



**5° Workshop
AutomotiveSPIN Italia
Milano, 4 Giugno 2009**

Top Metrics for SPICE-compliant projects

Luigi Buglione
Engineering.it
luigi.buglione@eng.it



Goals:

- ✓ **G1.** To analyze the AutomotiveSPICE process scopes for measurement purposes
- ✓ **G2.** To discuss the measures that can be adopted in an Automotive project
- ✓ **G3.** To propose a possible 'top metrics' scope and boundary for SPICE-compliant projects





◆ Introduction

- ✓ Why measure?
- ✓ ISO/IEC 15504: current status
- ✓ AutomotiveSPICE – History & possible process scopes for appraisals

◆ The Measurement issue

- ✓ Some basic questions
- ✓ What to measure: STAR Taxonomy
- ✓ GQM: Goal-Question-Metric
- ✓ Requirements, Constraints and Solutions

◆ Possible solution

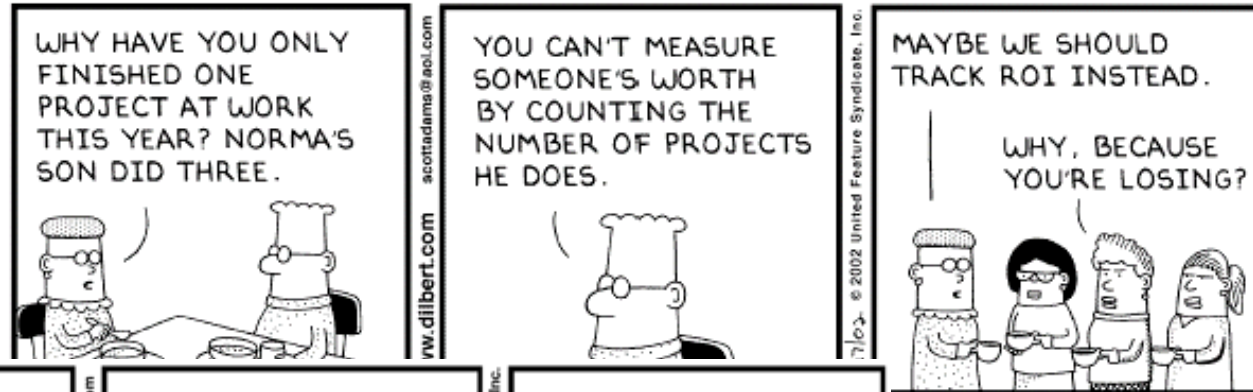
- ✓ Balancing Criteria and Numbers of Measures
- ✓ BMP(Balancing Multiple Perspectives)
 - ❖ measurement procedure
 - ❖ An application in the Automotive context

◆ Conclusions & Prospects



Introduction

Why measure?



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Source: Scott Adams's Dilbert website: www.dilbert.com



Introduction

Why measure?

You Tube Broadcast Yourself™
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Home page Video Canali Community

Mercedes A Class



0:03 / 0:03

★★★★☆ 78 voti

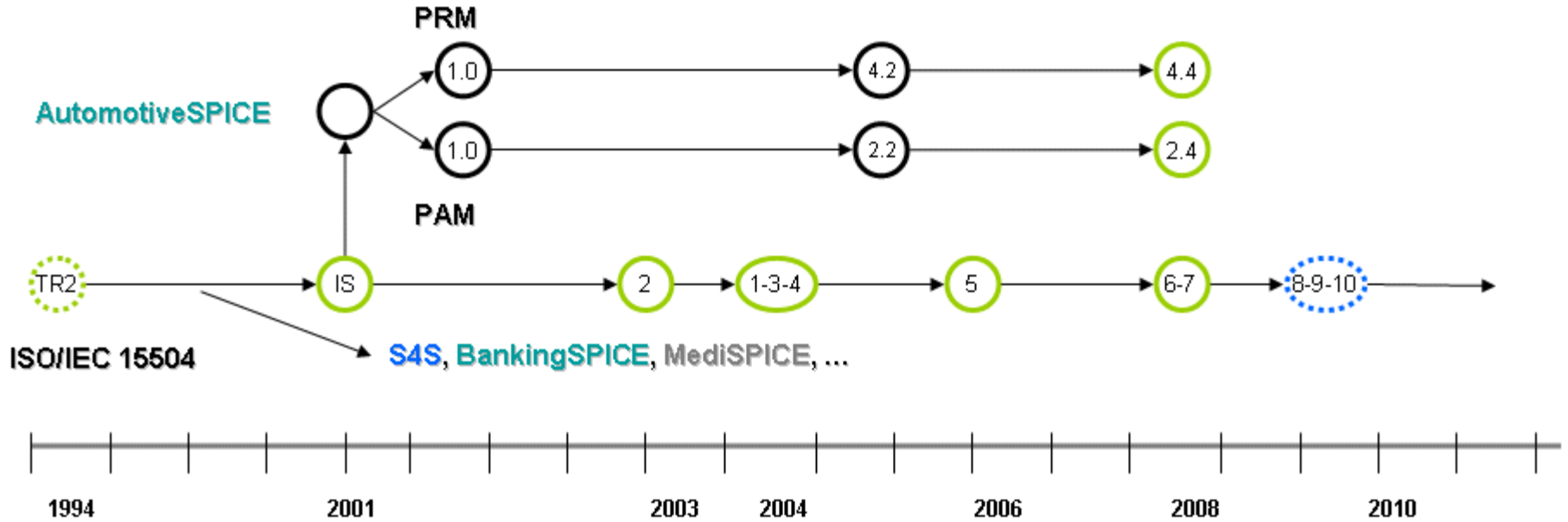
Visualizzazioni:

