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” $7 \pm 2$?
- **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 Wiegers)*
Agenda

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  - Rationale & Objectives

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  - Objectives
  - The proposed measurement procedure
  - Causal Relationships

- **Initial Results from a BMP application**
  - The BMP Questionnaire (BMP-Q)
  - BMP-Q: the measures
  - Presentation of the samples
  - First results & feedbacks

- **Conclusions & Prospects**
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?

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
Agenda

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  - Objectives
  - The proposed measurement procedure
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  - The BMP Questionnaire (BMP-Q)
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  - Presentation of the samples
  - First results & feedbacks

- **Conclusions & Prospects**
Applying BMP

BMP-Q: the Questionnaire

4 sections:

✓ Respondents profile & viewpoints
✓ Measures
✓ Causal Relationships
✓ Cost for “Tracking & Control” (T&C) process

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

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BMP Questionnaire

1a In the project(s) you worked, you have contributed in terms of (please which is your current role):
- Project Manager
- Team Leader
- Quality Assistant
- Employee
- Other

Yrs of Experience in the Role:

1b How many viewpoints were usually in the project?
- Time
- Cost
- Quality
- Risk
- Other

1c And which one(s) in your opinion, was the most important:
- Time
- Cost
- Quality
- Risk
- Other

---

2a [Question about project performance]

2b [Question about project measures]

2c [Question about project indicators]

3a In your opinion which metric(s) from those previously selected should be jointly analyzed (i.e. if the metric 4 has a value above average and metric 3 a value below average, it means that...)

3b Why?

3c Do you know (approximately) the cost spent for monitoring & control activities on the project(s) you worked in?

3d If positive, please could you provide the percentage (approx) for monitoring & control activities?

3e 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**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Respondents profile by project role (# and %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>1</td>
<td>Experience profiles for current project role (# and %)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td># analysis viewpoints (OLD)</td>
</tr>
<tr>
<td>1b</td>
<td>3</td>
<td># analysis viewpoints (NEW)</td>
</tr>
<tr>
<td>1c</td>
<td>4</td>
<td># selected measures (OLD)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td># selected metrics (NEW)</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td># affected viewpoints (NEW)</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Avg of measures by viewpoint (# and %)</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Ranking of selected measures by: abs value, respondent project role, analysis viewpoint</td>
</tr>
</tbody>
</table>

|   |   | List of causal relationships among measures |
| 3a| 1 | Ranking of relationships by: abs value, respondent project role, analysis viewpoint |

|   |   | % respondents knowing amount of costs for m&c (monitoring & control) activities |
| 4a| 1 | Max, Min, Avg and Med for the returned values (%) – OLD |
| 4b| 1 | Max, Min, Avg and Med for the returned values (%) – NEW |

[http://www.geocities.com/lbu_measure/gestlime/bmp.htm](http://www.geocities.com/lbu_measure/gestlime/bmp.htm)
Applying BMP

The samples

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

Q1a. Profiles

![Graph showing profiles of respondents](image)
Applying BMP

Results

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

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**

![Graph showing Viewpoints Affected](image)

S1 🇨🇦

S2 🇩🇪
## Applying BMP

### Results

#### Q2.4. # of Measures - by Project Role

<table>
<thead>
<tr>
<th>Project Role</th>
<th>#</th>
<th># OLD</th>
<th># NEW</th>
<th>Avg # (OLD)</th>
<th>Avg # (NEW)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developer</td>
<td>4</td>
<td>10</td>
<td>9</td>
<td>2.5</td>
<td>2.25</td>
<td>No usage of measures in 50% of the respondents’ companies</td>
</tr>
<tr>
<td>Project Manager</td>
<td>1</td>
<td>14</td>
<td>1</td>
<td>14</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Tester</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>No usage of measures in his/her company</td>
</tr>
</tbody>
</table>

### [NEW]

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

### Results

**Q2.5. Top selected measures by project role**

#### General (n=23)

<table>
<thead>
<tr>
<th># Id.</th>
<th>Category</th>
<th>Measure</th>
<th>Indicator</th>
<th>Old</th>
<th>New</th>
<th>Tot</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Milestone Performance</td>
<td>Milestone Dates</td>
<td>Dev. Milestone Schedule</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>Work Unit Progress</td>
<td>Component Status</td>
<td>Design Progress w/ replan</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>17</td>
<td>Financial Performance</td>
<td>Eearned Value</td>
<td>Cost &amp; Schedule Variance</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>20</td>
<td>Envir.-Support Resour.</td>
<td>Resource Utiliz.</td>
<td>Resource Utilization</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Developers (n=14)

