



***Suggestions for Improving Measurement Plans:
First Results from a BMP Application***

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Agenda

- **Introduction**
 - ✓ Multidimensional Analysis in Project Management
 - ✓ Rationale & Objectives
- **BMP: Balancing Multiple Perspectives**
 - ✓ Objectives
 - ✓ The proposed measurement procedure
 - ✓ Causal Relationships
- **Initial Results from a BMP application**
 - ✓ The BMP Questionnaire (BMP-Q)
 - ✓ Presentation of the samples
 - ✓ BMP-Q: the measures
 - ✓ First results & feedback
- **Conclusions & Prospects**

Introduction

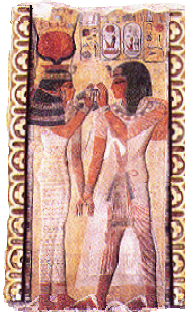
Multidimensional Analysis in PM

- Growing interest in Integrated Software Measurement...
 - ✓ E.g. BSC, EFQM, MBQA, QEST/LIME
- ...but still few documented industrial implementations
 - ✓ Usually **Time** and **Cost** dimensions used, while at least 3 dimensions should be considered
- Other possible dimensions of analysis (eg: Quality, Risk, ...) are not often taken into account
 - ✓ **Q**: How much does it cost for project monitoring & control?
 - ✓ **Q**: How many measures/indicators are usually tracked during the project lifecycle? And from which perspectives?

Introduction

Rationale & Objectives

- Rationale:
 - ✓ Loss of project control is one of the most frequent causes of failure in Project Management
 - ✓ Prevention: Detailed analysis of content and quality of project tracking
- Some basic questions:
 - ✓ Right number of perspectives?
 - ✓ Right number of indicators?
 - ✓ What about hypotheses of relationships among processes?



At least, 3 dimensions:

- ✓ Management
- ✓ Users
- ✓ Technical

- Objective:
 - ✓ Optimize the costs/benefits of tracking & control projects, by **balancing** the number of measures/indicators used by each perspective of analysis useful to the project.

Introduction

Which set of indicators to select?

- **Q:** What is the right number of indicators to use?
 - The Miller's "magic number" 7 ± 2 ?
- General suggestion to avoid misbalancing in selecting the measures critical to success, whatever the number
 - *"Select a small suite of key measures that will help you 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 Wiegerts)

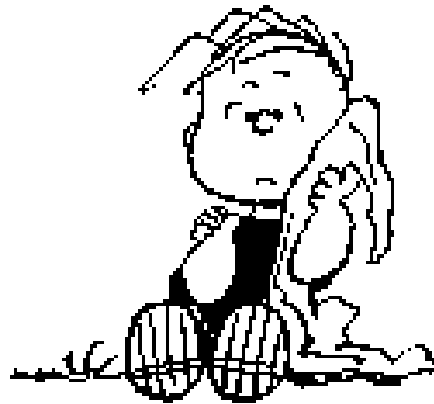
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BMP: Balancing Multiple Perspectives

General issue and Objective

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



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The real issue 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.

