



# UK COSMIC Special Interest Group

Meeting 2

17<sup>th</sup> October 2014

# Agenda

1. Introductions (brief round table)
2. Feedback from COSMIC Annual meeting in Rotterdam (CS/CW)
3. Feedback on key papers from IWSM Conference Rotterdam (CS/CW)
4. Measurement Practices Committee progress (CS)
5. Benchmarking Needs (Carol Buttle)
6. The role of COSMIC sizing in projects from requirements to implementation – exchange of experience (Bernard Londeix)
7. Use of COSMIC in Agile projects – update from research in Canada, experience in Aon Australia (CS + discussion)
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9. Update from UKSMA (Mike Eagles)
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# IWSM 2014 / NESMA 25<sup>th</sup> Anniversary Conference



- ~ 60 papers, workshops, etc. very good quality
  - 135 attendees
  - NESMA now an 'international brand'
- [www.nesma.org](http://www.nesma.org)

All papers available via: <http://www.computer.org/portal/site/store/index.jsp>

Slides for many COSMIC-related papers available via: [www.slideshare.net/cosmic-fsm](http://www.slideshare.net/cosmic-fsm).

# Keynote: further progress with using COSMIC at Renault

*“Manage the automotive embedded software development cost & productivity with the automation of a Functional Size Measurement Method (COSMIC)” Alexandre Oriou et al*

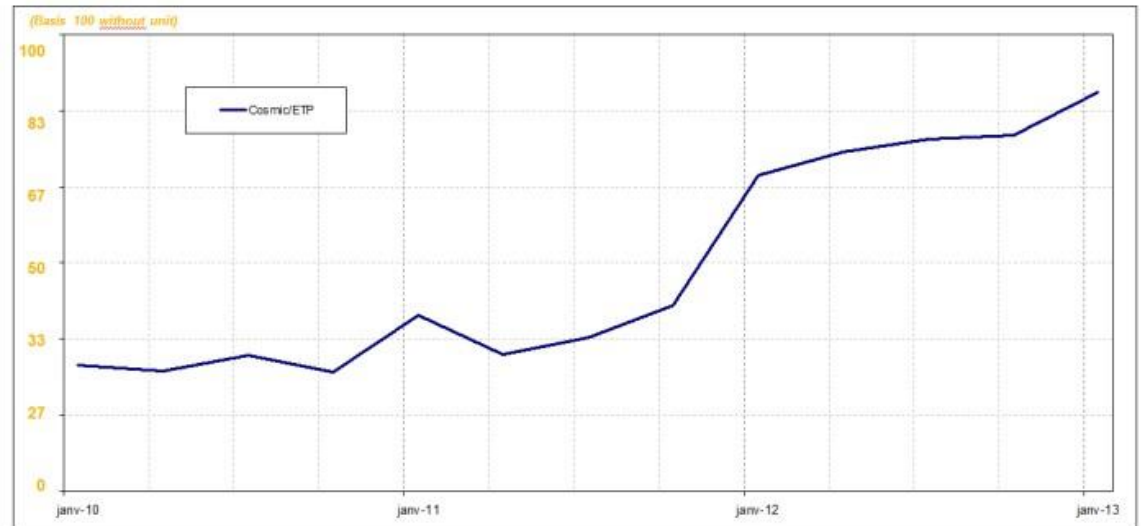
- 50 – 100 ECU’s per car, getting bigger and bigger
- ECU designs in Simulink, size measured automatically at ‘block’ level
- Example Body Control ECU: size 2000 CFP, 4 days to measure manually
- Entire Simulink model: 4670 blocks, 1 hour to measure automatically

# Some results

## Body Control ECU. Effort vs CFP

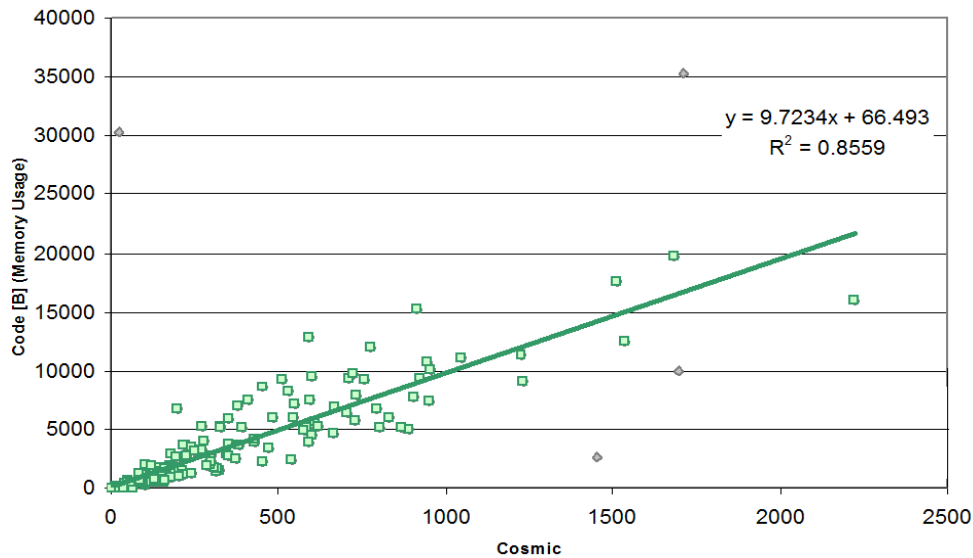


## Control of Powertrain software team productivity : Production of CFP / FTE



# More Renault results

CFP used to predict ECU memory size, months before production



CFP used to track progress of design teams

Delivery reference	1	2	3	4	5	6	7	8	9	10
Volume of specification (basis on 100)	68	72	75	77	81	86	89	91	98	100
Intelligent teams added specifications	0	1	0	1	1	1	1	2	1	2
Produced CFP	14	20	24	19	23	25	26	29	31	26
FTE (Mj)										
FTE (Cycle)										

