第三届（2018）

中国软件成本度量大会

暨 IWSM-MENSURA INTERNATIONAL CONFERENCE

Estimation of Software Projects: Placebos or Engineering Practices?

演讲人：Alain Abran

Estimation of Software Projects: Placebos or Engineering Practices?

Alain Abran

SSM & IWSM⁄ MENSURA conferences
Beijing (China) September 19, 2018

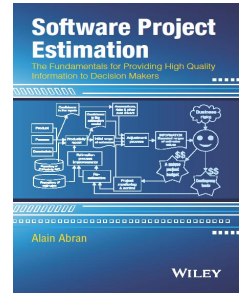
Presenter background - Alain Abran

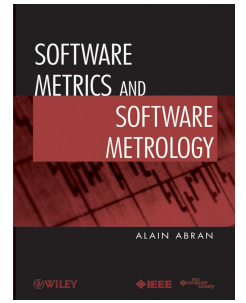
20 years

+ 20 years

45 PhD

ISO: 19761, 9126, 25000, 15939, 14143, 19759





- **Development**
- **Maintenance**
- **Process Improvement**

Agenda

1. Complex Effort Estimation Models: Placebos?
2. A key concept for estimation: simple productivity-based estimation models for monitoring & control
3. Size estimation: The foundation for Effort Estimation