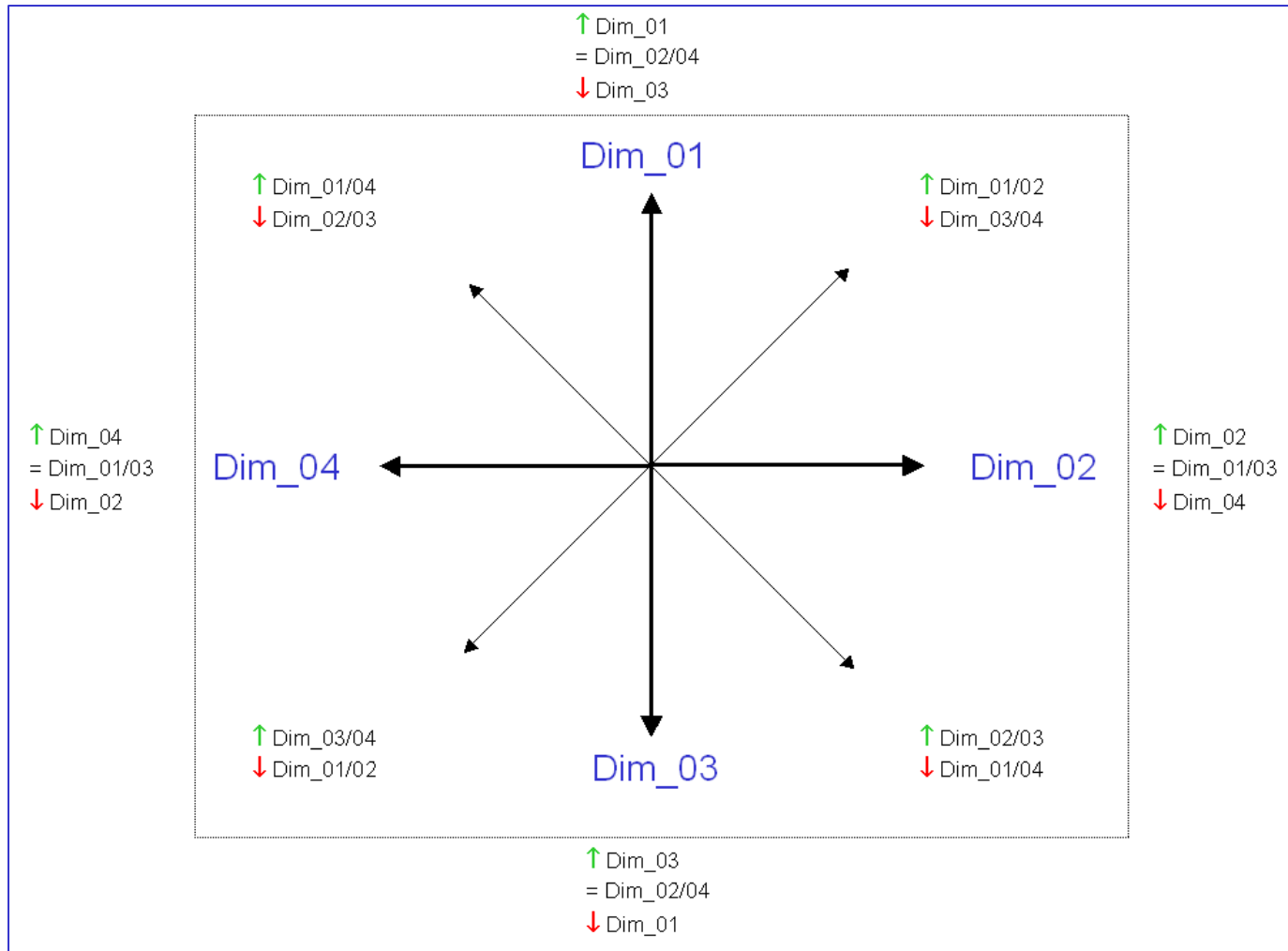
BMP: Balancing Multiple Perspectives

The proposed Measurement Procedure

- 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.