• URL: YouTube website: <http://www.youtube.com/watch?gl=IT&v=Um-XIKerWvA>



ISO/IEC 15504 **WG10**: Information Technology – Process Assessment

Part #	Title	Type	Year	ICS
15504-1	Concepts and Vocabulary	IS	2004	90.60
15504-2	Performing an Assessment	IS	2003	90.60
15504-3	Guidance on Performing an Assessment	IS	2004	90.60
15504-4	Guidance on Use for Process Improvement and Process Capability Determination	IS	2004	60.60
15504-5	An Exemplar Process Assessment Model	IS	2006	60.60
15504-6	An Exemplar System Life Cycle Process Assessment Model	TR2	2008	60.60
15504-7	Assessment of Organizational Maturity	TR2	2008	60.60
15504-8	An Exemplar Assessment Model for Service Management Process	TR2	---	10.99
15504-9	Target Process Profiles	TR2	---	30.20
15504-10	Safety Extensions	TR2	---	NWIP



The Procurement Forum **SPICE**

Title: Automotive SPICE Process Assessment Model

Author(s): Automotive SIG

Date: 2008-08-01

Status: RELEASED

Confidentiality: Automotive SIG

File Ref: \t\p\automotivesig\pam\2.4

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Management Process Group (MAN) MAN.1 Organizational alignment MAN.2 Organization management A MAN.3 Project management MAN.4 Quality management A MAN.5 Risk management A MAN.6 Measurement	Engineering Process Group (ENG) A ENG.1 Requirements elicitation A ENG.2 System requirements analysis A ENG.3 System architectural design A ENG.4 Software requirements analysis A ENG.5 Software design A ENG.6 Software construction A ENG.7 Software integration A ENG.8 Software testing A ENG.9 System integration A ENG.10 System testing ENG.11 Software installation ENG.12 Software and system maintenance	Supporting Process Group (SUP) A SUP.1 Quality assurance A SUP.2 Verification SUP.3 Validation A SUP.4 Joint review SUP.5 Audit SUP.6 Product evaluation A SUP.7 Documentation A SUP.8 Configuration management A SUP.9 Problem resolution management A SUP.10 Change request management
The Acquisition Process Group (ACQ) ACQ.1 Acquisition preparation ACQ.2 Supplier selection A ACQ.3 Contract agreement A ACQ.4 Supplier monitoring ACQ.5 Customer acceptance A ACQ.11 Technical requirements A ACQ.12 Legal and administrative requirements A ACQ.13 Project requirements A ACQ.14 Request for proposals A ACQ.15 Supplier qualification	Resource & Infrastructure Process Group (RIN) RIN.1 Human resource management RIN.2 Training RIN.3 Knowledge management RIN.4 Infrastructure	Operation Process Group (OPE) OPE.1 Operational use OPE.2 Customer support
Supply Process Group (SPL) A SPL.1 Supplier tendering A SPL.2 Product release SPL.3 Product acceptance support	Process Improvement Process Group PIM.1 Process establishment PIM.2 Process assessment A PIM.3 Process improvement	Reuse Process Group (REU) REU.1 Asset management A REU.2 Reuse program management REU.3 Domain engineering

A Automotive-SPICE

not included in ISO/EC 15504

HIS (VW, Audi, BMW, Porsche, D&C)

FIAT

FORD



Q: why MAN.6 (Measurement) is not included in any profile?

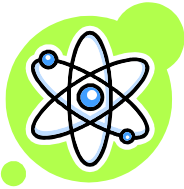
Q: could it be reasonable to consider MAN.6 covered by MAN.3 (Project Management)?



Q: which kind of measures are selected for monitoring the project and from which entities?