Renault intends to commercialize the tool for measuring CFP in Simulink

Suppliers now using same automatic measurement processes

# Functional Size Measurement automation

- (See Renault Keynote) + *“Verifying the Accuracy of Automation Tools for the Measurement of Software with COSMIC – ISO 19761 including an AUTOSAR-based Example and a Case Study”*, Hassan Soubra, etc, Esteca, France
- *“Automatic COSMIC sizing of requirements held in UML”*, Jaroslaw Swierczek, 300 D&C, Warsaw, Poland in the ‘COSMIC Masterclass’
- *“Measuring COSMIC software size from functional execution traces of Java Business Applications”*, Ayca Tarhan et al, Hacettepe University, Ankara, Turkey
- *“Automated Functional Size estimation using Business Process Models with UPRON Method”*, Banu Aysolmaz, etc. METU, Ankara, Turkey
- CAST automation of FPA from source code, discussed in *‘Lies, damned lies and software metrics’*, Charles Symons.

# Four approaches to automatic CFP measurement

<b>Source</b>	<b>Input</b>	<b>Process</b>	<b>Output</b>	<b>Status</b>
Renault	Simulink blocks	Proprietary tool	CFP	Production
300 DC	UML MSD's	Creative Common Licence tool	CFP	Just available
METU	Event-driven Process Chain	'UPROM tool'	CFP	?
Tarhan	Executing Java code	Advanced prototype	CFP & UML MSD's	Demonstrated to work

# 300 D&C tool: some details

- Pure UML: to work for new developments and enhancement
- Assumptions: Use Case  $\equiv$  Functional Process; Data Class  $\equiv$  Data Group
- Tool has been developed for Enterprise Architect from Sparx Company but standard proposal is not limited to that software
- Tool consists of:
  - MDG
  - Validation scripts
  - Measurement scripts
  - Documentation generation scripts

<http://300dc.pl/oferta/standardy-modelowania/>

# CAST Automation of IFPUG measurement

*“CAST Automated Function Points (AFP) capability is an automatic function points counting method based on the rules defined by the IFPUG.*

*CAST automates this counting process by using the structural information retrieved by source code analysis, database structure and transactions.”*

[www.castsoftware.com/products/automated-function-points](http://www.castsoftware.com/products/automated-function-points)

Note: AFP measurements conform to the OMG Automated Function Point Standard <http://www.omg.org/spec/AFP>, which does not distinguish EO's and EQ's.

# Using COSMIC to measure mobile apps

*“Defect Density Measurements Using COSMIC. Experiences with Mobile Apps and Embedded Systems”*, Thomas Fehlmann, etc, Europroject Office, Switzerland

Uses UML models; ties defects to individual data movements

*“Defect Density Measurements Using COSMIC: Experiences with Mobile Apps and Embedded Systems”*, Harold van Heeringen, etc, Sogeti, Netherlands

(This approach assumes all data storage and retrieval takes place in another layer, so unnecessarily replaces Reads and Writes with Exit/Entry pairs)

# (Measurement of) Non-functional Requirements

*“The COSMIC approach for dealing with Non-Functional Requirements (NFR)”*, Chris Woodward, in the ‘COSMIC Masterclass’

*“Estimating the Cost of Heterogeneous Solutions”*, Eltjo Poort, Eric van Vliet, CGI