BMP: Balancing Multiple Perspectives

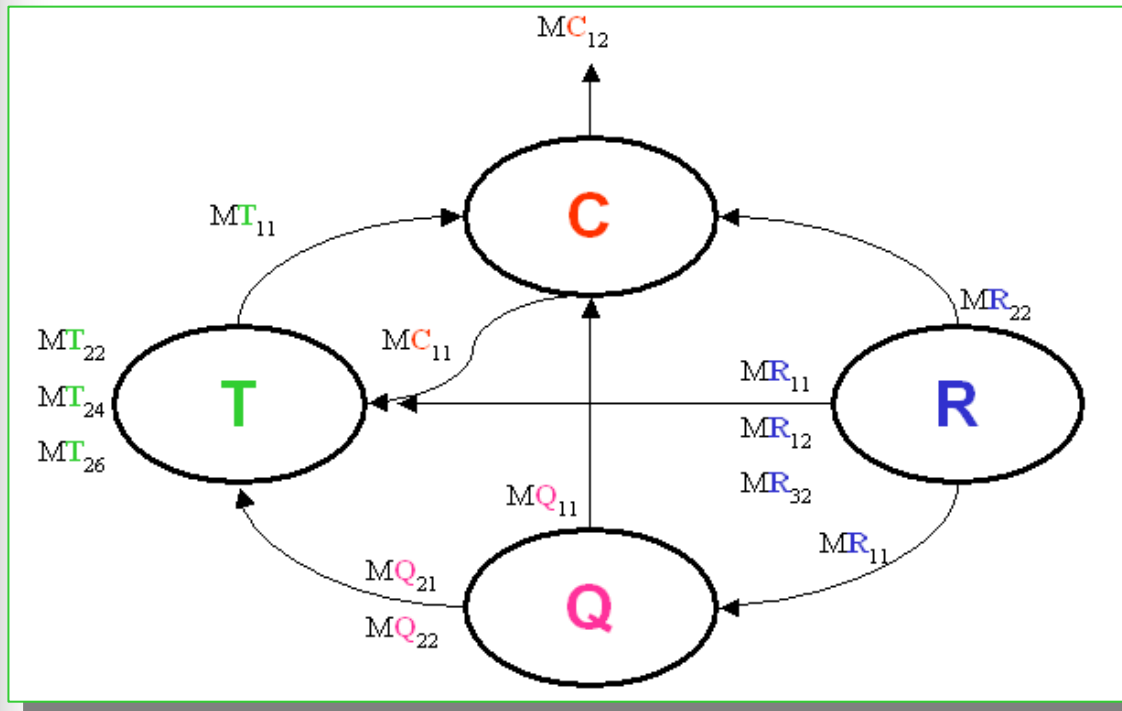
A Generic four-dimensional BMP template



BMP: Balancing Multiple Perspectives

Causal Relationships

- **Not sufficient** to perform steps#1 and #2 (*design a measurement plan*)
- Next (**required**) step: establish coherent and proper relationships among goals through measures (i.e. the BSC *strategic map*) for achieving both single perspective goals, as well as overall organizational ones



Time	<ul style="list-style-type: none"> • MT₁₁ – Milestone Dates • MT₂₂ – Problem Report Status • MT₂₄ – Change Request Status • MT₂₆ – Test Status
Cost	<ul style="list-style-type: none"> • MC₁₁ – Earned Value • MC₁₂ – Cost
Quality	<ul style="list-style-type: none"> • MQ₁₁ – Defects • MQ₂₁ – Defect Containment • MQ₂₂ – Rework
Risk	<ul style="list-style-type: none"> • MR₁₁ – Staff Experience • MR₁₂ – Staff Turnover • MR₂₂ – Functional Change Workload • MR₃₂ – Resource Utilization

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Applying BMP

BMP-Q: the Questionnaire

http://www.geocities.com/lbu_measure/qesttime/bmp.htm



- 4 sections:
- ✓ Respondents profile & viewpoints
 - ✓ Measures
 - ✓ Causal Relationships
 - ✓ Cost for "Tracking & Control" (T&C) process

BMP Questionnaire vers. 1.00 Respondant: _____ Date: _____

1a In the project(s) you worked, you have contributed in terms of (*stress which is your current role*):

Role

Project Manager

Team Leader

Quality Assistant

Developer

Tester

Other

Yrs of Experience in the Role

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39

2 Referring to Your experience, please select from the following list the metrics usually used in the project(s) you worked in (OLD column) and those You'd choose for a next project (NEW column) of the same typology and complexity, selecting also to which viewpoint(s) you associate it from the ones listed above.

	Old	New	Category	Measure	Indicator	Viewpoint					
						T	C	O	R	O(1)	O(2)
1			Milestone Performance	Milestone Dates	Dev.Milestone Schedule						
2					Milestone Progress						
3					Maintenance Activities						
4			Work Unit Progress	ProblReport Stat	PR Status						
5					PR Aging - Open PRs						

1b How many viewpoints were usually used in the project(s) you worked in?

Viewpoint

Time

Cost

Quality

Risk

Other(1)

Other(2)

1c And which one(s) in Your opinion, were the most important?