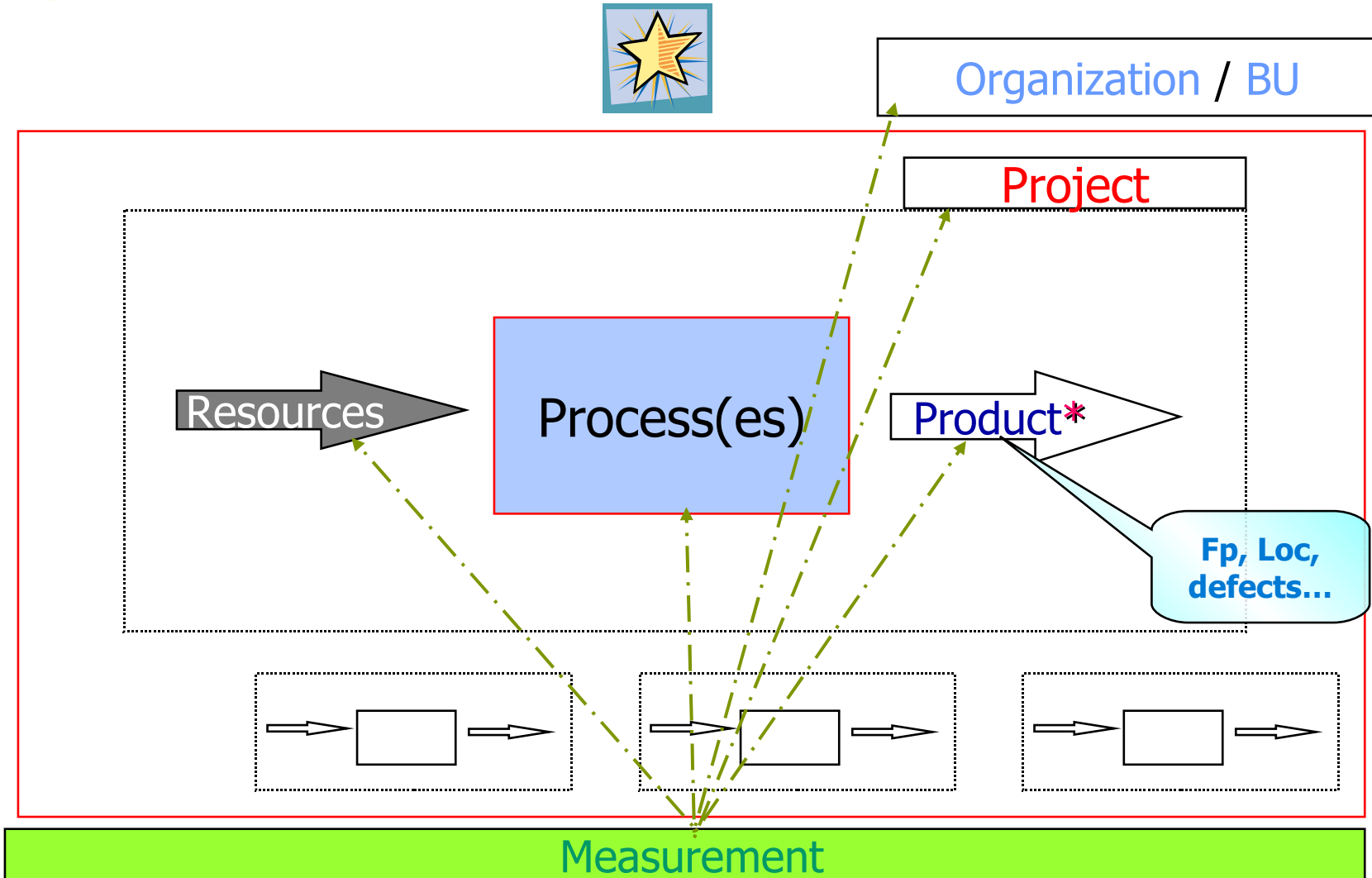
Q: are those measures chosen just for testing the *product* or for managing the *project* producing the product?





Introduction

STAR Taxonomy



Source: Buglione L. & Abran A., ICEBERG: a different look at Software Project Management, IWSM2002, 12th International Workshop on Software Measurement, Magdeburg, October 7-9, 2002, Germany



GQM: Goal-Question-Metric

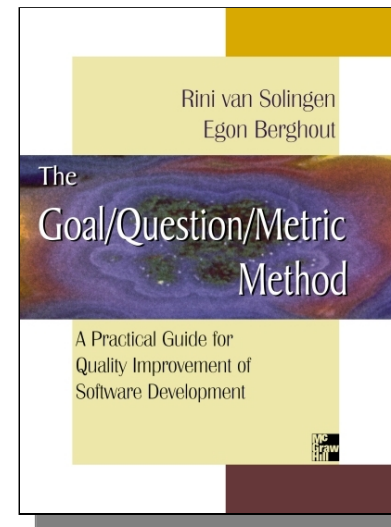
A common-sense paradigm for choosing measures

Three main steps driven by the need of satisfy informative goals:

