the leading market research agencies worldwide and Global 1000 companies, and together, we have defined the future of online surveying and reporting, represented with the Confirmit 9.0. Confirmit 9.0 was released onto FIRM’s ASP environments in London and New York on November 27th. The new version will be available for server customers in January 2005. * *Measured in FIRMÌs Test Lab by monitoring internal and external stakeholders executing predefined test scenarios.***Press contact:**· Kjell Øksendal, FIRM's VP of Marketing +1 646 229 5655

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

36

Quantifying Quality

Enlargement real example of Quality Specification (Oct 2004, Norway)

see full detail next slide

•Design Effort [Roadbed.Drainage System, Product XX]: 'Approved by Team' 13:59 Tuesday (Day 1)
–*Ambition Level: 10X "at least 10 times less engineering effort than now"*

•Design Effort [Roadbed.Drainage System, Product XX]: 'Approved by Team' 13:59 Tuesday (Day 1)

–*Ambition Level: 10X "at least 10 times less engineering effort than now"*

–Administration:

•Approved: by Team' 13:59 Tuesday (Day 1) ok to progress to strategy phase.

•Type: Product Quality [Product XX].

•Version: 12 Oct 2004 10:12, 11:38

•Owner: Idar

–Stakeholders: Senior Road Designers, Road Designers, Drainage System Designers, Contractors.

–Scale: **Hours of Engineering Effort per 10 km road to Complete Roadbed Description for a defined Ideal Engineering Level: default 100%.**

•Assumption: the level of qualities is the same for comparative measurements. E g we do not save time, only to turn around and use it to increase quality. We still saved time for the old quality level. <-TG

o

GLOSSARY----------

Hours of Engineering Effort: net, actually applied to the task hours.

Complete: {all considerations taken, engineering quality controlled, contractor approved, to a defined % level of IEL}

oadbed Description: defined as: {cross-section drawings, mass calculation, Geometrical Description: {existing terrain, related water and sewer, other roads, tunnel}, geometrical control}.

Ideal> Engineering Level: IEL: defined as: doing all tasks to an ideal level of completion. This is often compromised intentionally to save engineering effort and time. <table to define % must be developed, or at least classify things>

eter: <how to measure this in practice>

esign: defined as: design and redesign

Quantifying Quality

A detailed real example of Quality Specification (Oct 2004, Norway)

•**Design Effort** [Roadbed.Drainage System, Product XX]: 'Approved by Team' 13:59 Tuesday (Day 1)
–*Ambition Level: 10X "at least 10 times less engineering effort than now"*
–Administration:
•Approved: by Team' 13:59 Tuesday (Day 1) ok to progress to strategy phase.
•Type: Product Quality [Product XX].
•Version: 12 Oct 2004 10:12, 11:38
•Owner: Idar
–Stakeholders: Senior Road Designers, Road Designers, Drainage System Designers, Contractors.
–Scale: Hours of Engineering Effort per 10 km road to Complete Roadbed Description for a defined Ideal Engineering Level: default 100%.
•Assumption: the level of qualities is the same for comparative measurements. E g we do not save time, only to turn around and use it to increase quality. We still saved time for the old quality level. <-TG
---- **Benchmarks-------** Analysis---------
•Past [VXX Our Infrastructure Design, Finland] ??? <-IK
•Bad: Past [IEL = 20%? "<wrong mass calculations & drawings, absence of stakeout data>", 2004, Project = <general guess IK>] **<30>** ±10 hours/10km <- SWAG IK
•o
•Good: Past [IEL = 90%? "<better mass calculations & drawings, some stakeout data>", 2004, Project = <general guess IK>, Excel & our product, Swedish Users] **<80>** ±20 hours/10km <- SWAG IK
•o
•Trend [Our Product XX] <customers are more demanding, 20% is no longer a good enough level>. <- Heidi
•o
•o Record [InXXX, 2004] <better than us in design, high Engineering Level, more consistent but not redesign> <-IK "our system is clearly worse here than the competitor – so we must improve"
---- **Constraints--------** Requirement-----
•Tolerate [End 2005, Road Designers, ….] Past – 25% of hours
• Rationale: least powerful sales argument for selling new version.
•Survival [Anytime,] <today's level or better>
–Rationale: we could lose customers to competitors.
---- **Targets** ---------- Requirement ----------
•G1. Goal [IEL = 90%?, 2005 Q4, Norwegian & English] **<8>** ±2 hours/10 km <- Heidi, Berit, Inge
•G2. Goal [IEL = 90%?, 2006 Q1, Swedish] **<8>** ±2 hours/10 km <- Heidi, Berit, Inge
---- **Evolutionary Goals----------**
•o
•Short Term 1: Goal [End November 2004, Stakeholder = {SVV, Road Designers}] Past -20%?
•Short Term 2: Goal [End 2004] Past -40%?
•o Goal [End January 2005] Past -50%?
•o Goal [End Feb 2005] Past -60%?
•o Goal [End Mar 2005] Past -70%?
•o Goal [End Dec 2005] Past – 90% =Long Term
•o
•o *Note: we lack clarity in Stakeholder to be served at each step. This decides some things to be included such as which reports and export formats are necessary. <-TG 13 oct 04 10:53*
•o ---------- Long Term Goals
•Long Term: Goal [End 2005] > Past/10
•Stretch[End 2006?] Past/20
•Wish <wish from stakeholder> >Past/100 ??
•o
– --- Background ----------
•o Impacts Stakeholder Values: Model

o

GLOSSARY----------

Hours of Engineering Effort: net, actually applied to the task hours.