Viewpoint

Time

Cost

Quality

Risk

Other(1)

Other(2)

3a In Your opinion which metrics from those previously selected should be jointly analysed (i.e. if the metric A has a value above average and metric B a value below average, it means that...) in order to analyze and solve eventual problems in the monitoring & control phase on Your project(s)?

3b Why?

4a Do you know (approximately) the cost spent for monitoring & control activities on the project(s) you worked in?

Yes

Don't Know

4b If positive, please could you provide the percentage (approx) for monitoring & control activities?

4c And in Your opinion - for a next project of the same typology and complexity - which percentage (approx) of the project budget should be assigned to monitoring & control activities?



Applying BMP

BMP-Q: the Measures

http://www.geocities.com/lbu_measure/gesttime/bmp.htm





1a	1	Respondents profile by project role (# and %)
	2	Experience profiles for current project role (# and %)
1b	3	# analysis viewpoints (OLD)
1c	4	# analysis viewpoints (NEW)
2	1	# selected measures (OLD)
	2	# selected metrics (NEW)
	3	# affected viewpoints (NEW)
	4	Avg of measures by viewpoint (# and %)
	5	Ranking of selected measures by: abs value, respondent project role, analysis viewpoint
3a	1	List of causal relationships among measures
	2	Ranking of relationships by: abs value, respondent project role, analysis viewpoint
4a	1	% respondents knowing amount of costs for m&c (monitoring & control) activities
4b	1	Max, Min, Avg and Med for the returned values (%) – OLD
4c	1	Max, Min, Avg and Med for the returned values (%) – NEW

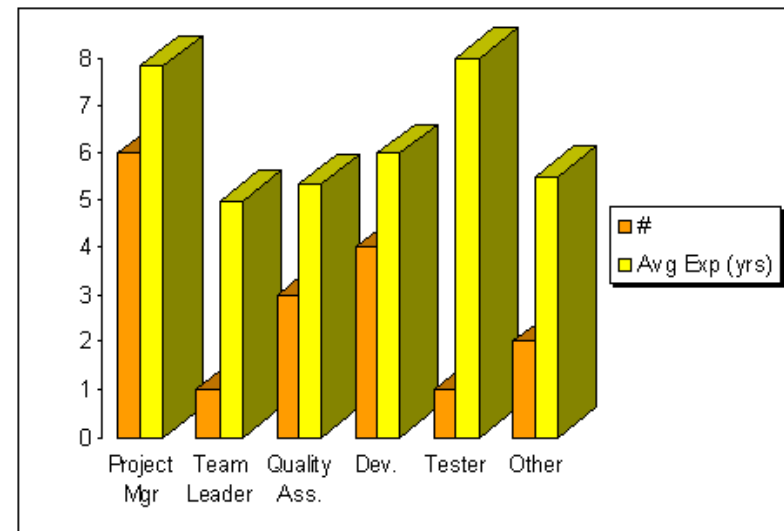
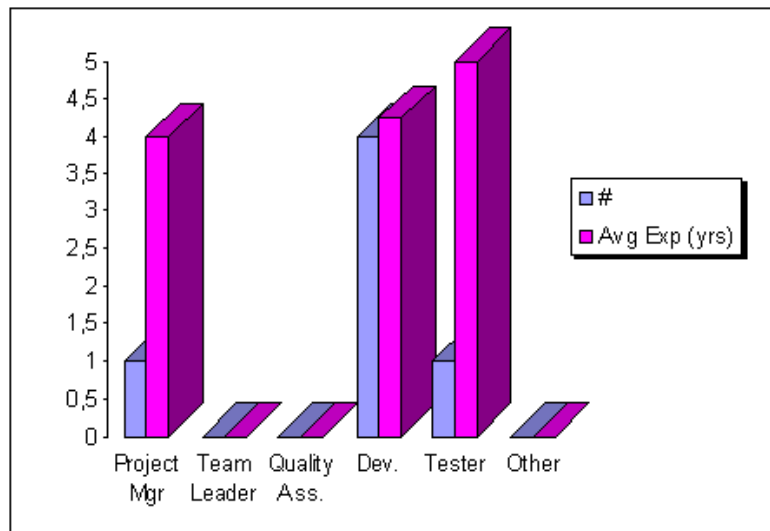
Applying BMP