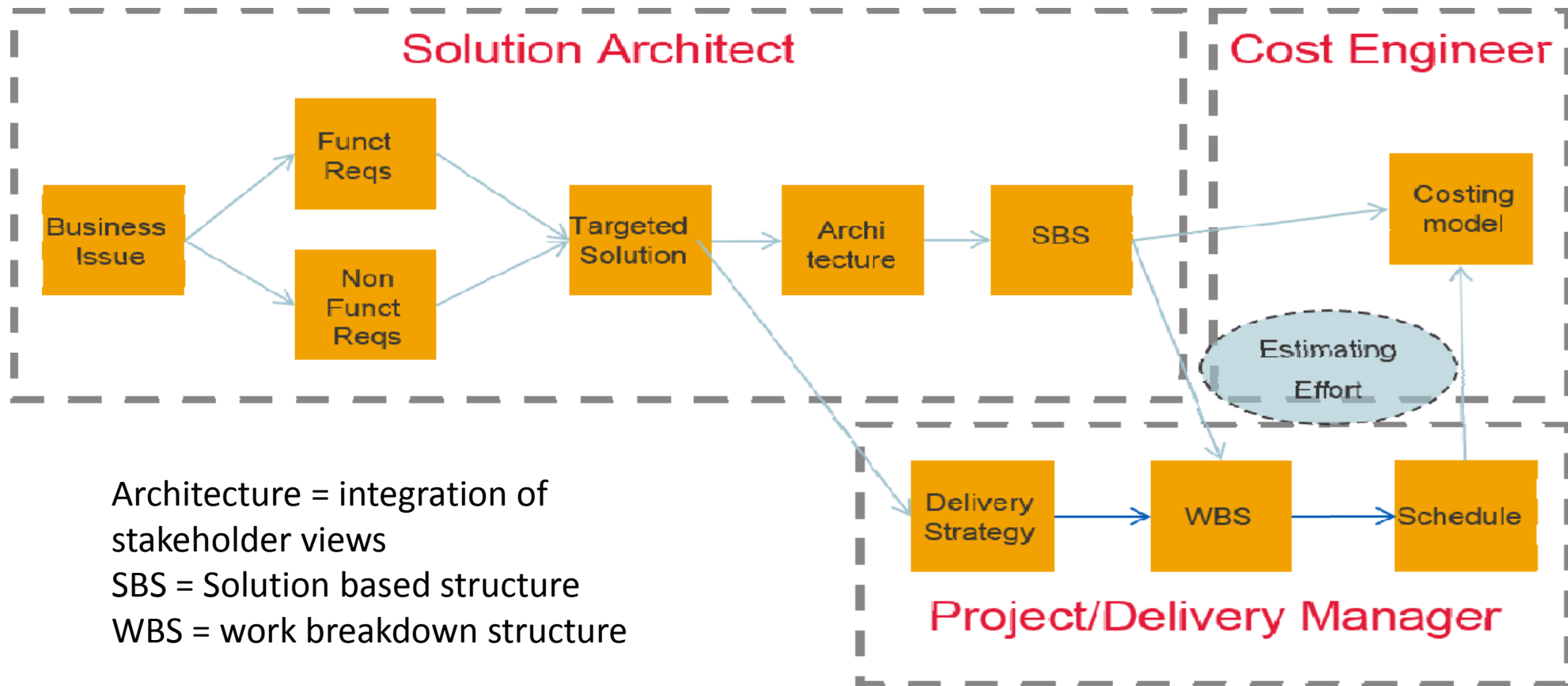
*“Sizing the Entire Development Process Functional and Non-Functional Perspectives”* (aka ‘SNAP’), Mauricio Aguiar, Luigi Buglione (IFPUG)

*“Empirical-based extension of the COSMIC FP method”*, Reiner Dumke et al, University of Magdeburg, Germany

# Poort's challenge: estimating for Enterprise-level systems that are heterogeneous

- *“Enterprise-level solutions are delivered by integrating a wide variety of components (including):*
  - *Bespoke software applications.*
  - *Software embedded in hardware and firmware.*
  - *Many flavors of Commercial Off-The Shelf (COTS)”*
  - *(Non-software deliverables)*
- FSM sizing assumes homogeneity
- ***“The non-functional requirements or quality attributes are the primary driver for the architecture of software-intensive systems”***

# The process by which CGI estimates projects



*“Research shows that applying solution architecture practices is ... correlated with higher accuracy of budget prediction and lower expected budget overruns.”*

# SNAP Results

*“ .... we define these kinds of software requirements as “non-functional” requirements because they are not included in the ISO standard function point methodology in the IFPUG Counting Practices Manual yet require additional work effort to develop.”* (‘Crosstalk’ 25<sup>th</sup> Anniversary edition)

SNAP Beta test results after removing projects with high SNAP points due to Help functionality and increasing the weight of ‘Delivering Value Added to Users through Data Configuration’

N.B. the slope of the fitted line is almost entirely determined by one data point at 4500 SNAP points

Buglione now proposes:

Effort = f(FUR, NFR, project activities) ????

