GUFPI ISMA

Software Productivity Factors
The A Taxonomy

SBC {SOFTWARE BENCHMARKING COMMITTEE}

Luca Santillo | Guido Moretto

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GUFPI-ISMA

- Gruppo Utenti Function Point Italia – Italian Software Metrics Association
- promotes software measurement for ICT solutions, processes and services, by encouraging:
- cooperation, experience sharing, and research results exchange among participants, since 90's

GUFPI-ISMA Working Groups (as of today)

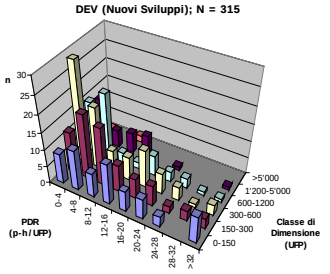
- Counting Practices Committee
- COSMIC Special Interest Group
- Security Metrics Committe
- Software & Systems Standards Committee
- ***Software Benchmarking Committee***
  - ...
  - comparing performances (eg. productivity)
  - ...

Software Benchmarking Committee

- Aims
  - inform members about new and relevant publications and to collect metrics standards which are publicly known
  - promote data collection / ***analysis***
  - liaise with international bodies such as ISBSG
  - establish agreements with other Research Institutes to promote joint research initiative
- Outputs
  - ***Data Analysis Activities/Results***
  - Integration with International Benchmarking Databases
  - ***Methods Analysis Activities/Results***

Past Works

- Numerical Analysis
  - Descriptive statistics of ISBSG D&E data v8 & v9
  - Projects' size «ranges»
  - Distribution analysis per ranges (eg. PDR
  - Discriminant Analysis on ISBSG D&E v9



DEV Size Classes (UFP)

XS	0-150
S	151-300
M	**301-600**
L	601-1.200
XL	1.201-5.000
XXL	>5.000

- Publications
  - International events (since 2003)
  - GUFPI-ISMA textbook – Ch. 21 (2006)
  - «***Benchmarking Glossary***» (2009, ongoing)

Taxonomy of Productivity Impact Factors (PIF's)

- A weel-reasoned list of relevant factors for use in productivity analysis/estimation of (dev. & enh.) software projects, to be
  - self-consistent
  - homogeneous
  - exhaustive

why...?

Why a general Taxonomy of PIF's

- $Effort = f\,(SW\_Size, Process/Project\_Aspects)$

- Several models exists – each using a (slightly/largely) different set of process/project (& product) characteristics

- We should speak the same «language»
  - A commonly defined list of factors (a «shopping list») for instantiating any real model (just as FP for FUR's)

Simple examples (real issues)

- Model A «Staff Tool Skills» vs.
  Model B «Analyst Capability»
  (and Model B «Programmer Capability»)

- Model C «Online Data Input» vs.
  Model C «Online Update»
  (same model, not independent factors!)

- Model D «Stability» vs. Model E «Stability», but different definitions or even different topics!

Research Methodology

1. Identification of existing models/frameworks
2. Factors extracted from each model/framework
3. 1st level classification for grouping (4 classes)
4. Factors mapping from different models/f's onto a single list of (standard) PIF's (per class)
   - Redefinition of specific PIF where appropriate (no «new» PIF actually added/invented)
5. Reverse mapping of starting PIF's onto the (standard) unique PIF's list for further analysis
   - Most step: double/independent + cross-check

#	Ref.	Desc	PIF
1	COCOMO	Constructive Cost Model II (Boehm et al.), 2000.	22
2	MKII	General System Characteristics, MK II Counting Practices Manual, UKSMA, v. 1.3.1, 1998.	25
3	MAX_FORS	Factors list in “Benchmarking SW Development Productivity”, IEEE Software, Jan-Feb 2000 (Maxwell/Forselius).	8
4	MAXWELL	Excerpt “Applied Statistics for SW Managers”, Maxwell, 2002.	18
5	CPM	General System Characteristics, IFPUG Function Point Counting Practices Manual, v. 4.2, 2004.	14
6	GSM	Guideline to Software Measurement, v. 2, IFPUG, 2004.	42
7	LGC	Linee Guida per l'uso Contrattuale dei FP, GUFPI-ISMA, 2006.	36
8	ISBSG	ISBSG repository/glossary, 2007.	16
9	ACME1	Parametri courtesy «ACME 1», 2007.	19
10	ACME2	Parametri courtesy «ACME 2», 2007.	17
11	ACME3	Parametri courtesy «ACME 3», 2007.	25
12	ACME4	Parametri courtesy «ACME 4», 2007.	20

Remarks

- No pre-existing model is ever identified as «the» correct framework
- No numerical values, scales, or formulae are collected to assess any PIF and/or derive effort
  - First aim: sharing the same way of identifying/understanding the PIF's
  - Further goal: quantitative research, based on the taxonomy itself (next steps)
- The PIF's are productivity factors, NOT size adjustment factors
  (although some pre-existing models used them that way)

Classes

Class	Description	
PERS	Personnel: groups all characteristics related to the staff involved in the software development/enhancement project/process.	Who
PROC	Process: groups all characteristics related to the work process and the project management approach being adopted.	How (logical)
PROD	Product: groups all characteristics related to the software product being developed or enhanced.	What
TECN	Technology: groups all characteristics related to the technology being used (or required) for developing or enhancing the software.	How (physical)

And the factors mapping results are...