Complete: {all considerations taken, engineering quality controlled, contractor approved, to a defined % level of IEL}

Roadbed Description: defined as: {cross-section drawings, mass calculation, Geometrical Description: {existing terrain, related water and sewer, other roads, tunnel}, geometrical control}.

<Ideal> Engineering Level: IEL: defined as: doing all tasks to an ideal level of completion. This is often compromised intentionally to save engineering effort and time. <table to define % must be developed, or at least classify things>

Meter: <how to measure this in practice>

Design: defined as: design and redesign

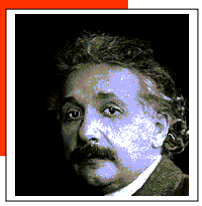
Quantifying Quality

Al Says

"Not everything that can be counted counts,

and not everything that counts can be counted."

Albert Einstein



I agree. But this does not include system qualities.

Tom

Quantifying Quality

Simon Ramo (tRw)

"No matter how complex the situation,

good systems engineering involves putting value measurements on the important parameters of desired goals and performance of pertinent data,

and of the specifications of the people and equipment and other components of the system.

It is *not easy* to do this

and so, very often, we are *inclined to assume that it is not possible* to do it to advantage.

But skilled systems engineers can

change evaluations and comparisons of alternative approaches

from purely speculative to highly meaningful.

If some *critical aspect* is not known,

the systems experts seek to make it known.

They go dig up the facts.

If doing so is very tough, such as setting down the public's degree of acceptance among various candidate solutions, then perhaps the *public can be polled*.

If that is not practical for the specific issue, then at least an attempt can be made to *judge the impact of being wrong in assuming the public preference*.

Everything that is clear is used with clarity:

what is not clear is used with clarity as to the estimates and assumptions made,

with the possible negative consequences of the assumptions weighed and integrated.

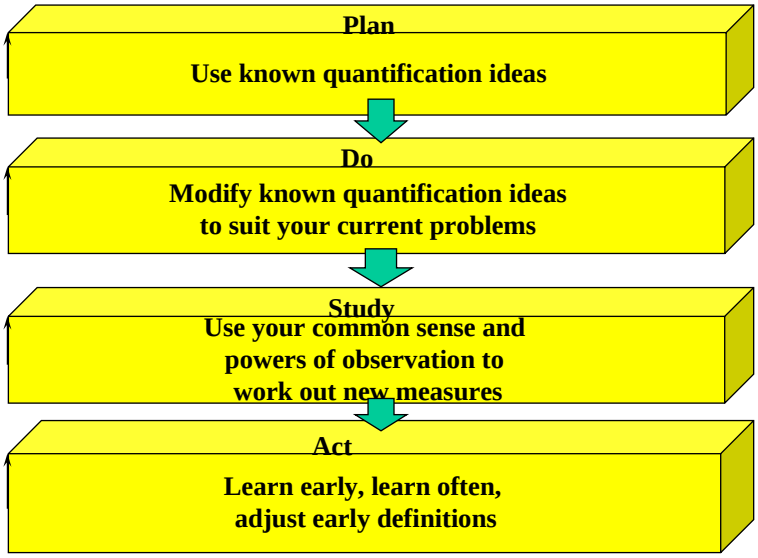
We do not have to work in the dark, now that we have professional systems analysis.

Ramo98 page 81

Simon Ramo and Robin K. St.Clair, The Systems Approach: Fresh Solutions to Complex Civil Problems Through Combining Science and Practical Common Sense, 1998, 150pp, © TRW, Inc., Manufactured in USA, KNI Incorporated, Anaheim CA. Free copy at TRW Stand at INCOSE conference 2002