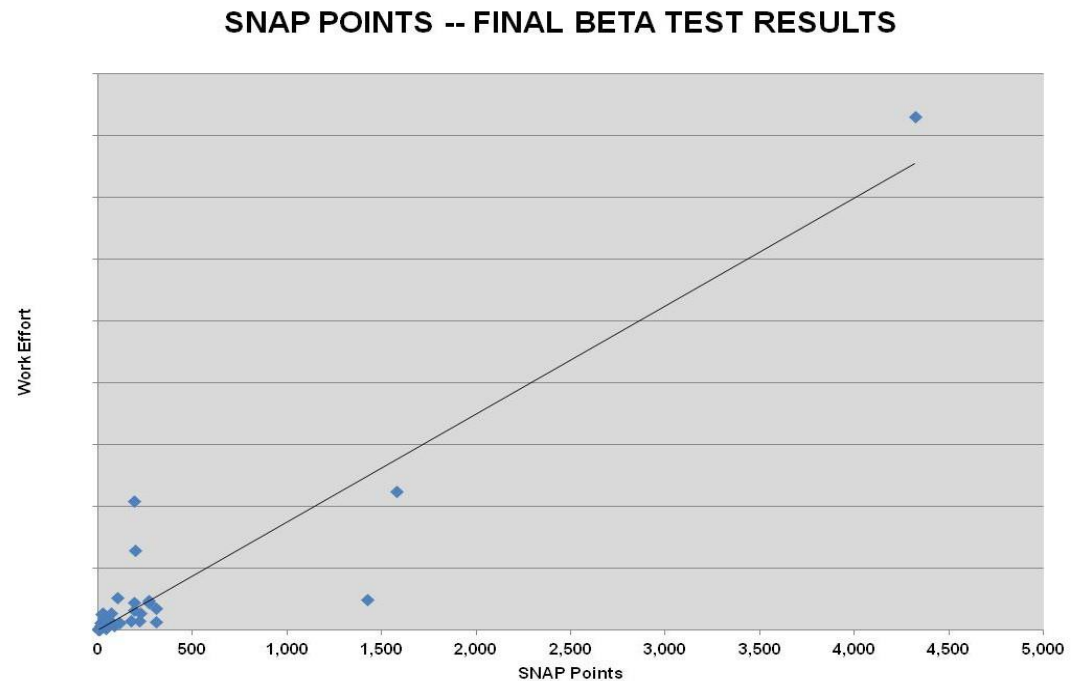


Figure 4:

# Some results for IFPUG/NESMA Enhancement FPA

- *“The added value of enhancement function points: an empirical evaluation”*, Frank Vogelezang, etc, NESMA
- Evaluates NESMA EFP against use of standard IFPUG FP for sizing enhancements
- Recorded EFP and FP for 25 releases of enhancements to a system over 4+ years, and effort for build + test
- Conclusion EFP is less accurate than standard FP for predicting this maintenance effort

# Simple Function Points

*“An Evaluation of Simple Function Point as a Replacement of IFPUG Function Point”*, Luigi Lavazza, Roberto Meli, Italy

- $SiFP = 4.8 \times (\text{no. of EP's}) + 7 \times (\text{no. of LF's})$
- For 766 ISBSG projects,  $SiFP = 0.998 \text{ UFP}$  (after eliminating 321 ‘outliers’!) (with  $R^2 = 0.994$ )

Conclusions:

- SiFP is easier to learn and much faster than FPA
- Neither FPA nor SiFP predict effort very well (with  $R^2 = \sim 0.55$ )
- *“the whole system of rules aimed at the differentiation between EI, EO, EQ, ILF and EIF and at the determination of the complexity of the single BFC (DET, RET, FTR), (is) useless in business terms”*
- SiFP provides a simple way of determining FP sizes from CFP measurement data, if you can match OOI’s to LF’s (Symons observation)

# The project effort vs duration trade-off relationship

*“Lies, damned lies and software metrics”, Charles Symons*

*“Putnam’s Effort-Duration Trade-Off Law: Is the software estimation problem really solved?”, Han Suelmann, CGI, Netherlands*

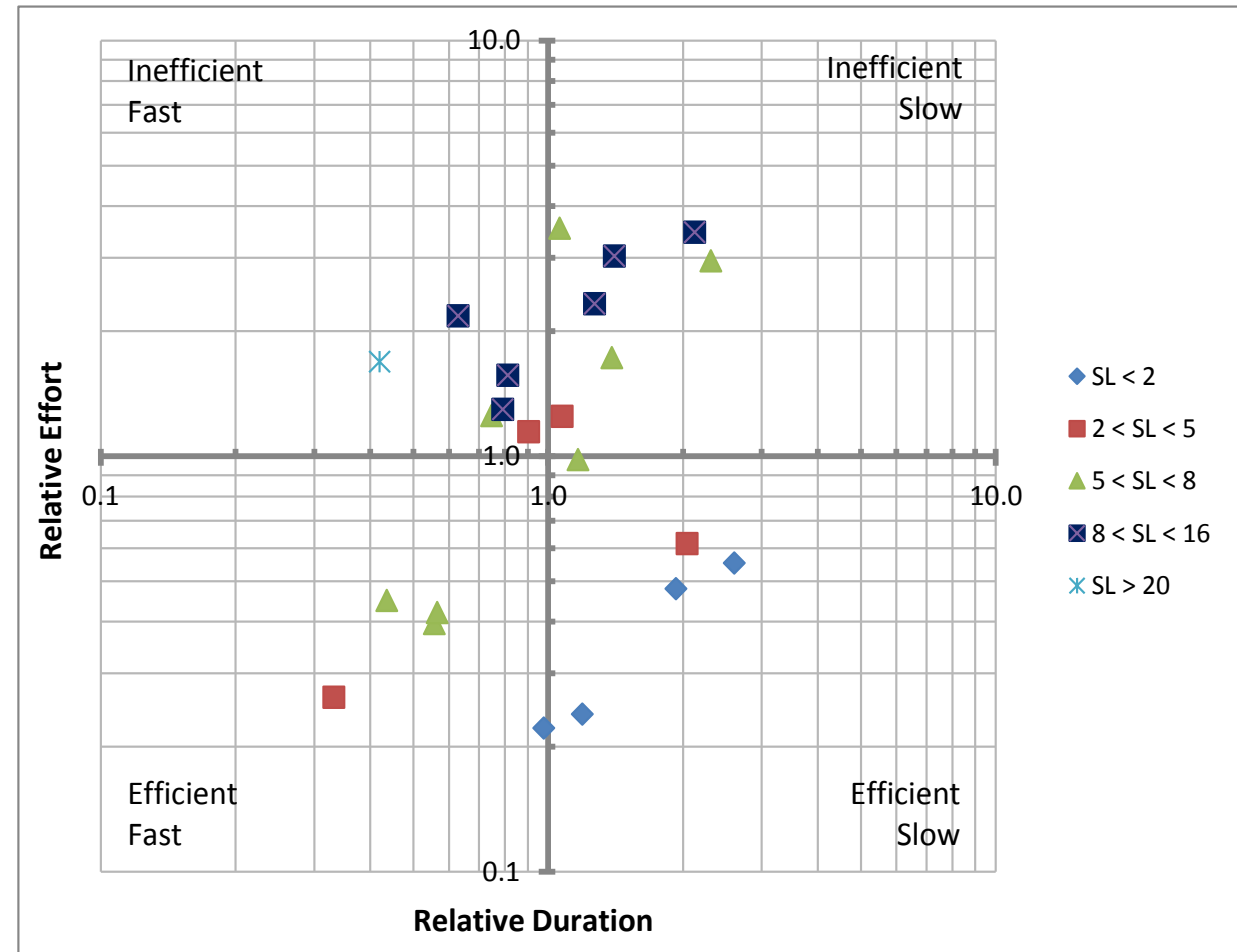
# Analysis can show how projects trade effort and duration