Agenda

1. **Complex Effort Estimation Models: Placebos?**
2. A key concept for estimation: simple productivity-based estimation models for monitoring & control
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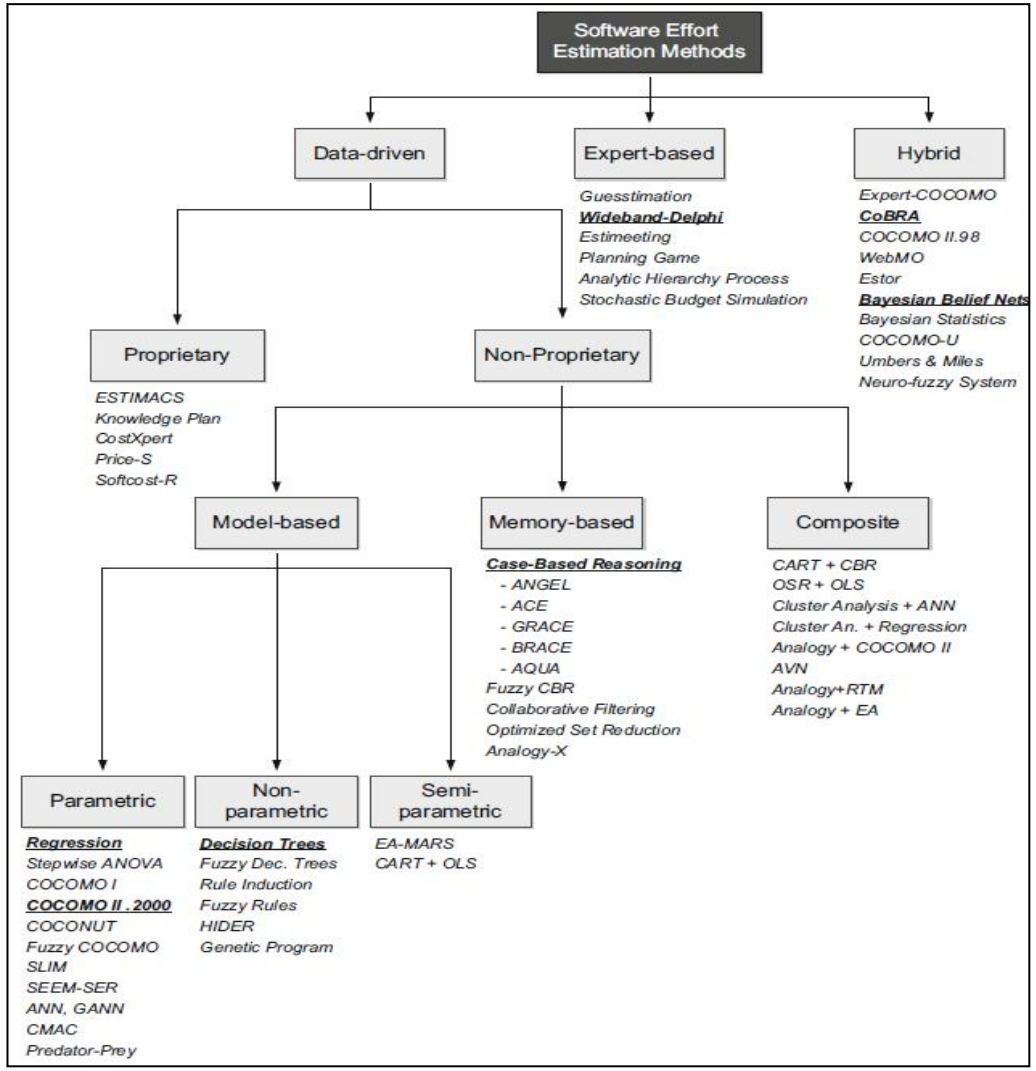
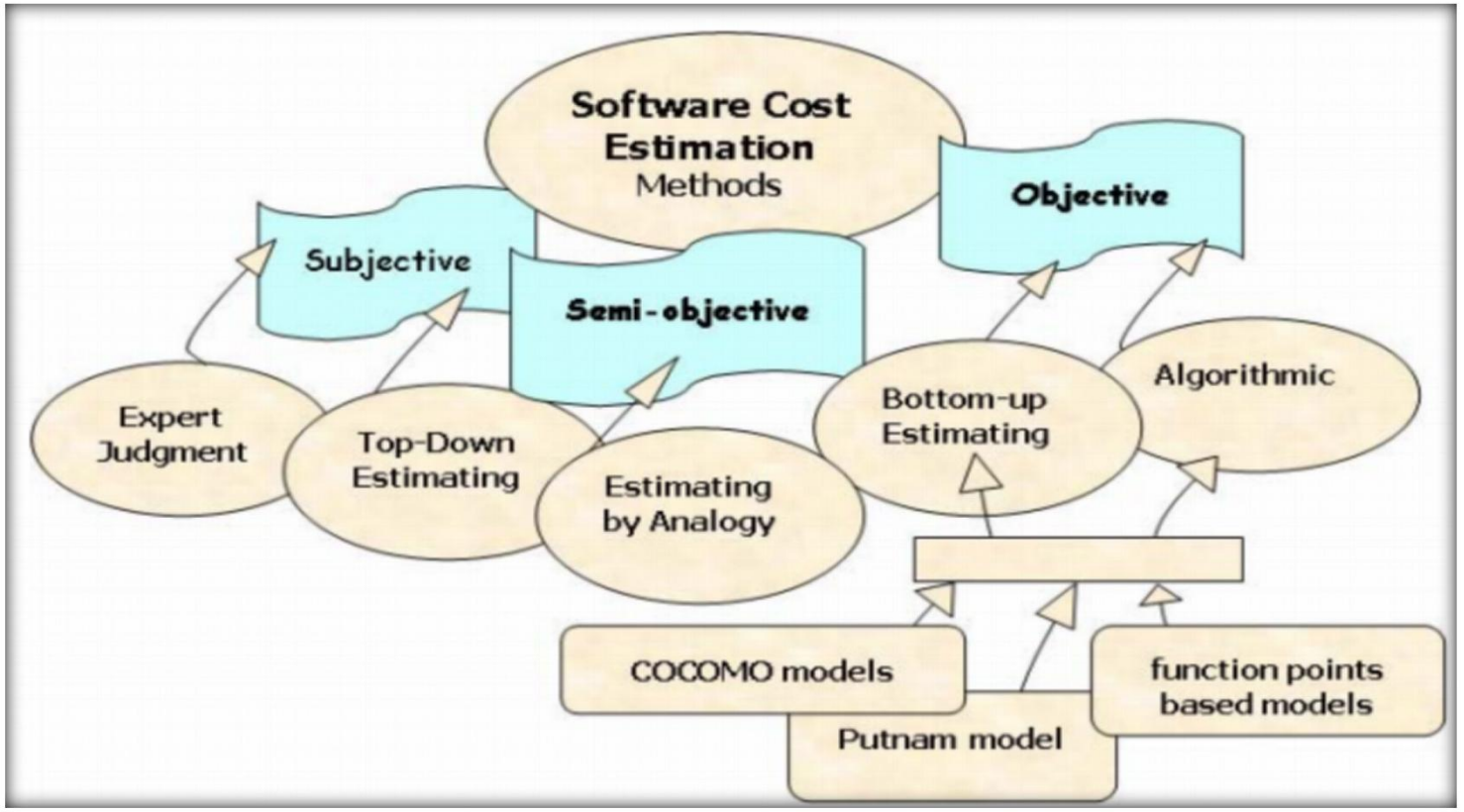
Complex White box & Black Box Effort Estimation Models