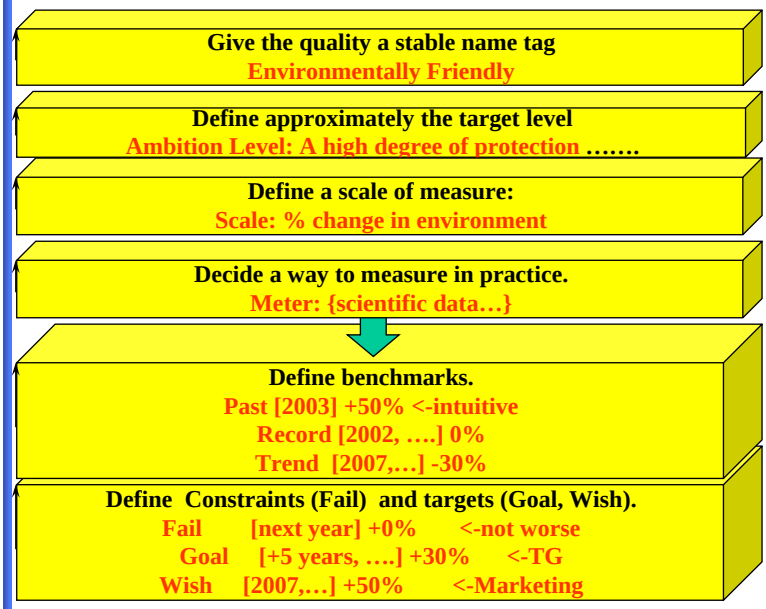
Quantifying Quality

How to Quantify Quality



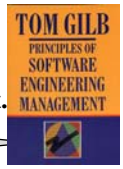
Quantifying Quality

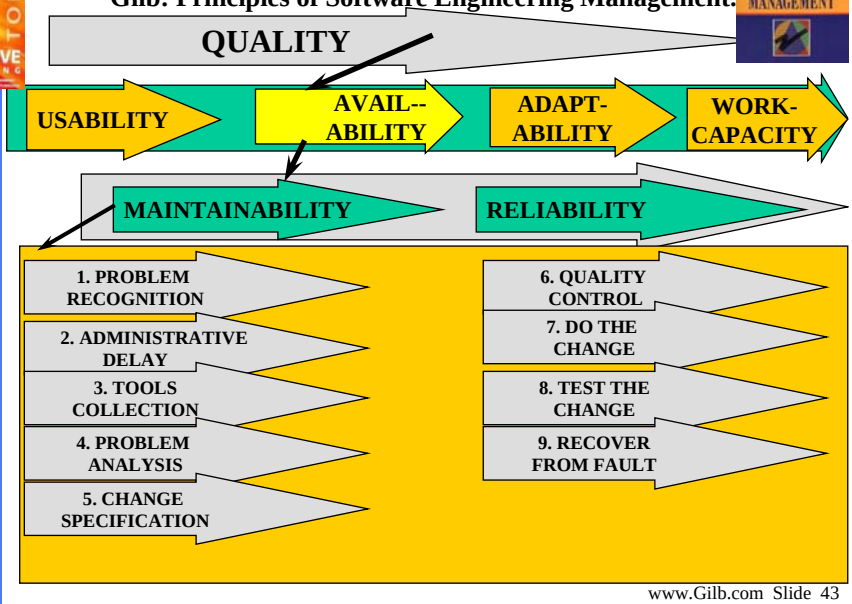
'Environmentally Friendly' Quantification Example



Quantifying Quality

Devices to help quantify quality ideas:
Standard Hierarchy of Concepts from
Gilb: Principles of Software Engineering Management.





Quantifying Quality

Using 'Parameters' when defining a Scale of Measure

Goal
[Users = NOVICES,
Components = USER MANUAL,
Tasks = ERROR CORRECTION]
60%

- ***Using [qualifiers] in the SCALE definition***
  - ***gives flexibility of detailed specification later.***
- Example
  - SCALE: the % of
    - **defined [Users]**
    - using **defined [system Components]**
    - who can successfully accomplish **defined [Tasks]**

[Scale Parameters]

Quantifying Quality

Quality Quantification Process

(full detail 'Competitive Engineering', Scales chapter, & slide here later 'QQ')

Entry

E1. Do not enter if you can reuse existing standards.
E2.Do not enter if your source documents are poor.

Procedure

P1. Use applicable rules (GR, QR, QQ).
P2. Build list of quality ideas needing control.
P3. Detail qualities by exploding hierarchically.
- use evolutionary or pilot *feedback*.
P4. Revise your draft based on *design work*.
P5. Quality Control the specification.
P6. Get experience and then revise specifications.

Exit

X1. Don't exit if *calculated remaining defects* are more than one per page.
X2. Unless you intentionally do so to learn more from experience.

Quantifying Quality

A 'Quality Quantification' Principle

He had a lot of hats.
He wants to be best in hatmanship.

Scale: hats on his head.
Past:3
Goal: 13

0. *THE PRINCIPLE OF*
'BAD NUMBERS BEAT GOOD WORDS'
Poor quantification is more useful than none; at least it can be *improved systematically*.

General Hatmanship:
GIST: improve ability to have hats on head and nearby

Hatmanship On Head:
SCALE: hats on top of persons head
PAST [Me, This year] 10 <- Guess
RECORD [2003, UK] 15 <- GB Record
WISH [Guinness Record, April] 20 <- Tom

Hatmanship Nearby:
SCALE: hats not on head, but on, or near, body;within 10 meter radius.
Past…. Goal……..etc.

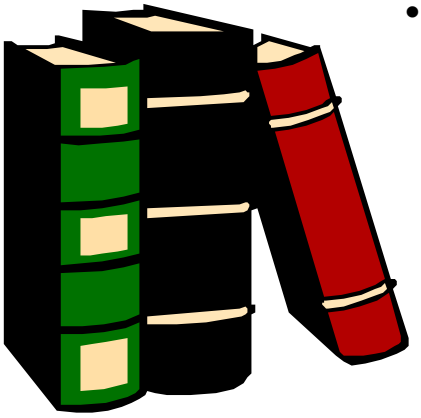
Quantifying Quality

Quantify for realistic judgements

- *"To leave [soft considerations] out of the analysis*
  - *–simply because they are **not readily quantifiable***
  - *–or to avoid introducing "personal judgments,"*
  - *– clearly biases decisions against investments*
    - *that are likely to have a significant impact on considerations*
      - *– as the quality of one's product, delivery speed and reliability, and the rapidity with which new products can be introduced"*
- *← R. H. Hayes et al "Dynamic Manufacturing", p. 77 in MINTZBERG94: page124*

Quantifying Quality

Principles for Quality Quantification.