For a homogeneous project dataset:

- Plot effort vs size, and duration vs size on separate graphs
- Fit 'norm' power curves to each graph
- Compute 'Rel. effort' = actual/norm effort for each project;

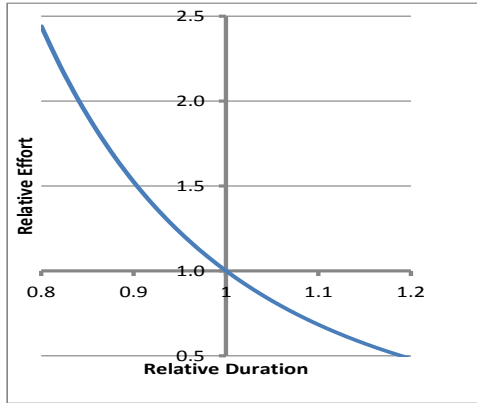
Similarly 'Rel. duration'.

- Plot 'Rel. effort' vs 'Rel. duration' on a log-log graph and distinguish the projects in groups of average staffing level



...but my follow-on analysis of the relationship, relying on the Putnam model, was flawed!

Putnam



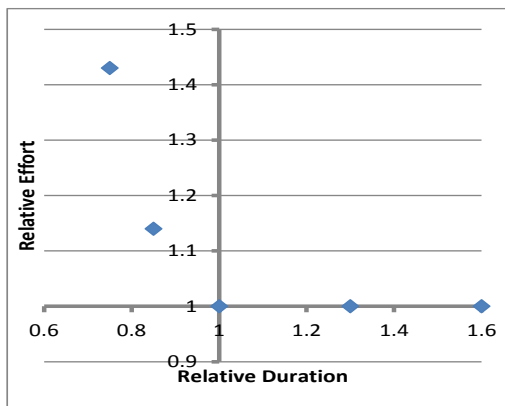
**Unlikely**



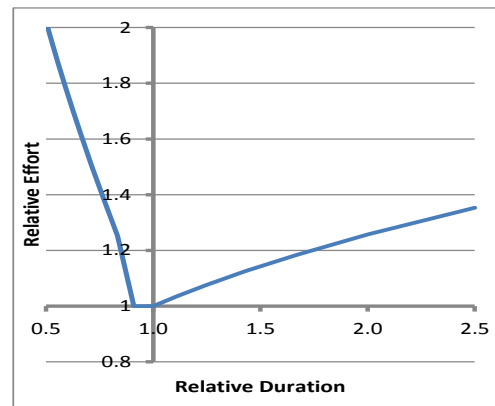
Four theories of the effort/duration relationship for schedule expansion

**Much more likely**

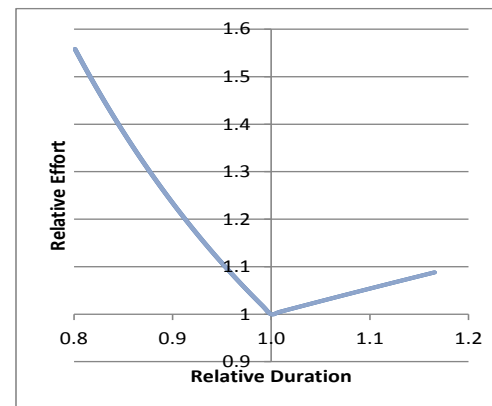
COCOMO



True-S



SEER-SEM



# Suelmann's analysis destroys Putnam's theory

- In 1978, Putnam claimed a 'general empirical solution' for his 'fourth power' effort-duration trade-off law
- His analysis was based a dataset consisting of 13 projects, all stemming from the US Army Computer Systems Command
- The analysis is flawed, confusing cause and effect
- No other study has reproduced Putnam's results
- Suelmann's simulations (work in progress) indicate the other three models are more likely