<table>
<thead>
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<th># Id.</th>
<th>Category</th>
<th>Measure</th>
<th>Indicator</th>
<th>Old</th>
<th>New</th>
<th>Tot</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Milestone Performance</td>
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<td>Dev. Milestone Schedule</td>
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<td>1</td>
<td>2</td>
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<tr>
<td>16</td>
<td>Personnel</td>
<td>Staff Experience</td>
<td>Staff Experience</td>
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<td>2</td>
</tr>
<tr>
<td>20</td>
<td>Envir.-Support Resour.</td>
<td>Resource Utiliz.</td>
<td>Resource Utilization</td>
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<td>40</td>
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<td>Std Compliance</td>
<td>Interface Compliance Validation</td>
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</table>

#### Project Managers (n=15)

<table>
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<th>Category</th>
<th>Measure</th>
<th>Indicator</th>
<th>Old</th>
<th>New</th>
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<tbody>
<tr>
<td>9</td>
<td>Work Unit Progress</td>
<td>Component Status</td>
<td>Design Progress w/ replan</td>
<td>0</td>
<td>2</td>
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<tr>
<td>11</td>
<td>Work Unit Progress</td>
<td>Action Item Stat.</td>
<td>Action Item Status</td>
<td>2</td>
<td>0</td>
<td>2</td>
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<tr>
<td>17</td>
<td>Financial Performance</td>
<td>Eearned Value</td>
<td>Cost &amp; Schedule Variance</td>
<td>2</td>
<td>0</td>
<td>2</td>
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Applying BMP

Results

Q2.5. Top selected measures by project role

General (n=59)

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<th>Indicator</th>
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<th>New</th>
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<tr>
<td>2</td>
<td></td>
<td>Milestone Performance</td>
<td>Milestone Dates</td>
<td>Milestone Progress</td>
<td>12</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Work Unit Progress</td>
<td>Prob/Report Stat</td>
<td>PR Status</td>
<td>13</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Work Unit Progress</td>
<td>Component Status</td>
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<td>11</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
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<td></td>
<td>Milestone Performance</td>
<td>Milestone Dates</td>
<td>Dev/Milestone Schedule</td>
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<td>0</td>
<td>11</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>Personnel</td>
<td>Effort</td>
<td>Effort Allocation w/plan</td>
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<td>11</td>
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<tr>
<td>16</td>
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<td>Staff Experience</td>
<td>Staff Experience</td>
<td>7</td>
<td>4</td>
<td>11</td>
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Developers (n=11)

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<th>Indicator</th>
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<th>New</th>
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<td>Time to Restore</td>
<td>Syst. Failures and Restoration</td>
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<td>4</td>
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<td>Milestone Dates</td>
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<td>2</td>
</tr>
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<td>4</td>
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<td>Prob. Report Stat</td>
<td>PR Status</td>
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<tr>
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<td>35</td>
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<td>Supportability-Maint.</td>
<td>Time to Restore</td>
<td>Mean Time to Repair or Fix</td>
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<td>0</td>
<td>2</td>
</tr>
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</table>
### Applying BMP Results

#### Q2.5. Top selected measures by project role

**Project Managers (n=52)**

<table>
<thead>
<tr>
<th># Id</th>
<th>Category</th>
<th>Measure</th>
<th>Indicator</th>
<th>Old</th>
<th>New</th>
<th>Tot</th>
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<tr>
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<td>Milestone Performance</td>
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<td>Dev Milestone Schedule</td>
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<tr>
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<td>IncrementContent</td>
<td>Incremental Content</td>
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<td>5</td>
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<tr>
<td>46</td>
<td>Process Compliance</td>
<td>Ref Model Rating</td>
<td>Ref Model Level – Continuous type</td>
<td>5</td>
<td>0</td>
<td>5</td>
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<tr>
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<td>Milestone Performance</td>
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<td>Milestone Progress</td>
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<td>4</td>
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<td>3</td>
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<td>4</td>
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**QM/ QA (n=32)**

<table>
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<th>C</th>
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<th>R</th>
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<th>Q(2)</th>
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<tr>
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<td>Functional Size-Stabil</td>
<td>Funct. Change WL</td>
<td>CRS by Priority</td>
<td>2</td>
<td>1</td>
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<td>0</td>
<td>6</td>
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<td>Personnel</td>
<td>Effort</td>
<td>Effort Allocation w/ replan</td>
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<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>
Applying BMP

Results

Q3. Causal Relationships

- 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”

- 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

- 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

- **S1**

- 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

- **S2**
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 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
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.
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)
  - BMP-Q: the measures
  - Presentation of the samples
  - First results & feedbacks

- **Conclusions & Prospects**
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 (Balancing Multiple Perspectives) 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.
Thank you!

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