- Some hopefully deep and useful guidelines
- to help you quantify quality ideas

Quantifying Quality

0. THE PRINCIPLE OF 'BAD NUMBERS BEAT GOOD WORDS' (re-visited!)

- *Poor* quantification is more useful than none;
- at least it can be improved systematically.

State of the Art Flexibility

Enhanced Usability

Improved Performance

Quantifying Quality

1. THE PRINCIPLE OF 'QUALITY QUANTIFICATION'

- All qualities can be expressed quantitatively,
- *'qualitative'* does *not* mean unmeasurable.

"If you think you know something about a subject, try to put a number on it. If you can, then maybe you know something about the subject. If you cannot then perhaps you should admit to yourself that your knowledge is of a meager and unsatisfactory kind.

Lord Kelvin, 1893

Quantifying Quality

THE PRINCIPLE OF 'QUALITY QUANTIFICATION'

•All qualities can be expressed quantitatively,
• *'qualitative'* does *not* mean unmeasurable.

"In physical science the first essential step in the direction of learning any subject is to find principles of numerical reckoning and practicable methods for measuring some quality connected with it.

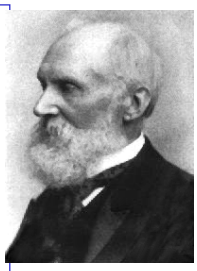
I often say that when you can measure what you are speaking about, and express it in numbers, you know something about it;

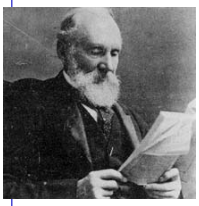
but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind;

it may be the beginning of knowledge, but you have scarcely in your thoughts advanced to the state of Science, whatever the matter may be."

Lord Kelvin, 1893

from
http://zapatopi.net/kelvin/quotes.html





Quantifying Quality

2. THE PRINCIPLE OF 'MANY SPLENDORED THINGS'

- Most quality ideas

–are usefully broken into *several* measures of goodness.

Usability:

Entry Qualification: Scale IQ, …….

Learning Effort: Scale: Hours to learn, …..

Productivity: Scale: Tasks per hour,…….

Error Rate: Faults per 100 tasks, …..

Like-ability: % Users who like the system, …

Quantifying Quality

Quantifying Usability (Real C&C System)

QUALITY

USABILITY | **AVAILABILITY** | **ADAPTABILITY** | **WORK-CAPACITY**

INTUITIVENESS | **INTELLIGIBILITY**

AND MORE!

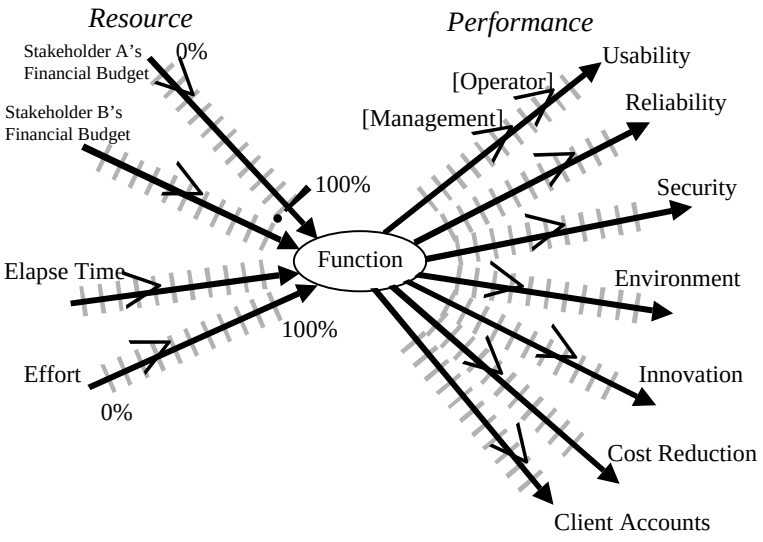
Intuitiveness
GIST: Great intuitive capability
SCALE: Probability that intuitive guess right.
METER: <100 observations.>
PAST **[GRAPES]** 80% <-LN
RECORD **[MAC]** 9%?<-TG
Fail **[TRAINED**, **RARE]** 50-90%
Goal **[TASKS]** 99% <-LN

Intelligibility
GIST: Super ease of immediate understand
SCALE:% OK interpretations**.**
METER: 10 ops., 100 infos, 15 mins.
P:PAST[20 ops., 300 info, 30 min.]99%
RECORD **[P]** 99.0%
Fail **[DELIVERY[1]]**99.0%<-MAB
[ACCEPTANCE] 99.5%
Goal **[M1]** 99.9% <-LN

TRAINED: DEFINED:C&Ctl. operator, approved course, 200 hours duration.
RARE: DEFINED: types of tasks performed less than once a week per op.
TASKS: DEFINED: onboard operator distinct tasks carried out.
ACCEPTANCE: DEFINED: formal acceptance testing via customer contract.
DELIVERY: DEFINED: Evolutionary delivery cycle, integrated and useful.