# Use of COSMIC in Agile Projects for QC

*“Requirements Engineering Quality Revealed Through Functional Size Measurement: An Empirical Study in an Agile Context”*, Jean-François Dumas-Monette, etc., Université du Québec à Montréal, Canada

- Study of five projects in a small software house, experienced in using Agile methods
- All requirements stored as User Stories in a web-based tool
- CFP functional sizes measured at US level
- Requirements quality rated according to COSMIC Guideline
- Preliminary results

# Measurements support process improvement and estimating

Size measurement effort relates closely to requirements quality

Analysis of requirements quality resulted in proposals to improve RE processes

Project Effort vs CFP relationship looks good

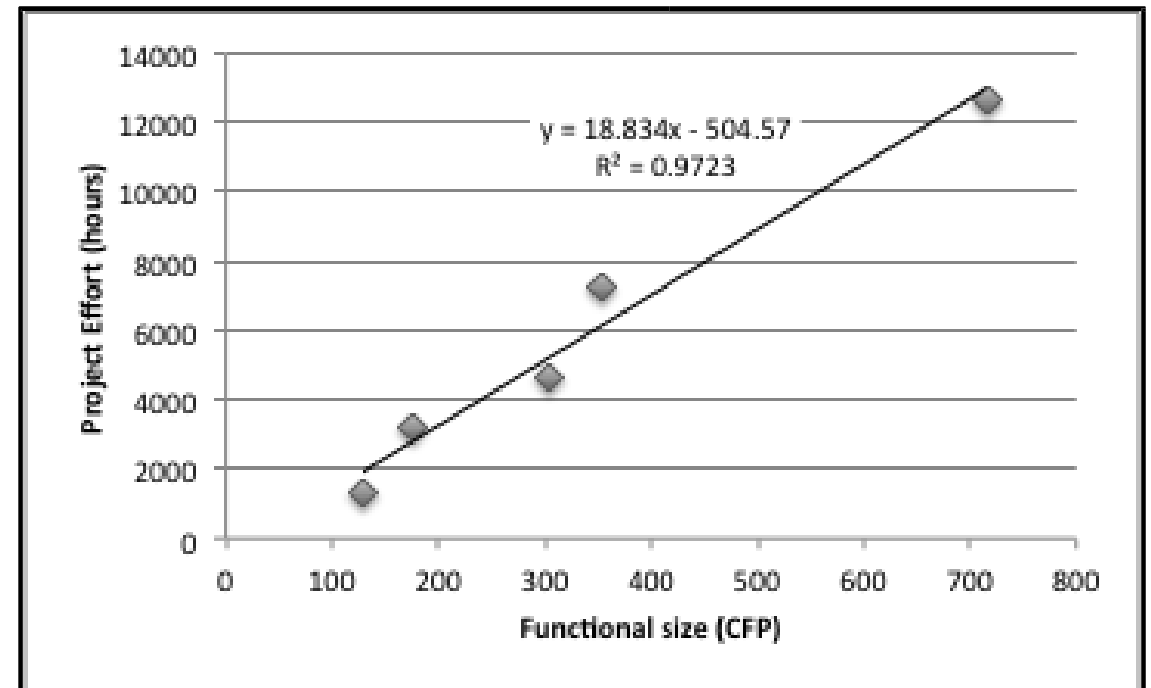


Figure 4. Preliminary estimation model.

# Experience of COSMIC training improvement

*“The Effect of Highlighting Error Categories in FSM Training on the Accuracy of Measurement”, Ali Mert Ertugrul et al, METU, Ankara, Turkey.*

*“In this study, we analyzed the effect of highlighting error categories during training by extracting the errors throughout four years. We showed that, highlighting the frequent error categories during the same training period without a fundamental change in the content would significantly decrease the error rate.”*