- establish the general **goals** for the project/product
- generate **questions** whose answers can determine if such goals have been achieved (or not)
- generate a series of **metrics** that can help in (quantitatively) determining if goals have been achieved (or not)

Examples of goals by stakeholders:

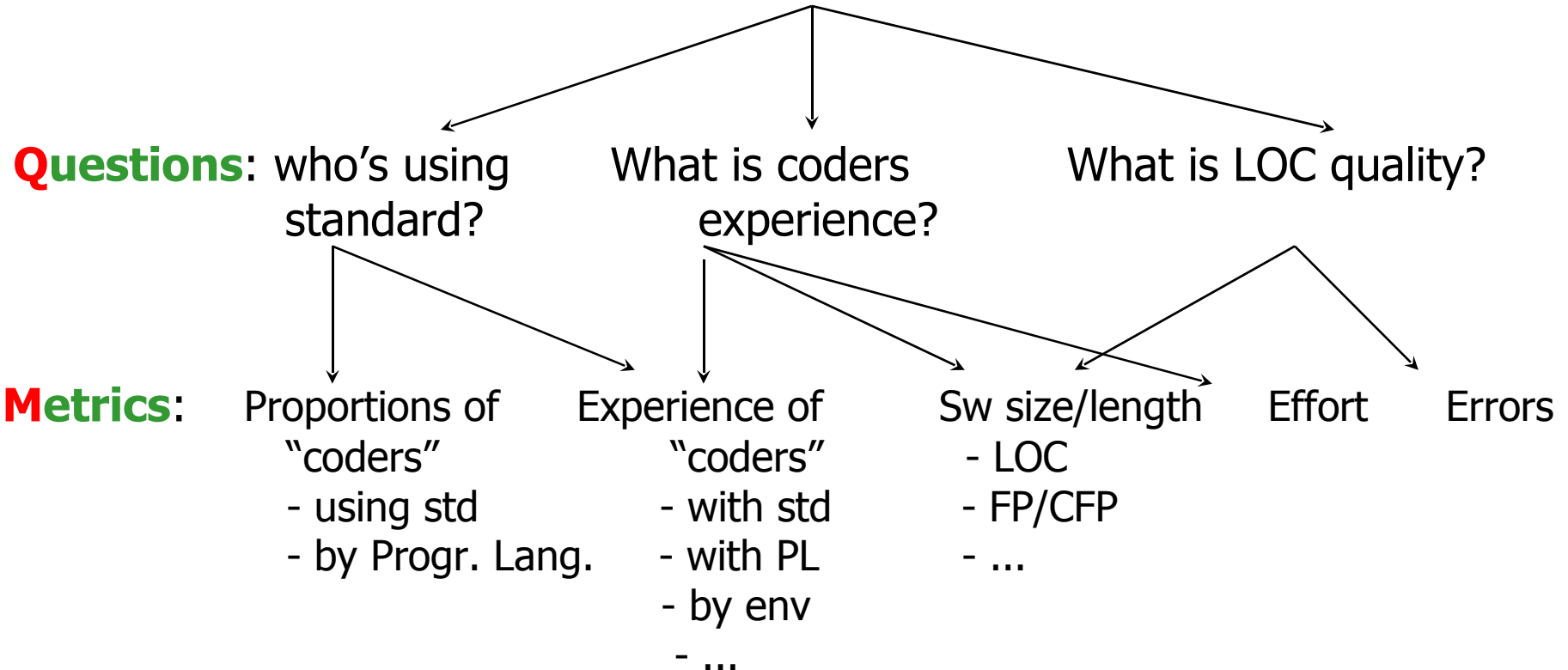
- ❖ **High-level management**
 - Improve product quality
 - Improve staff productivity
- ❖ **Software manager**
 - estimate effort and costs
 - evaluate new tools and methods
 - Increase reuse
- ❖ **Software engineers**
 - identify defective modules
 - Improve reliability & maintainability
- ❖ **Users**
 - improve usability
 - Increase amount of training hours



<http://www.gqm.nl/>
<http://www.sei.cmu.edu/pub/documents/96.reports/pdf/hb002.96.pdf>
<http://www.vtt.fi/ele/profes/>



Goal: evaluate the effectiveness of writing sw code using standards





GQM: Goal-Question-Metric

A three-tier level example

Some assumptions/notes:

- each entity can be measured by 1+ attributes
- each measure has a cost for being thought, gathered, checked and used (PDCA)
- the informative value of two joint measures is more than from single measures
- the conflicting informative value among measures should be avoided
- focus on the initial informative goal


Entity	Attribute	Measure
Person	Age	# yrs from last birthday
Person	Age	# months from birth
User Requirements	Functional Size	fsu (e.g. FP, CFP)
Source Code	Length	# LOC (generic)
Source Code	Length	# Exec. Statements
Source Code	Quality	# found faults / KLOC
Testing Process	Duration	# hrs start-to-end
Testing Process	Fault Frequency	# found faults / KLOC
Tester	Efficiency	# found faults / KLOC
Operating System	Reliability	MTTF rate