Quantifying Quality

Multiple Required Performance and Cost Attributes
are the basis for architecture selection and evaluation



Quantifying Quality

3. THE PRINCIPLE OF 'SCALAR DEFINITION'

- A *Scale of measure* is a powerful practical *definition* of a quality

Flexibility:

Scale: Speed of Conversion to New Computer Platform

Quantifying Quality

(Quality) Requirements Specification Template with <hints>

HOW WE SPECIFY SCALAR ATTRIBUTE PRIORITY

<name tag of the objective>
Ambition: **<give overall real ambition level in 5-20 words>**
Version: **<dd-mm-yy each requirements spec has a version, at least a date>**
Owner: **<the person or instance allowed to make official changes to this requirement>**
Type: **<quality|objective|constraint>**
Stakeholder: **{ , , } "who can influence your profit, success or failure?"**
Scale: **<a defined units of measure, with [parameters] if you like>**
Meter **[<for what test level?>]**
====Benchmarks ========== the Past
Past **[ ] <estimate of past> <--<source>**
Record **[<where>, <when >, <estimate of record level>] <-- <source of record data>**
Trend **[<future date>, <where?>] <prediction of level> <-- <source of prediction>**
===== Targets ========== the future needs
Wish **[ ] <-- <source of wish>**
Goal **[…] <target level> <-- Source**
Value **[Goal] <refer to what this impacts or how much it creates of value>**
Stretch **[ ] <motivating ambition level> <-- <source of level>**
========== Constraints ==========
Fail **[ ] <-- <source> 'Failure Point'**
Survival **[ ] <- <source of limit> 'Survival Point'**

Quantifying Quality

4. THE PRINCIPLE OF 'THREATS ARE MEASURABLE'

- **If *lack of quality* can destroy your project**
- **then you <u>can</u> measure it *sometime*;**
- **the only discussion will be 'how early?'.**

Quantifying Quality

5. THE PRINCIPLE OF 'LIMITS TO DETAIL'

- **There is a *practical* limit to the number of facets of quality you can define and control,**
- **which is far less than the number of facets that you can *imagine* might be relevant.**

Quantifying Quality

6. THE PRINCIPLE OF 'METERS MATTER'

Practical measuring instruments
improve
the *practical understanding*
and *application*
of ‘Scales of measure’.

Portability:

Scale: Cost to convert/Module

Meter [Data] measure/1,000 words converted

Meter [Logic] measure/1,000 Function Points Converted

Quantifying Quality

7. THE PRINCIPLE OF 'HORSES FOR COURSES'

Different quality-Scale *measuring processes*
will be necessary
for different *points in time*,
different *events* and different *places*.

Availability:
Scale: % Uptime for System
Meter [USA, 2001] Test X
Meter [UK, 2002] Test Y

Quantifying Quality

8. THE PRINCIPLE OF 'BENCHMARKS'

Past history and future trends *help* define words like "improve" and "reduce".

Reliability

Scale: Mean Time To Failure

Past [US DoD, 2002] 30,000 Hours

Trend [Nato Allies, 2003] 50,000 Hours

Goal [UK MOD, 2005] 60,000 Hours

Quantifying Quality

9. THE PRINCIPLE OF 'NUMERIC FUTURE'

Numeric future requirement levels *complete* the quality definition of relative terms like 'improved'.

Usability:

Scale: Time to learn average task.

Past [Old product, 2003] 20 minutes

Wish [New product, 2007] 1 minute

Stretch [End 2008, Students] 2 minutes

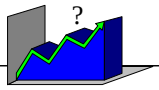
Goal [End 2005, Teachers] 5 minutes

Some Planguage 'Quality Quantification' Concepts

Quantifying Quality

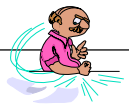
PAST: any useful reference point. Your old product, a competitors organization, a quality achieved in same discipline but different branch of business.

RECORD: best in some class, state of the art. Something to beat. A challenge for you. An extreme PAST.



TREND: a future ? guess based on the PAST.

Survival : a level needed for survival of the entire system.

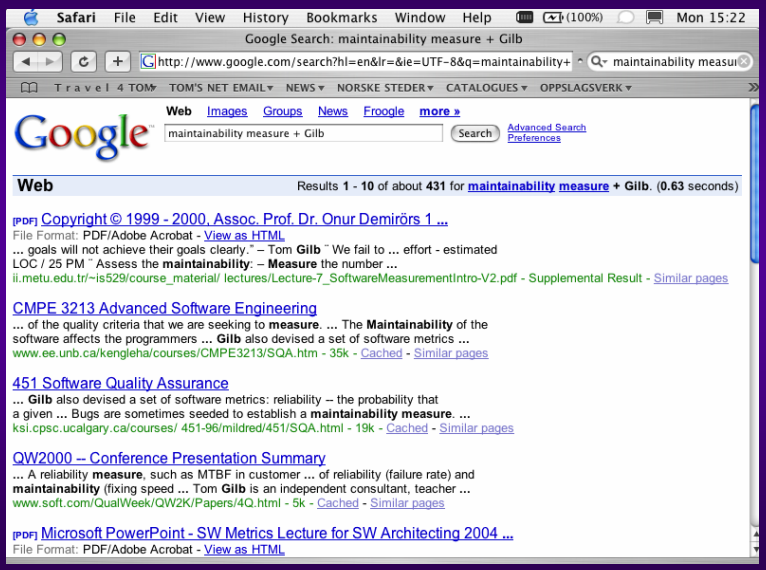


Goal: the level needed for satisfaction, happiness, joy and 100% full payment!