Source: Adam Trendowicz, Ross Jeffery. *Software Project Effort Estimation*. Springer, 2014.

Black Boxes & White Boxes Estimation Models



Source: Violeta Bozhikova, Mariana Stoeva. An Approach for Software Cost Estimation. *CompSysTech'10*, June 17–18, 2010, Sofia, Bulgaria, pages 119-124.

Examples of major weaknesses in Estimation Models

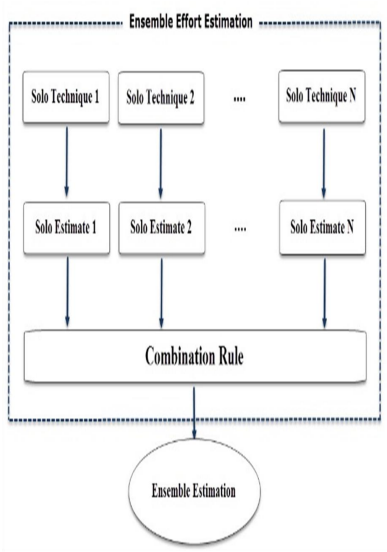
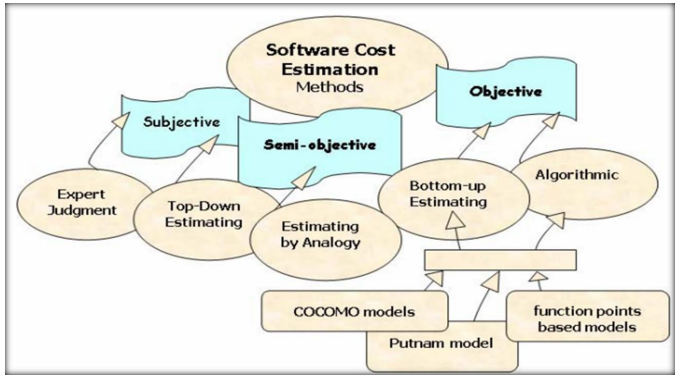


Fig. 1. Ensemble Effort Estimation (EEE) process.



$$\text{Impact of all cost drivers} = \sum_{n}^{i} PF_i$$

$$\text{Effort} = a \times \text{Size} \times \left(\sum_{n}^{i} PF_i\right) + b$$

Sources:

- 'Improved Estimation of Software Development Effort Using Classical and Fuzzy Analogy Ensembles', Idri, Hosni, Abran, Applied Soft Computing, Elsevier, vol. 49, 2016.
- 'On the value of parameter tuning in heterogeneous ensembles effort estimation', Hosni, Idri, Abran, Bou Nassif. In Soft Computing, Springer, 30 November 2017, pp. 1-34