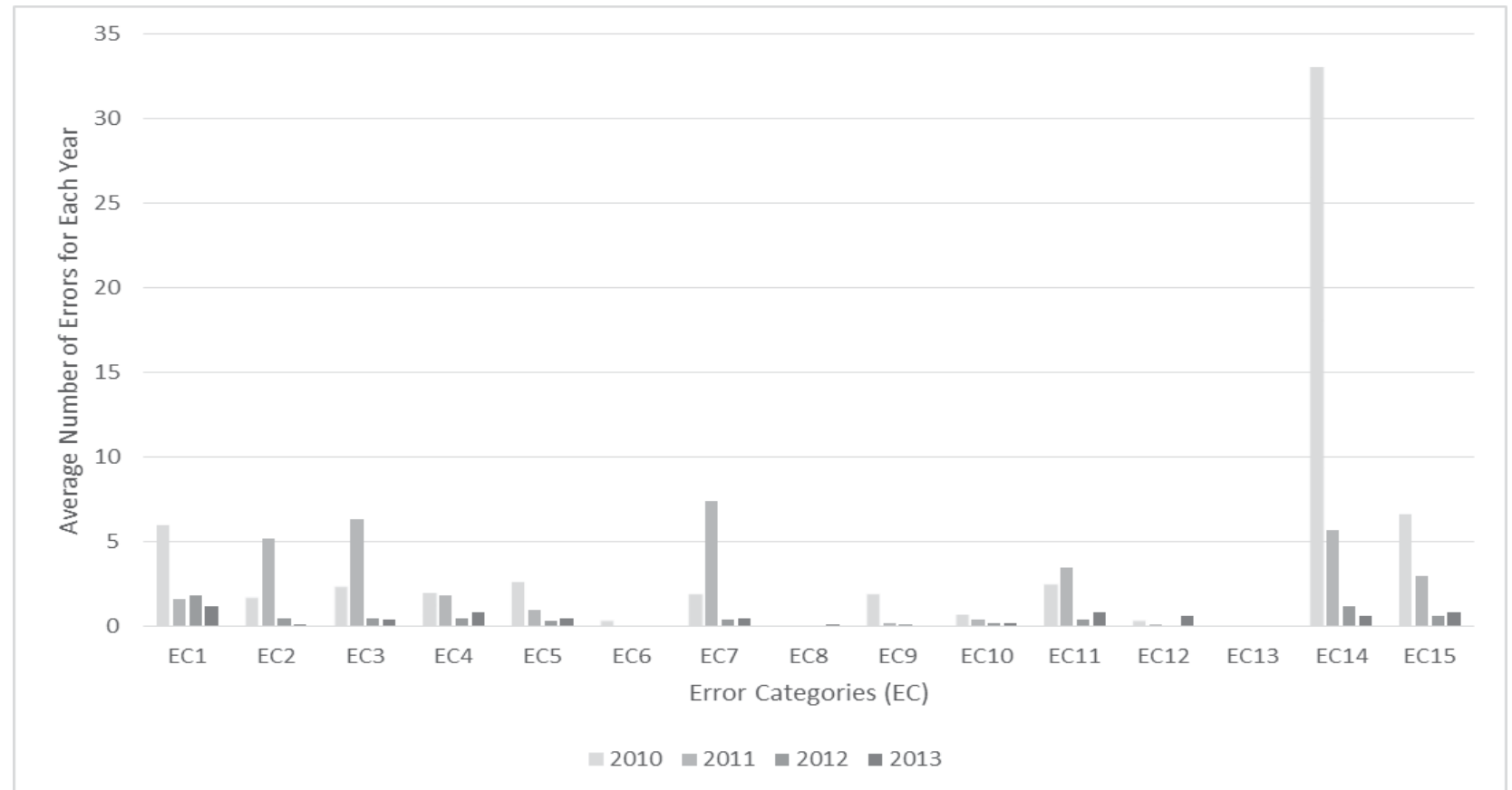
# The study listed '15 error categories'

These are the first four categories

Error Cat.	Name	Description
EC1	Duplicate Functional Process (FP)	<b>If two different FPs have exactly the same (DG, DM) tuple and represent the same functionality of the system, one of these two FPs is redundant.</b>
EC2	Lack of List FP before Update FP	<b>For a specific Update FP, if user forgets to measure its related List FP, measurement may have this type of defect.</b>
EC3	Lack of List FP before Delete FP	<b>For a specific Delete FP, if user forgets to measure its related List FP, measurement may have this type of defect.</b>
EC4	Lack of Retrieve FP before Update FP	<b>For a specific Update FP, if user forgets to measure its related Retrieve FP, measurement may have this type of defect.</b>

# Data shows great reduction in error rates

EC14 - the most common error  
“User interface components and system users are considered as DG’s or as OOI’s”



# NESMA plans to publish a guide for outsourced software contracting

*“FPA and Quality Metrics in Contracts”, Harold van Heeringen et al, Sogeti*

*“This publication zooms in on RFP’s in which Function Points and derived metrics like productivity of the development team and quality of the development process are used. NESMA presents this guideline in order to help client organizations to ask the right questions in the bid phase and the contracting phase.*

*But also for the supplier organizations, it gives directions on which data of completed projects should be collected and analyzed and which metrics should be calculated, stored and benchmarked.”*

# Estimating

*“Project estimating using COSMIC”, Alain Abran, Montréal, Canada, in ‘COSMIC Masterclass’*

*“Software estimating: turning dust into pots of gold”, Alain Abran*

*“Why can’t people estimate: estimation bias and strategic estimation”, Dan Galorath, Galorath Inc., USA*

# Abran and Galorath gave similar messages

Some quotes from Abran's paper: what has NOT changed much with 40 years of estimating experience?

- *“Software managers ... are still expected to meet budget targets and deadlines typically based on imprecise requirements.*
- *Researchers continue to develop increasingly complex estimation models and techniques in pursuit of ‘accurate’ estimates.*
- *Estimation tools ... are still offered for which there is little or no documented evidence on how these tools have performed on projects completed”*

He concludes:

- *“The role of the software estimator is not to promise miracles, but to provide the best and most complete technical information, context, and insights ... i.e. information to support decision making;*
- *The role of the manager is to look at all this information, select and allocate a project budget, and then ... to take risks and manage those risks along the way.”*

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# Measurement Practices Committee progress

## Published

- Measurement Manual, v4.0 + Errata list
- Guideline for sizing business application for v4.0

## Guidelines nearing completion:

- Early and fast approximate size measurement
- Convertibility
- Accounting for Non-Functional Requirements