The samples



	Canada 	Germany 
<i>Sample Id.</i>	S1	S2
<i># of Respondents</i>	6	10
<i>Type of Respondents</i>	Graduate Students- (including professionals)	SE professionals
<i>BMP-Q gathering time</i>	Q1/2005	Q1/2006

Q1a. Profiles

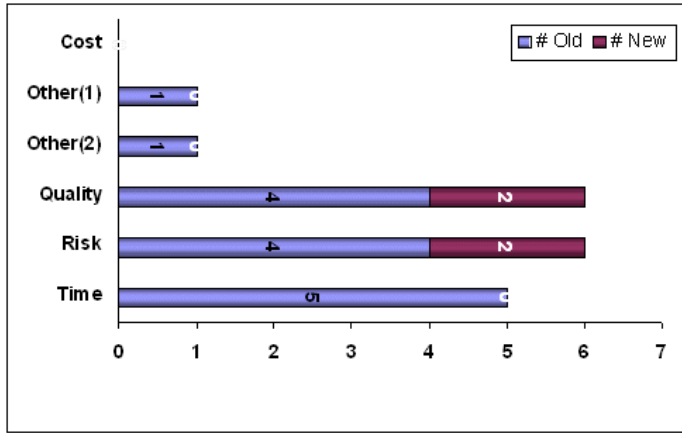


Applying BMP

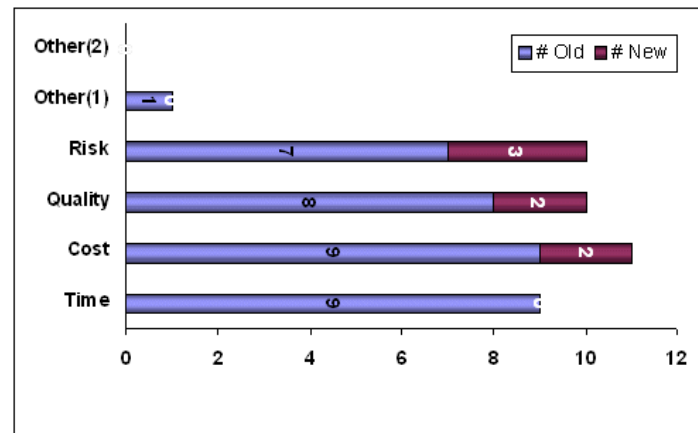
Results



Q1b-c. # of PoV – Current & Past Projects vs Next Projects

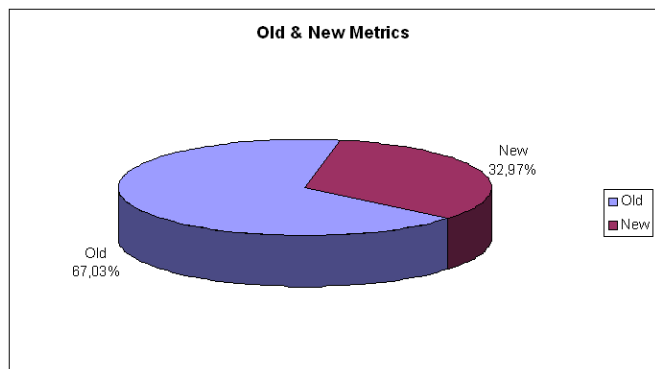
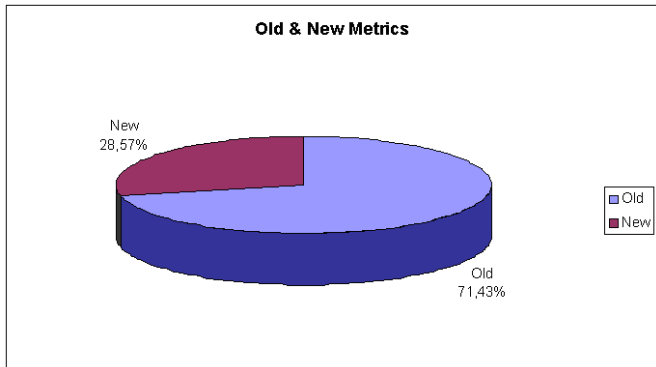