Key Weaknesses in COCOMO-like Estimation Models

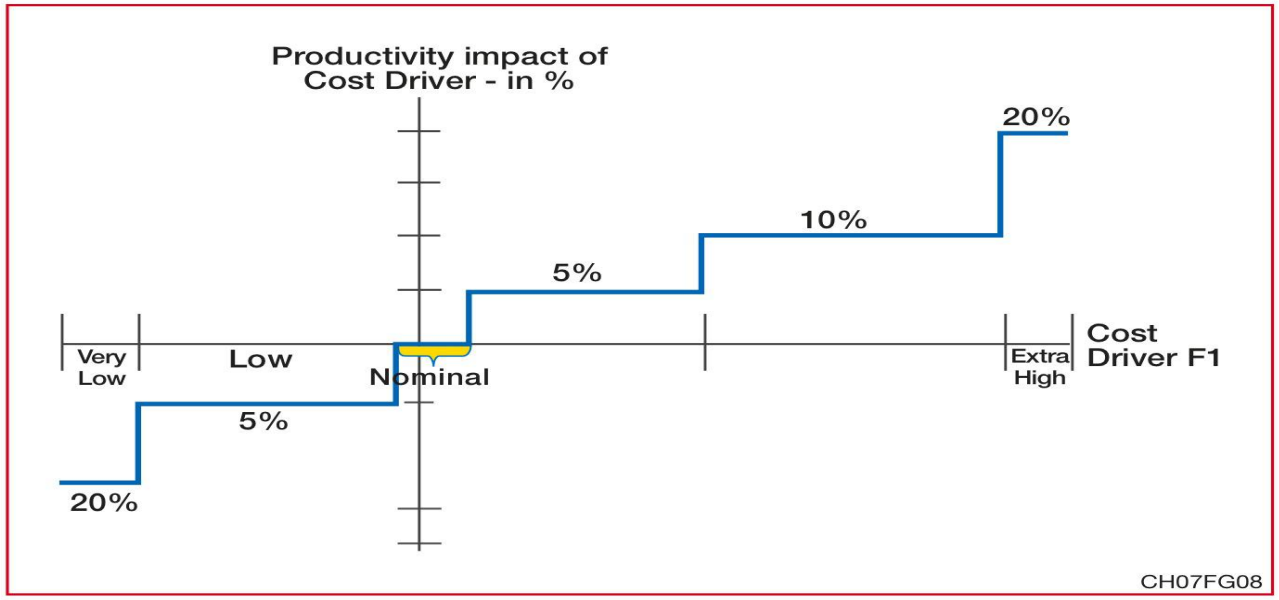


Figure 7.8 A step-function estimation model-with irregular intervals.

Impact guessed by 'experts'