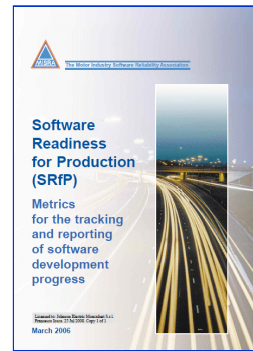


Requirements / Constraints:

- Scope: consider the chosen A-SPICE PRM-scope (e.g: HIS, Fiat, Ford, ...)
- (Process) capability target: CL2
- Cost/benefit: the higher ROI as possible, minimizing the cost of quality
- # of measures: few measures, possibly to be automated for data gathering

Possible Solutions:

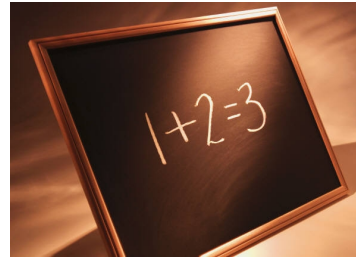
- Scope: **HIS** process scope
- Balancing criteria:
 - ✓ BMP technique by entities and attributes of interest (with causal links)
- Sources for measures:
 - ✓ **Project-level**: PMBOK, MISRA SRfP... 
 - ✓ by stakeholder's viewpoint/perspective (Time, Cost, Quality, Risk, Ethic, ...)
 - ✓ **Process-level**: ISO/IEC 15504, AutomotiveSPICE, ISO/TS 16949, ...
 - ✓ by process group (ENG, SUP, MAN, CUS, ACQ, ...)
 - ✓ **Product-level**: ISO 9126-x (25000x), ISO 26262 (Functional Safety), ISO 25012 (Data Quality), PSM v4.0b, etc...
 - ✓ by attribute (functionality, defectability, maintainability, functional safety, etc...)





• **Q:** What is the right number of measures to use?

– The Miller's "magic number" 7 ± 2 ?



• General suggestions to avoid the misbalance in selecting the measures critical to success, whatever the number:

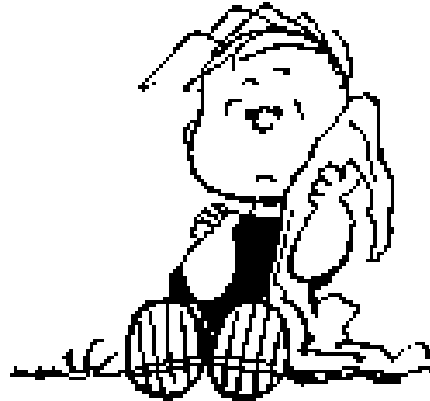
➤ *Select a **small suite** of key measures that will help you to **understand** your group's work **better**, and begin collecting them right away, measuring several **complementary aspects** of your work, such as quality, complexity, and schedule"*
(**Karl Wieggers**)



Possible Solution

Balancing Criteria and Number of Measures

- **Q:** how can a proper balance of perspectives and indicators be selected when managing a portfolio of projects?

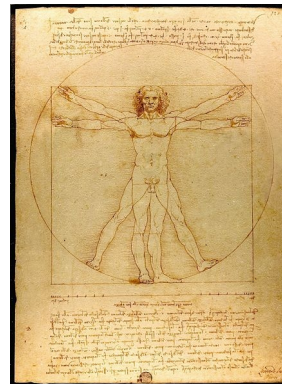


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The problem is **not to reduce** the cost of measurement, **but optimising** it against the informative value provided by the number of measures/indicators balancing them by each perspective of analysis