S1



S2

Q2.1-2.2. # of Measures – Current & Past Projects vs Next Projects

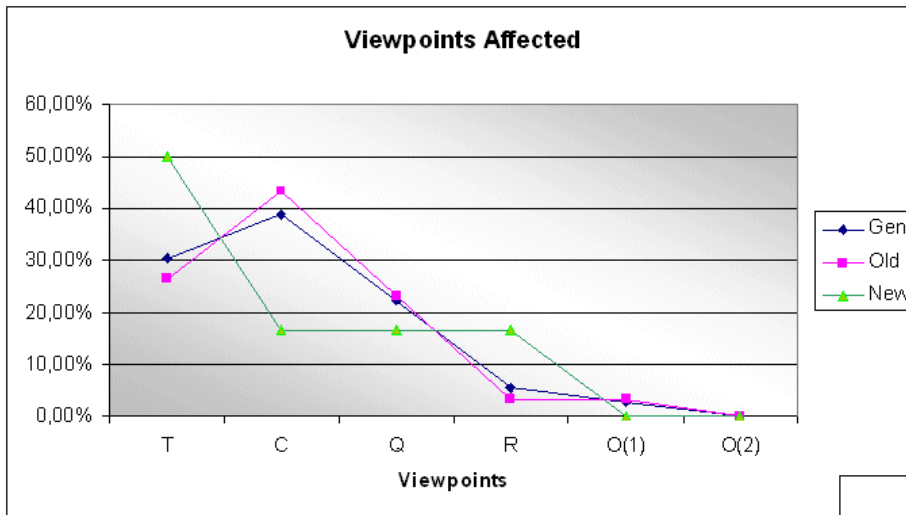


Applying BMP

Results

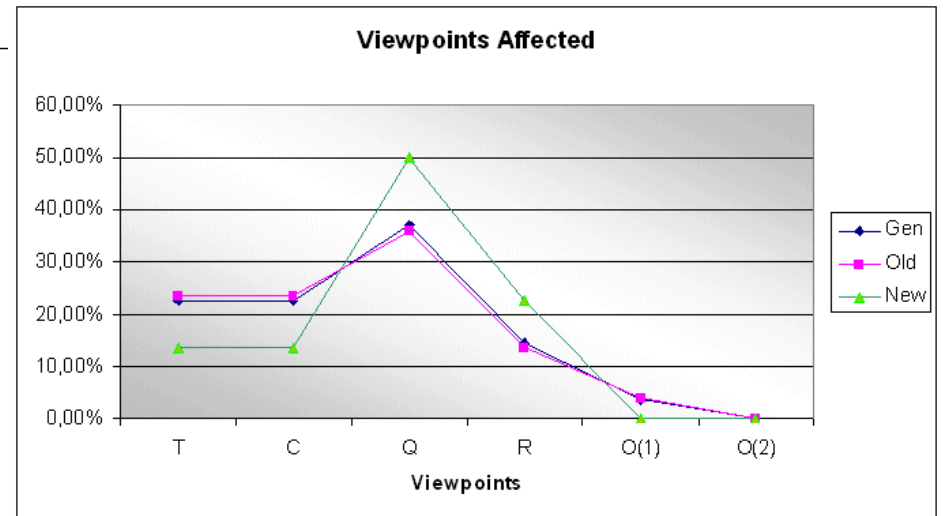


Q2.3. PoV affected and Avg # of measures by viewpoint



S1

S2



Applying BMP Results



Q2.4. # of Measures – by Project Role

S1 

Project Role	#	# OLD	# NEW	Avg # (OLD)	Avg # (NEW)	Comments
Developer	4	10	9	2.5	2.25	No usage of measures in 50% of the respondents' companies
Project Manager	1	14	1	14	1	
Tester	1	0	0	0	0	No usage of measures in his/her company

S2 

Project Role	#	# OLD	# NEW	Avg # (OLD)	Avg # (NEW)	Comments
Project Manager	5	53	7	5.3	0.7	More than 7:1 (old-new) ratio
Developer	2	12	24	1.2	2.4	1:2 (old-new) ratio
QA/QM	2	31	5	3.1	0.5	c.a. 6:1 (old-new) ratio
Project Office	1	31	0	3.1	0	Really conservative