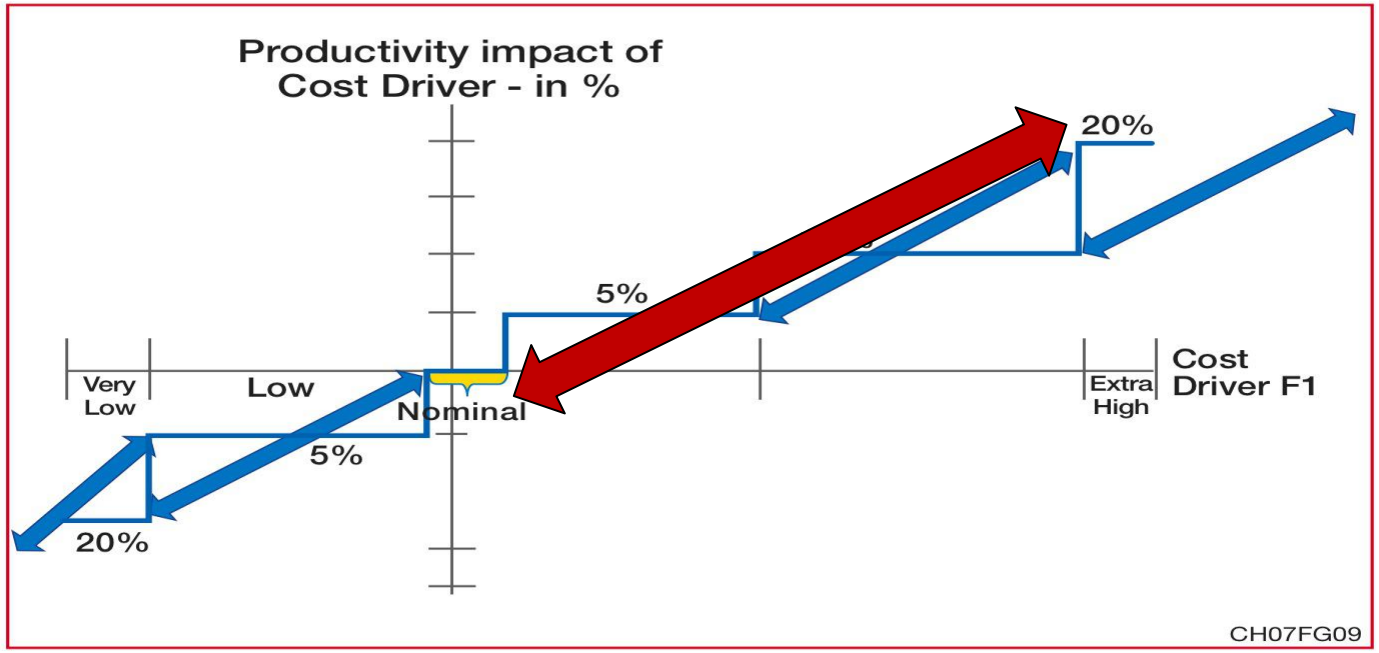
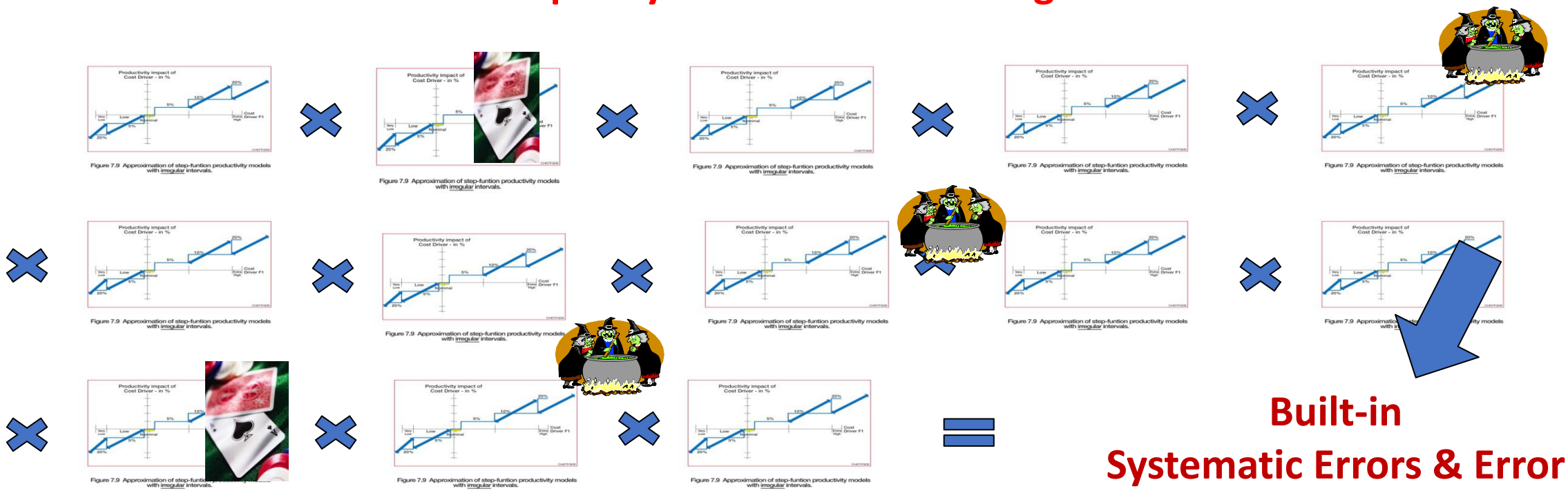


Figure 7.9 Approximation of step-funtion productivity models with irregular intervals.