. . .

(skipping boring steps that required «several» person hours
by about ten people in SBC, with double/checks, and management)

Taxonomy PIF's / Class: PERSONNEL

ID	PIF	Description	Models#	Factors#
PERS1	Domain Knowledge	Level of knowledge/experience about the application domain by the project team.	7	8
PERS2	Personnel Capability	Capability and experience of team members in analysis, design, programming, communication and cooperation tasks, as well as in terms of autonomy and efficiency.	8	13
PERS3	Technology Knowledge	… … …	9	12
PERS4	Team Turnover	… … …	9	14
PERS5	…	… … …	5	10
PERS6	…	… … …	1	1

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Taxonomy PIF's / Class: PROCESS

ID	PIF	Description	Models	Factors
PROC1	Organization Maturity	Level of efficiency/effectiveness in use, consolidation and/or standardization of methods, techniques and practices used in development and project management (CMMI, SPICE, etc.).	6	16
PROC2	Schedule Constraints	Project constraints regarding, or resulting from, pressing requirements on release timing.	5	5
PROC3	Requirements Completeness	… … …	9	13
PROC4	Reuse	… … …	2	3
PROC5	Project Type	… … …	3	5
PROC6	Methodology	… … …	4	5
PROC7	…	… … …	6	8
PROC8	…	… … …	2	2
PROC9	…	… … …	5	7

Taxonomy PIF's / Class: PRODUCT

ID	PIF	Description	Models	Factors
PROD1	Product Size	Properties related to the software product size (functional size, volume of the database, etc.).	5	6
PROD2	Product Architecture	Properties related to the product architecture, such as amount of installation sites, method of processing logic distribution, etc.	7	12
PROD3	Product Complexity	… … …	8	8
PROD4	Other Product Properties	… … … (*)	10	38
PROD5	Required Documentation	… … …	6	7
PROD6	…	… … …	4	7
PROD7	…	… … …	4	4

Taxonomy PIF's / Class: TECHNOLOGY

ID	PIF	Description	Models	Factors
TECN1	Programming Language	Programming language type (language generation, level and/or language(s) specifically used).	2	2
TECN2	Development Tools	Framework, tools, DBMS, utilities for developing, testing, configuring and/or deploying the software product, impacting its implementation.	7	12
TECN3	Technical Environment	… … …	4	4
TECN4	…	… … …	2	2
TECN5	…	… … …	8	11

Summary Distribution of PIF's

Class	PIF's	*Percent*	*Remaps*	*Percent*
Personnel	6	22%	39	26%
Process	9	33%	42	29%
Product	7	26%	44 (*)	30%
Technology	5	19%	23	15%

- Minor/major frequencies do NOT denote relevancy of impact on productivity
  - Possibly due to ease of assessment / historical analysis of specific factors
  - Depends on some groupings in the final PIF's (*)

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Collateral Assessment: Visibility/Measurability (1/2)

ID	PIF	Visib.	Measur.
PERS1	Domain Knowledge	High	High
PERS2	Personnel Capability	High	Avg
PERS3	Technology Knowledge	High	High
PERS4	Team Turnover	High	High
PERS5	...	High	Avg
PERS6	...	High	Low

ID	PIF	Visib.	Measur.
PROC1	Organization Maturity	High	Avg
PROC2	Schedule Constraints	High	High
PROC3	Requirements Completeness	Avg	High
PROC4	Reuse	High	High
PROC5	Project Type	High	Avg
PROC6	Methodology	High	Low
PROC7	...	High	Avg
PROC8	...	High	Avg
PROC9	...	High	High

Collateral Assessment: Visibility/Measurability (2/2)

ID	PIF	Visib.	Measur.
PROD1	Product Size	High	High
PROD2	Product Architecture	High	High
PROD3	Product Complexity	High	Low
PROD4	Other Product Properties	High	Avg
PROD5	Required Documentation	High	High
PROD6	...	High	High
PROD7	...	High	High

ID	PIF	Visib.	Measur.
TECN1	Programming Language	High	Low
TECN	Development Tools	High	Low
TECN	Technical Environment	High	Low
TECN	...	Avg	High
TECN	...	High	Avg

→ Suggests for missing metrics / topics to develop

Remarks

- The Taxonomy led from

  approx 250 factors (original models, with duplicates or breakdowns) to 27 PIF's
  (remapped onto ca 150 «clean» original factors)

- PIF's are split onto 4 classes
  for ease of use and sub-selection
  - 5 to 9 PIF's per class

Conclusions

- The proposed taxonomy can be mapped onto any existing model / framework (and viceversa)
- The taxonomy therefore allows to
  - ease comparisons between models
  - build general estimation models or schemes
  - standardize productivity analysis («same language»)
- The taxonomy is recommended for practical usage... how?

How to, and Next Steps

- You!
  - May apply for the full Taxonomy
    (directly or through your Association, it's free, but traced)
- SBC
  - Factors usage survey (and validation)
  - Quantitative research (assessments, weights, etc.)
- GUFPI-ISMA
  - → ISBSG: proposal for adoption/refinements of glossary and data attributes collection
  - → MAIN → Community: standard reference scheme for productivity research

Contact / Application

- Feedback/comments/survey participation highly recommended and welcome, pls write @

luca.santillo@gufpi.org
guido.moretto@gufpi.org

- Upon application, you get a full version of PIF descriptions, and further updates … thanks!

Question Time