Applying BMP

Results



Q2.5. Top selected measures by project role

S1 

General (n=23)

# Id.	Category	Measure	Indicator	Old	New	Tot
1	Milestone Performance	Milestone Dates	Dev.Milestone Schedule	2	1	3
9	Work Unit Progress	Component Status	Design Progress w/ replan	1	2	3
17	Financial Performance	Earned Value	Cost & Schedule Variance	3	0	3
20	Envir.-Support Resour.	Resource Utiliz.	Resource Utilization	3	0	3

Developers (n=14)

# Id.	Category	Measure	Indicator	Old	New	Tot
1	Milestone Performance	Milestone Dates	Dev.Milestone Schedule	1	1	2
16	Personnel	Staff Experience	Staff Experience	2	0	2
20	Envir.-Support Resour.	Resource Utiliz.	Resource Utilization	2	0	2
40	Portability	Std Compliance	Interface Compliance Validation	2	0	2

Project Managers (n=15)

# Id.	Category	Measure	Indicator	Old	New	Tot
9	Work Unit Progress	Component Status	Design Progress w/ replan	0	2	2
11	Work Unit Progress	Action Item Stat.	Action Item Status	2	0	2
17	Financial Performance	Earned Value	Cost & Schedule Variance	2	0	2

Applying BMP

Results

Q2.5. Top selected measures by project role **S2** (1/2)



General (n=59)

# Id.	Category	Measure	Indicator	Old	New	Tot
2	Milestone Performance	Milestone Dates	Milestone Progress	12	1	13
4	Work Unit Progress	ProblReport Stat	PR Status	13	0	13
9	Work Unit Progress	Component Status	Design Progress w/ replan	11	1	12
1	Milestone Performance	Milestone Dates	Dev/Milestone Schedule	11	0	11
13	Personnel	Effort	Effort Allocation w/replan	11	0	11
16	Personnel	Staff Experience	Staff Experience	7	4	11

Developers (n=11)

# Id.	Category	Measure	Indicator	Old	New	Tot
34	Supportability/Maint.	Time to Restore	Syst. Failures and Restoration	4	0	4
2	Milestone Performance	Milestone Dates	Milestone Progress	2	0	2
4	Work Unit Progress	Prob. Report Status	PR Status	2	0	2
11	Work Unit Progress	Action Item Status	Action Item Status	2	0	2
23	Physical Size-Stability	Lines of Code	SW Size – Lines of Code	2	0	2
35	Supportability/Maint.	Time to Restore	Mean Time to Repair or Fix	2	0	2

Applying BMP

Results



Q2.5. Top selected measures by project role S2 (2/2)

Project Managers (n=52)

# Id.	Category	Measure	Indicator	Old	New	Tot
1	Milestone Performance	Milestone Dates	Dev/Milestone Schedule	6	0	6
12	Incremental Capability	IncrementContent	Incremental Content	5	0	5
46	Process Compliance	RefModel Rating	RefModel Level – Continuous type	5	0	5
2	Milestone Performance	Milestone Dates	Milestone Progress	4	0	4
4	Work Unit Progress	ProblReport Stat	PR Status	3	1	4

QM/QA (n=32)

# Id.	Category	Measure	Indicator	T	C	Q	R	O(1)	O(2)	Old	New	Tot
9	Work Unit Progress	Component Status	Design Progress w/ replan	2	2	2	2	0	0	8	0	8
2	Milestone Performance	Milestone Dates	Milestone Progress	2	2	1	1	0	0	6	0	6
4	Work Unit Progress	ProblReport Stat	PR Status	1	1	2	2	0	0	6	0	6
28	Functional Size-Stabil	Funct.Change WL	CRs by Priority	2	1	1	2	0	0	6	0	6
46	Process Compliance	RefModel Rating	RefModel Level – Continuous type	2	2	2	0	0	0	6	0	6
13	Personnel	Effort	Effort Allocation w/replan	2	1	0	2	0	0	5	0	5