Wish: a level desired by someone, but which might not be feasible. Project is not committed to it.

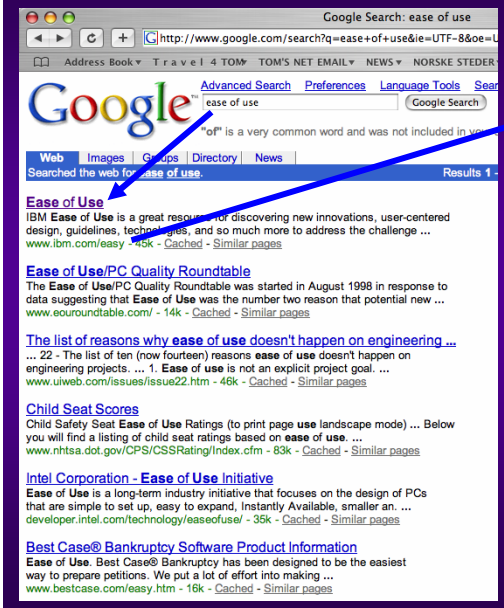
Google search: Maintainability + Gilb
Search for known scales of measure

64



65

You can quantify any qualitative objective



Google search,

example

Ease of Use gave (1st listing)
http://www-306.ibm.com/ibm/easy/eou_ext.nsf/Publish/2023
Measure: Satisfaction - Performance
Description:

A subjective measure of users' satisfaction with the speed with which the offering responds to their requests.

Performance encompasses every aspect of the way the offering responds to interactions.

This includes any start up time, general operation, critical situations and assistance.

Purpose: Establish the degree of user acceptance of the performance of the offering.

Technique: Mean user ratings expressed as a percent
Units: %

66

Seach Usability IBM

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

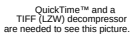
Detailed Usability measures IBM

67

Tools

IBM error Rate Usability Metric

68



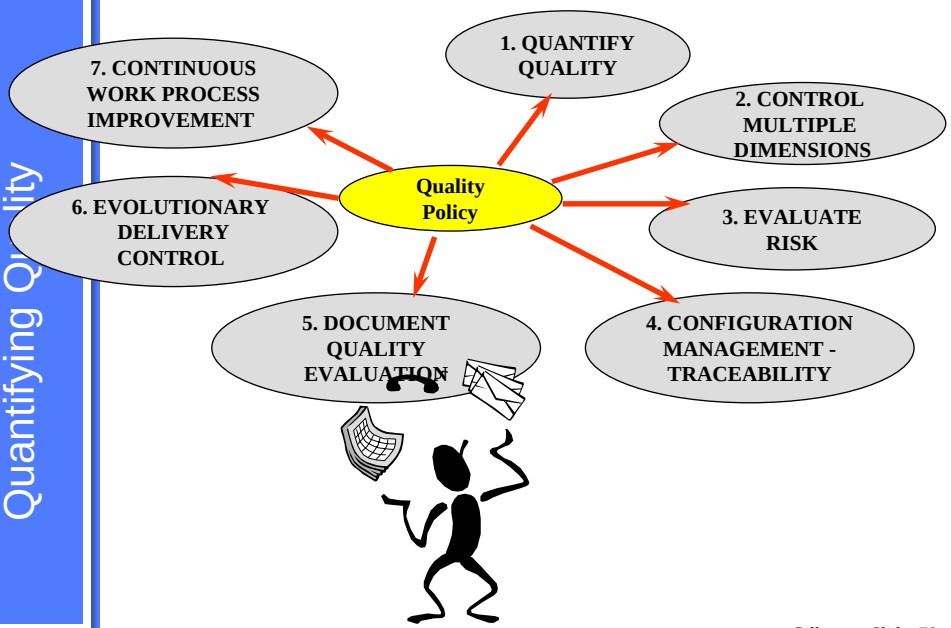
IBM User Satisfaction Metric detail

69

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

Quantifying Quality

A Corporate Quality Policy (Euro Multinational)



www.Gilb.com Slide 70

Quantifying Quality

Policy on QUANTIFICATION, CLARIFICATION AND TESTABILITY OF CRITICAL OBJECTIVES:

"All critical factors or objectives (quality, benefit, resource) for any activity (planning, engineering, management) shall be expressed clearly, measurably, testably and unambiguously at all stages of consideration, presentation, evaluation, construction and validation. "

<- (Quality Manual Source is) 5.2.2, 4.1.2, 4.1.5, 5.1.1, 6.1, 6.4.1, 7.1.1, 7.3 and many others.