## Guidelines being updated:

- Real-time, SOA, Data Warehouse, Agile (to do)

## Guideline In development:

- Software Project Estimating

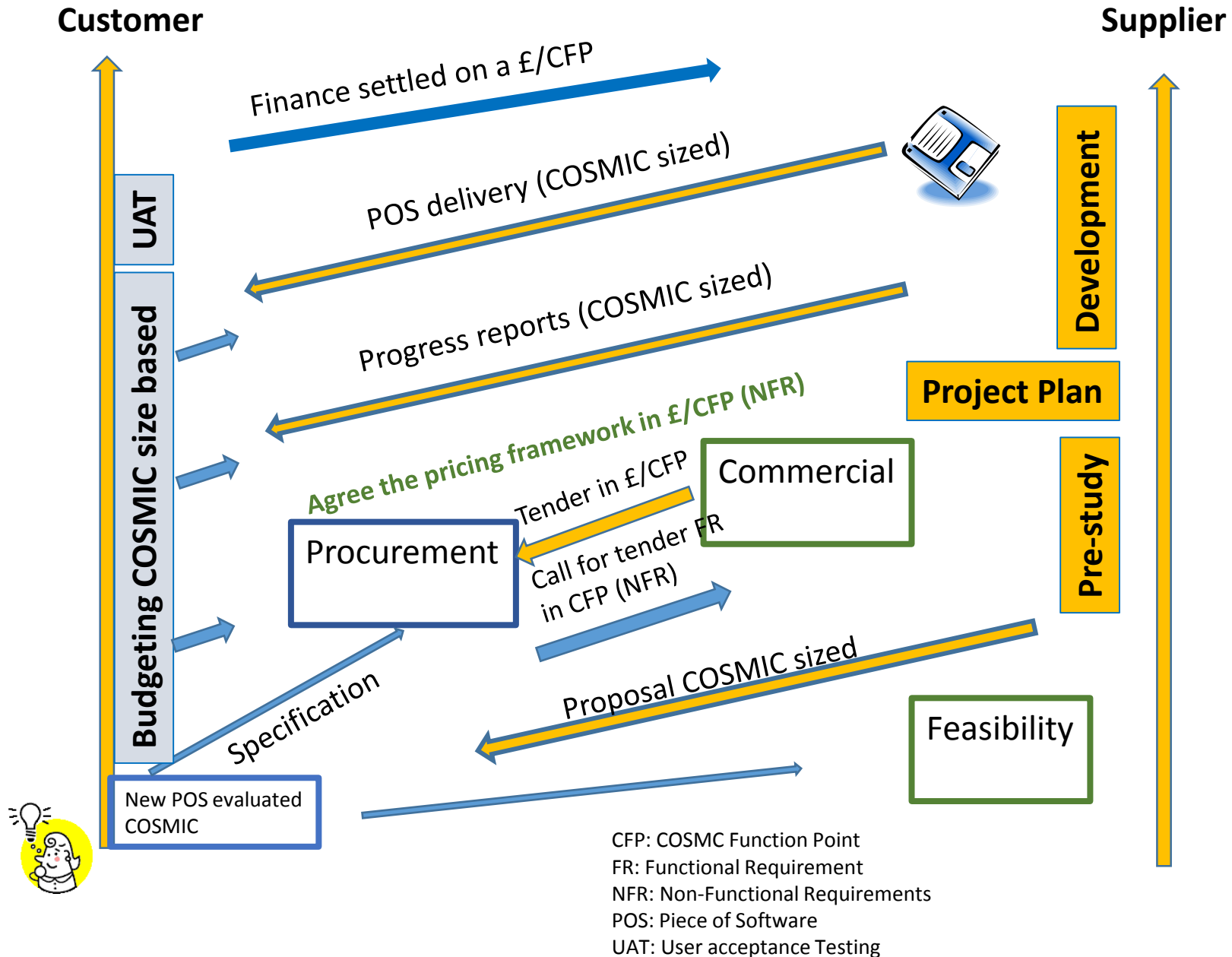
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# A COSMIC Procurement Life Cycle



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# The 'NIITE Proposal' is being re-written starting from our view of the Critical Success Factors for public sector ICT

1. **Continuity:** Maintain and provide assurance of the continuity and reliability of operational ICT-based systems that serve the public at large and public sector employees, including the protection of data at all times, but especially under conditions of change and threat.
2. **Architecture:** Maintain and progressively implement an ICT architecture that has the flexibility to respond economically to policy and organisational changes, to meet evolving user expectations, to allow modernisation and rationalisation of existing systems and to satisfy data privacy and security needs.
3. **Governance Processes:** Master the processes to establish requirements and targets for new and changing systems and to select and manage suppliers of ICT services, external and internal, so as to ensure suppliers meet targets (contractual or otherwise) and deliver demonstrable value for money.
4. **Personal Skills:** Develop and maintain appropriate skills (general and specialised) of public sector employees at all levels.
5. **Research:** Conduct or commission evidence-based research on evolving technologies from which public sector ICT can benefit, and facilitate their adoption where appropriate. Follow the adoption of such new technologies to monitor their effectiveness.
6. **Organisational Learning:** Gather and share project and system performance data and introduce processes to support organisational learning to achieve all of the above CSF's.

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