Applying BMP

Results



Q3. Causal Relationships

S1 

- 100% of silent respondents → measures often used as *islands* within the T&C process
- Proposal for revision: introduce a question asking if the respondent's company is (or not) certified ISO 9001:2000 and/or has an SPI program in place
- Rationale: In such cases rules exist Clause 8 in ISO 9001:2000 (asking for continuous improvement through a measurement process and analysis of gathered data) and the Measurement process in SPI models (i.e. MA in CMMI; ORG.5 in SPICE, ...), but are not properly applied. Why?
- Again: Clause 4.1b in ISO 9001:2000 asks an organization to "*determine the sequence and interaction of (QMS) processes*"

S2 

- 40% of silent respondents
- 60% pointed out on
 - measuring the whole SLC
 - Process compliance indicators, as a result of establishing causal relationships among processes

Applying BMP

Results



Q4. Cost of the T&C process

S1

- Only one respondent had an idea about the “how much” could cost T&C
- T&C process costs absorbed within Project Management ones
- Expectations: allocation of between 5% and 20% of project budget (avg: 10%)
 - **Note:** higher value proposed by a developer

S2

- 70% of respondents (typically PM)
- Project roles: the non-respondents were developers and QA/QM
- Expectations: allocation of between 5% and 35% of project budget (avg: 17%)
 - **Note:** higher value proposed by a developer

Applying BMP

First Results & Feedbacks (1/2)



Teaching viewpoint:

- Simplify the way for explaining the ISO/IEC 15939:2002 Information Model and introducing the cause-effect linkage among development processes, as a as a useful foundation for ICT Balanced Scorecards (BSC)
- Help in pointing out to practitioners and students that there are plenty of well-proven and established measures within the Software Engineering domain, but also that each Measurement Program must be built having in mind that unique situation and that every measure should be designed and verified to be effectively *goal-driven*

Applying BMP

First Results & Feedbacks (2/2)



Industrial viewpoint:

- Increase awareness about cost-benefit analysis in implementing (or not) a certain measure/indicator within their current QMSs.
 - ✓ Stimulus for industry people to know more and more about the effort/cost splitting of their projects by SDLC phase (in many cases the answer is: **don't know**).
 - ✓ Proposed the **Test Selection Algorithm**: each measure has its own cost from its definition till the project closure, within a budget constraint.
 - ✓ Key point: balancing the current available amount of budget and not to simply cut controls. And in that eventuality, the point to face was: but which drawbacks of deleting or adding some controls?
- Proposed to **re-label** such measures and indicators as project "controls", to provide a better match with managers' responsibilities

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Conclusions & Prospects

(1/2)



- Project managers often consider only two dimensions for tracking & control of their projects (Time, Cost): at least, the Quality perspective should be also taken into account;
 - further perspectives (eg: Risk) could be also be useful if considered from the planning phase on. Even more challenging, a multi-perspective approach – as in the BSC – is suggested.
- There does not exist a “magic number” of indicators to track, but the goal is to optimize costs and informative value derived from that amount of indicators, establishing also the causal relationships among their related goals.
- **BMP** (**B**alancing **M**ultiple **P**erspectives) proposes a 4-step procedure to select an appropriate balance of indicators from the various perspectives taken into account (e.g. Time, Cost, Risk and Quality) and focus on the core indicators from each of them, thereby helping the project manager in tracking and control activities.

Conclusions & Prospects

(1/2)



- A first application with two samples of respondents (from Canada and Germany) revealed that there is enough room to work on about:
 - The amount of budget to allocate in software projects for T&C
 - Usually measures are chosen mainly taking care to Time and Cost perspectives; the new desired perspectives would be Risk and Quality
 - **Developers** are more open to introducing new measures on projects, while **Project Managers** pay more attention to not increasing costs and **Testers** did not use any measures.
 - Usually the selection of measures is not done taking care of how they are/will be linked in a cause-effect chain (BSC-like)
 - The greater the experience (# of years), the greater the number of measures selected
- Due to its inner multidimensional nature, future joint usages with methods, tools and frameworks taking into account concurrent dimensions (eg: QEST/LIME) will be investigated.

Q & A



Thank you!



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