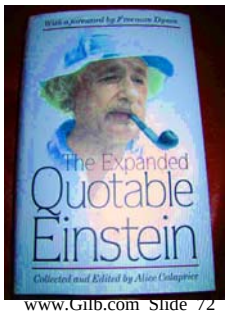
Quantifying Quality

Einstein on Stretching

- "One should not pursue goals that are easily achieved.
- One must develop an instinct for what one can just barely achieve through one's greatest efforts." (1915)

"We have to do the best we can.

This is our sacred human responsibility" (1940)



Source detail in notes section of this slide. (Calaprice, 2000)

73

A 7. ADAPTABILITY

A7.1 **Demonstrability**
- Customer self-demonstrability 7.1.1
- Our professional demonstrability 7.1.2

A7.2 **Installability**
- Customer 7.2.1
- Professional on-site 7.2.2
- Professional ex-works 7.2.3

A7.3 **Interchangeability**
- Replaceability 7.3.1
- Movability 7.3.2
- Interface 7.3.3

A7.4 **Upgradability**
- Node addability 7.4.1
- Connection addability 7.4.2
- Application addability 7.4.3
- Subscriber addability 7.4.4

A7.5 **Portability**
- Data portability 7.5.1
- Logic portability 7.5.2
- Command portability 7.5.3
- Media portability 7.5.4

A7.6 **Connectability**

(was detailed elsewhere)

As Stewart Kauffman,
a molecular biologist, wrote,
"Nature has been learning to adapt for four billion years; maybe we need to pay attention".

ADDONS | Monday | Tuesday | Wednesday | Thursday | Friday | Tools

74

Example of actual definition: A 7.1.1

Customer Self-demonstrability

Scale: ability of customer to solo self-demo any NPL product.

Meter: probability of successful completion of self-demo within one hour after arrival.

Fail: 95% to 97% <- Corporate Quality Policy

Goal: approaching 99%

Past [last year, us] less than 5% of the product line allows this now.

Note: this was used by my real client as an adaptability requirement, but you might have noticed that I intentionally built it into the Usability model example above. This is a matter of taste. The result is the same. TG

ADDONS | Monday | Tuesday | Wednesday | Thursday | Friday | Tools

Quantifying Quality

LAST SLIDE

SEE
WWW.Gilb.COM
FOR MORE DETAIL

Quantifying Quality

Supporting Standards for Quality Quantification

These following slides contain supporting Standards in detail which I do not expect to have time to show in my lecture

Quantifying Quality

A Process for Quality Quantification. (PROCESS.QQ)

Quantifying Quality

ENTRY: (ENTRY.QQ)

- 1. Do not enter if company files or standards <u>already</u> have adequate quantification devices.
  - Use existing quantification SCALES and METERS preferably.
- 2. Enter only if your process input documents
  - (contracts, marketing plans, product plans, requirements specification for example)
  - are Quality Controlled,
  - and have *exited* at a known and acceptable standard of defect-freeness
    - *(default standard; less than 1Major defect/page estimated remaining).*

Quantifying Quality

Procedure for the Quality Quantification Task (PROCEDURE.QQ)

NOTE: these following steps cannot be simply sequentially. They need to be repeated many times to evolve realistic quality quantifications.

1. Use applicable rules {RULES.GR, RULES.QR, RULES.QQ}

2. *Build a list* of all quality concerns from your process input documents. Include *implicit* quality requirements *derived from* design requirements. Include any recent practical experience such as from evolutionary steps (of this project, pilot experiences or prototypes.

3. *Detail* the specification to a useful level. Include any recent practical experience such as from evolutionary result delivery steps of this project.

4. Revise these specifications when some design engineering/planning work is done on their basis. Only through design work can you know about the available technology and its costs.

5. Perform Quality Control (Inspection method) calculating remaining Major defects per page for the exit control. Apply valid rules {RULES.GR, RULES.QR, RULES.QQ}

6. Get experience using these specifications and revise specifications to be more realistic.

7. Repeat this process until you are satisfied with the result.

8. Cumulate your improved idea experiences and make available to others.

Quantifying Quality

EXIT: (EXIT.QQ)

1. Calculated remaining Major defects/page less than 1.

2. or exit condition "1." above is <u>waived</u>

with the intent of getting experience or opinions

so as to <u>refine</u> it

for official exit and more-serious use.

Quantifying Quality

Specific Rules for Quality Quantification (QQ)

- 4.3. Rules: Quality Quantification. (RULES.QQ)

- The following rules would be
  - appropriate for a culture which was intent on raising quality specifications to a high level
  - and to systematically learn as a group,
  - in the long term,
  - from the experiences of themselves and others.
- The rules are guidance to the any writer or maintainer of quality specifications.
- Violations of these rules would be classed as *'defects'* in a quality control process on the document.

Quantifying Quality

Rules for Quality Quantification:(RULES.QQ) 1of2

0:RULES: Rules for technical specification (RULES.GR) apply. This may be used in *addition* to the Quality Requirement Specification Rules (RULES.QR) or whenever serious emphasis on quality definition is required.