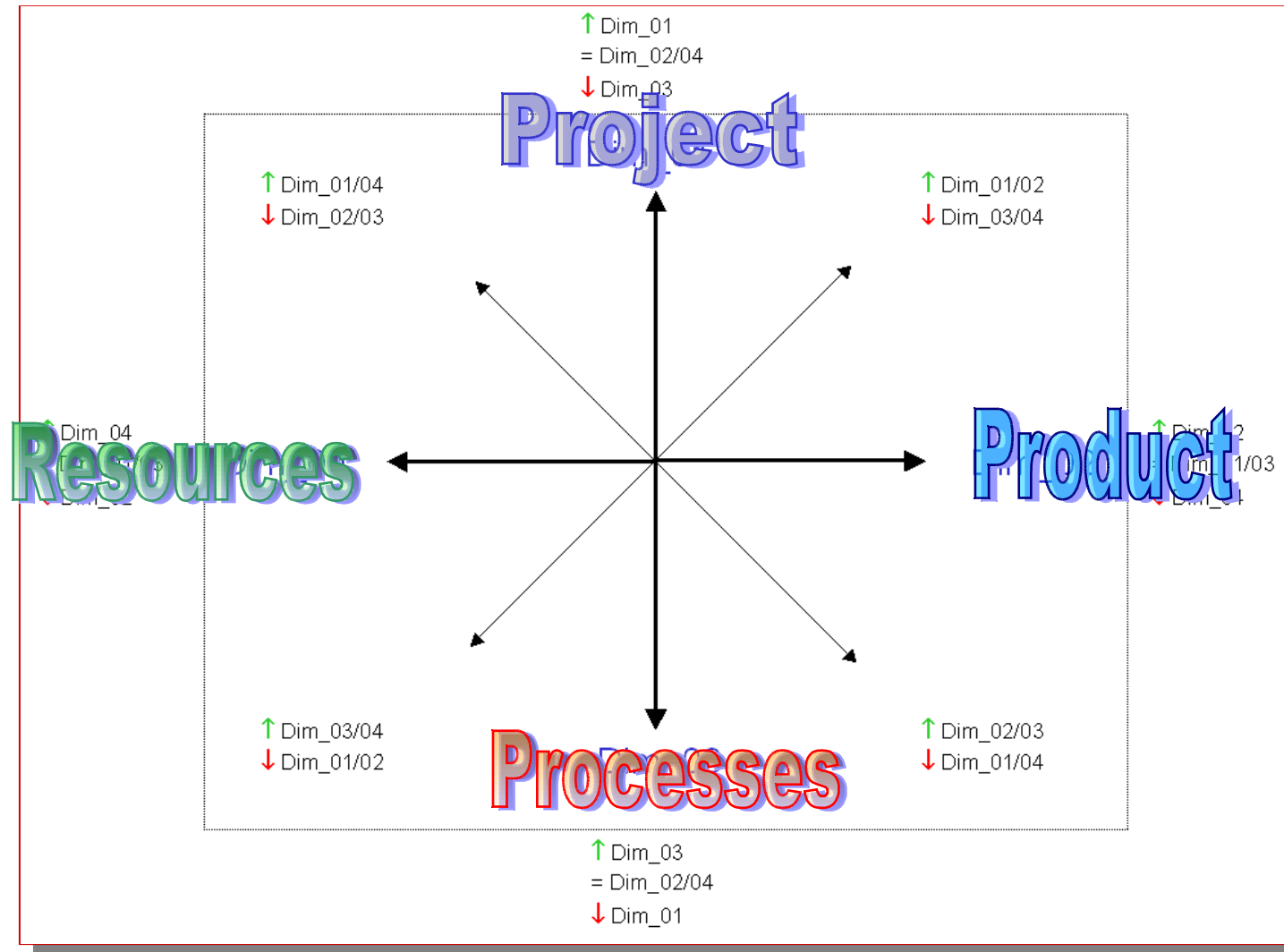
- 1 Determine the dimensions of interest in the project
- 2 Determine the list of the most representative measures associated with each dimension
- 3 For each of the measures selected, identify which other control variables might be impacted negatively
- 4 Figure out the best combination of indicators and the causal relations between them in order to build a measurement plan for the project