1:STANDARD: The Scale shall wherever possible be derived from a standard SCALE (in named files or referenced sources) and the standard *shall* be source referenced (←) in the specification.

2:SCALENOTE: If the Scale is not standard, a notification to Scale owner will inform about this case. "Note sent to <owner>" will be included as comment to confirm this act.

3:RICH: Where appropriate, a quality concept will be specified with the aid of *multiple* Scale definitions, each with their own unique tag, and appropriate set of defining parameters.

4: Meter : a practical and economic Meter or set of Meter s will be specified for each Scale. Preference will be given to previously defined Meter s in our Quantification archives.

5: Meter. NOTE: When 'essentially new' (no reference to previous case in generic archives) Meter specifications are made a Notification to Meter owner will notify about this case. "Note sent to <owner>" will be included as comment.

Continued next slide

Quantifying Quality

Rules for Quality Quantification:(RULES.QQ) 2of2

6:BENCHMARK: Reasonable attempt to establish 'baselines' (Past, Record, Trend) will be made for our system's past, and for relevant competition.

7:TERMS: Future-priority requirements (Fail, Goal) will be made with regard to both *long* and *short* term.

8:DIFFERENTIATE: A distinction will be made, using qualifiers, between those system components which must have significantly higher quality levels than others, and components which do not require such levels. "The best can cost too much".

9:SOURCE: Emphasis will be placed on giving the exact and detailed source (even if a personal guess) of all numeric specifications, and of any other specification which is derived from a process input document (like a Meter which is contractually defined).

10:UNCERTAINTY) Whenever numbers are uncertain, we will have rich annotation about the degree (plus/minus) and reason (a comment like "because contract & supplier not determined yet"). The reader shall *not* be left to guess or remember what is known, or could be known, with reasonable inquiry by the author.

Quantifying Quality

Generic Rules for Technical Specification (including Quality Quantification) GR

Quantifying Quality

0.3. Rules/Forms/Standards: Generic Rules and Requirements Rules sample.

- Here are some formal **rules** which could serve as a **standard** for how to communicate such ideas.
- We call this standard '**Generic**' because it applies to many types of **specification**.
- 'Rules' are a 'best practice' procedure for writing a document. Violation of rules constitutes a formal '**defect**' in that document.
- Rules are the local law of practice, and violation of them is an 'illegal' act.

Quantifying Quality

GENERIC RULES FOR TECHNICAL AND MANAGEMENT DOCUMENTATION
Tag: RULES.**GR**

- **1:CLEAR Statements should be clear and unambiguous to their intended reader.**
  2:SIMPLE: Statements should be written in their most elementary form.
  3:TAG. Statements shall have a unique identification tag.
  4:SOURCE: Statements shall contain information about their detailed source, AUTHORITY and REASON/Rationale.
  5:GIST: Complex statements should be summarized by a GIST statement.
  6:QUALIFY: When any statement depends on a specific time, place or event being in force then this shall be specified by means of the [qualifier square brackets].
  7:FUZZY: When any element of a statement is unclear then it shall be marked, for later clarification, by the <fuzzy angle brackets>.
  8: COMMENT: any text which is secondary to a specification, and where no defect could result in a costly problem later, shall be written in *italic text statements, or/and headed by suitable warning (NOTE, RATIONALE, COMMENT) or moved to footnotes*. Non-commentary specification shall be in plain text *Italic* can be used for emphasis of single terms in non-commentary statements. Readers shall be able to *visually* distinguish critical from not critical specification.
  9: UNIQUE: requirements and design specifications shall be made one single time only. Then they shall be re-used by cross reference to their identity tag. Duplication is strongly discouraged.

Quantifying Quality

In addition to the general rules,
we can specify some special rules
for the specific types of statement
we are dealing with.

For example SR (below), QQ (above), QR (above).

Quantifying Quality

REQUIREMENTS SPECIFICATION RULES. SPECIFIC RULES.**SR**

- **0:GR-BASE: The generic rules (RULES.GR) are assumed to be at the base of these rules.**
  1:TESTABLE: The requirement must be specified so that it is possible to define an unambiguous test to prove that it is later implemented.
  2:METER: Any test of SCALE level, or proposed tests, may be specified after the parameter METER.
  3:SCALE: Any requirement which is capable of numeric specification shall define a numeric scale fully and unambiguously, or reference such a definition.
  4:MEET:The numeric level needed to *meet requirements fully* shall be specified in terms of one or more [qualifier defined] target level {PLAN, MUST, WISH} goals; mainly the PLAN level here.
  5:FAIL: The minimum numeric levels to *avoid system, political, or economic failure* shall be specified in terms of one or more [qualifier defined] 'MUST' level goals.
  6. QUALIFY. Rich use of [qualifiers] shall specify [when, where, special conditions].

Quantifying Quality

Tom's New Book, Summer 2005

- Tom Gilb,
  - Competitive Engineering:A Handbook For Systems Engineering, Requirements Engineering, and Software Engineering Using Planguage
  - ISBN 0750665076 Publisher:
  - Elsevier Butterworth-Heinemann
  - Ask me for a free electronic copy !
  - Ordering details at www.gilb.com
  - Norsk Bokhandler: Ravenholm hanne@ravenholm.no, 48 05 55 00