Possible solution

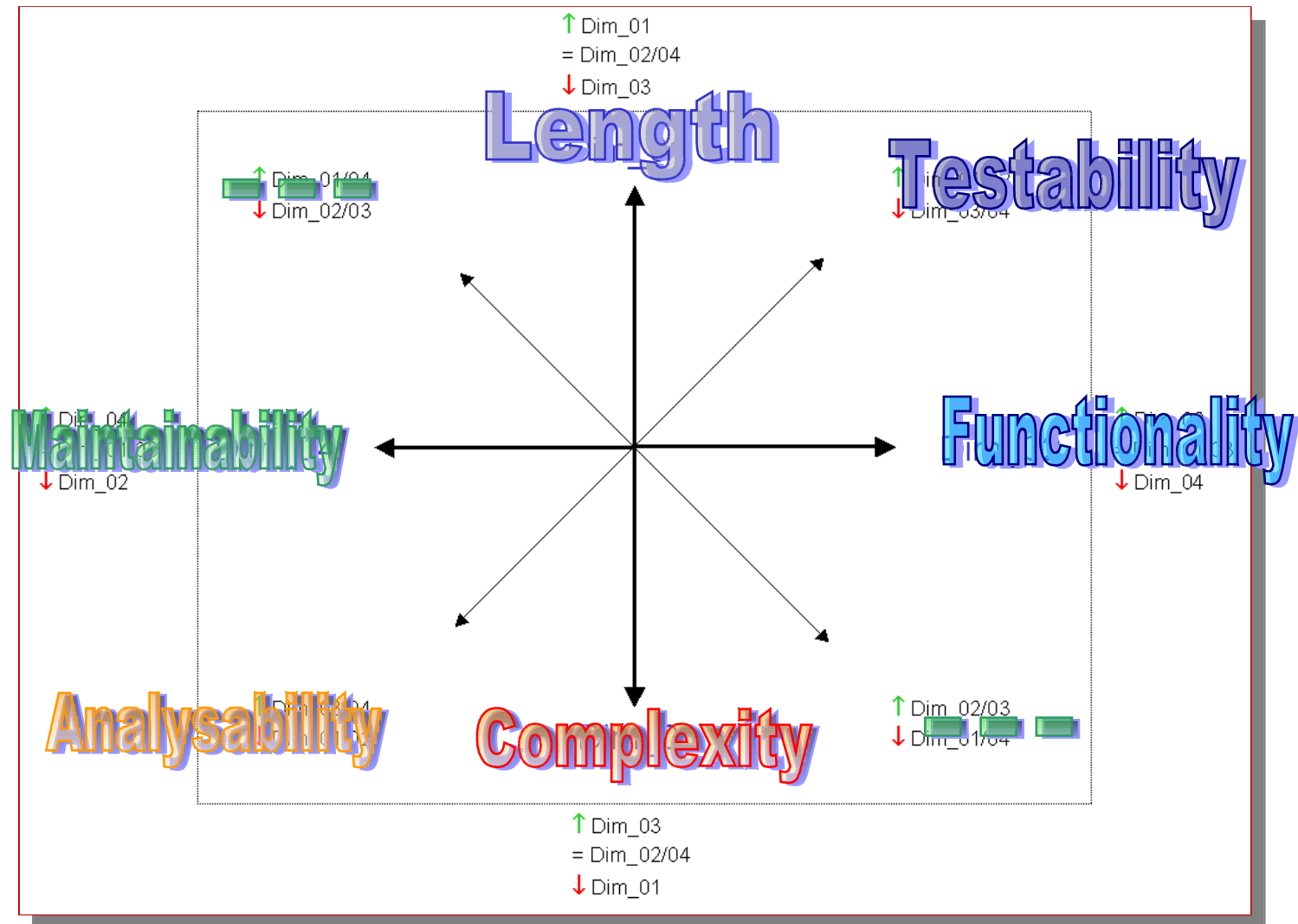
① Determine the dimensions of interest (a) – Multiple pov





Possible solution

① Determine the dimensions of interest (b) – Product-level





Possible Solution

② Determine the list of most representative measures (1)

Entity	Attribute	Measure	Threshold	A-SPICE
Project	Planning compliance	Effort (man/hrs) per SLC phase, per iteration (abs, %)	(profiles on hist.data)	MAN.3
Resource	Time	% of open complaints / notes for delaying in providing the agreed furnitures (tracked) per contract	≤10%	ACQ.4
Process*	Time performance	SPI (Schedule Performance Index)	ongoing	MAN.3
Process*	Cost performance	CPI (Cost Performance Index)	ongoing	MAN.3
Process	QA performance	% of non-conformances still open	≤15%	SUP.1
Process*	Maturity	Problem Reports (PR) by status (open, closed)	(profiles on hist.data)	SUP.9
Process	Changeability	Avg Change Requests (CR) working time by status	(profiles on hist.data)	SUP.8 - SUP.10
Process*	Planning reliability	Requirements Volatility of 'Scope Creep' Index (# of modified/new UR not formally traced / tot. # UR) by iteration	≤10%	ENG.4
Product*	Code Length	Kilo Lines of Code (KLOC) [system, function, module] <i>c.a 5 functions per module</i>	(abs, 100-150, 700-1000)	ENG.4
Product*	Functional Size	Functional Size (fsu) [system]	(abs)	ENG.4



Possible Solution

② Determine the list of most representative measures (2)

Entity	Attribute	Measure	Threshold	A-SPICE
Product*	Maintainability	Cyclomatic Complexity (of a function)	≤ 20	ENG.5, ENG.6
Product*	Maintainability	# of transfer parameters in a function	≤ 5	ENG.6
Product*	Maintainability	Avg size of a function statement (operands+operators / # of executable statements)	≤ 10	ENG.6
Product*	Code Stability	# of exit points from a function	1	ENG.5, ENG.6
Product*	Code Stability	# of calling functions of a function (fan-out)	≤ 10	ENG.5, ENG.6
Product	Code Stability	# of execution paths in a function	≤ 1000	ENG.5, ENG.6
Product	Testability	Branch Coverage	100%	ENG.8
Product*	Testability	Max # nesting depth of the function control structure	≤ 4	ENG.8



Possible Solution

③ Verify counter-impacts among measures

Some notes/doubts to solve (each time):

- **Taking into account all measurable entities (18 measures)...**
 - ✓ Project: 1 (4%); Resource: 1 (6%); Process: 6 (34%); Product: 10 (56%)
- **...or focusing on a mix of process-product measures (12 measures)?**
 - ✓ Process: 4 (33%); Product: 8 (67%)
- **Possible causal links among measures (for the analysis phase)**
 - ✓ RIN.1 (quality of H-resources) w/ ENG.8-10 (sw-sys testability)
 - ✓ ENG.4 (req. Volatility) w/ MAN.3 (project mgmt)
 - ✓ ...
- **Need to balancing and look for data gathering costs and counter-impacts**
 - ✓ Product-level measures: easier to keep by tools than for process-level based ones
 - ✓ **Q**: how much does it cost to measure the other measures?
 - ✓ **Q**: are we within the budget set for Monitoring & Control process (within MAN.3)?
 - ✓ **Q**: keep all measures or cancel some measures? Eventually which one(s)? Why?
- **Possible missing processes to be included for measurements**
 - ✓ MAN.5 (Risk Management), REU.2 (Reuse Prg. Mgmt)



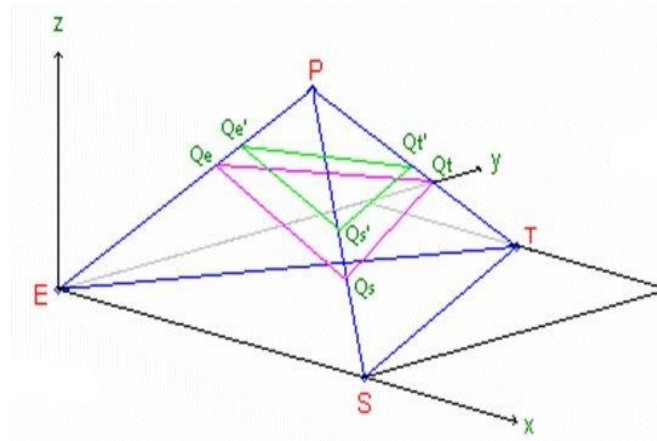
Possible solution

- 4 Determine the possible best combination of measures

Project



Resources

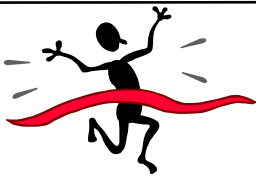


Product

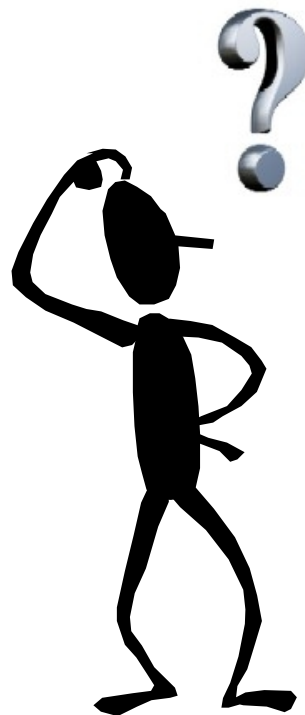


Processes





- **Monitoring & Control...**
 - ✓ ...is a critical activity and should be properly planned
 - ✓ ...must be a proactive process, in order to invest the right amount of budget
 - ✓ ...cannot be underestimated and must be run as a process, not only as an activity!
- **What to measure in a SPICE-compliant project?**
 - ✓ Different entities can be measured (org, project, resource, process, product)
 - ✓ Each entity can be measured according several attributes (length, size, defectability, etc..)
 - ✓ SPICE
 - ❖ COSMIC is a new FSMM allowing to measure also 'technical' layers, and has simplified counting rules
- **Some techniques/buzzwords**
 - ✓ SPICE, ISO/IEC 15504, AutomotiveSPICE, GQM, BSC, ISO 9126-x, ISO 26262-x, LOC, Function Point, LOC, MTTF, ...
- **Some Lessons Learned**
 - ✓ Measure a few, but measure the right things
 - ✓ A balanced set of measures can allow a proper monitoring of your projects
 - ✓ Make measures consistent with the SPICE PRM-scope and boundary
- **Some observations**
 - ✓ HIS process scope:
 - ✓ currently contains 16 processes (1 MAN, 9 ENG, 4 SUP, 1 ACQ)...
 - ✓ ...but does not take into account MAN.5, MAN.6 and any RIN processes (no processes on inputs and few controls in the scope)
- **Next Steps**
 - ✓ ...to start to apply (or reinforce, if yet applied) those concepts in your organization!



Thanks for your attention!



Misurare il software

Quantità, qualità, standard e miglioramento di processo nell'Information & Communication Technology

Franco Angeli, 2008 – 3ª edizione
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Luigi Buglione

www.geocities.com/lbu_measure/libri/mis.htm

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LuigiBuglione
t +39 06 83074472
m +39 335 1214813
luigi.buglione@eng.it

Engineering.it S.p.A.
Via Riccardo Morandi, 32
I-00148 Rome (Italy)
www.eng-it.it