Each COCOMO cost driver
=

an estimation
sub-model
with unkown quality &
large errors

COCOMO-like estimation models:
Effort is a function of (Size & +17 step-functions)
of unknown quality combined into a single number!



Built-in Systematic Errors & Error Propagation

M.I.T. study on COCOMO81 (Kemerer, 1987)

Small scale replication study - 17 projects

	Basic Exponential on Size	Intermediate & 15 cost drivers	Detailed & 4 project phases
R^2 (max=1.0)	**0.68**	**0.60**	**0.52**
Model Errors **(Mean magnitude of relative errors - MMRE)**	**610%**	**583%**	**607%**

Estimation Outcomes!

The ***'feel-good'***,

Quick & Easy…

Examples of similar ‘feel-good’ inputs to Estimation Models

- Story Points

- IFPUG SNAP points (for Non Functional Requirements):
  - Factors improperly bundled into a single number as adjustments to the Size variable:

Planning Poker & Story Points in Agile: Do they meet measurement criteria?

- Repeatability:
  - different individuals, in different contexts, at different times, & following the same measurement procedures will **NOT** obtain the same measurement results.
- Measurement results:
  - obtained with minimal judgment.
  - results auditable.

FAIL

FAIL

FAIL

Story Points

- **Unaccountability…..!**

Non-Functional Requirements: IFUG **SNAP Points**

Category	Sub-concepts for the classification	SNAP weights basis
Data Entry Validation	Nesting level complexity	2,3,4 * number of DETs
Logical operations	Control flow complexity	4,6,10 * number of DETs
Mathematical operations	Control flow complexity	4,6,10 * number of DETs
Data formatting	Transformation complexity	2,3,5 * DETs
Internal data movements	Internal boundaries crossed DET transferred	5* (# of internal boundaries crossed)+2*(#DETs)
Functionality by data config.	Complexity	3,4,6 * Number of records
UI Changes	UI types complexity	2,-,4 * DETs
Help methods	Help types	1,2,3 * number of Help items
Multiple input methods	Media types	3,4,6 * number of controls
Multiple output methods	Media types	3,4,6 * number of controls
Multiple platforms	No. of platforms to operate	8 * Number of platforms
Database technologies	Level & type of normalization of the physical schema	1,3,4,5,7 * levels of normalization
System configuration		SP=(middleware config.)+2*(# backend config.) +3*(# interface config.)
Batch processing	Number of batches or transactions	2*(number of batches or transactions)
System critical (real-time)	- Type of transactions - No. critical trans.	5,10,15 * number of critical transactions
Component based software	Type of components (In-house reuse or 3rd party component	4,8 * number of unique components
Design complexity	Interface complexity	8,16,24 *# of COTS applications + 12,24,36 *#nonCOTS applications

Scale type		Admissible Transformation	Operations	Examples
Nominal	(R,=)	f unique	Name, distinguish	Colors, shapes
Ordinal	(R,>=)	f strictly increasing monotonic function	Rank, Order	Preference, hardness
Interval	(R,>=,+)	f(x)= ax + b, a>0	Add	Calendar time, temperature (degrees Celsius)
Ratio	(R,>=,+)	f(x)= ax, a>0	Add, multiply, divide	Mass, distance, absolute temperature (degrees Kelvin)
Absolute	(R,>=,+)	f(x)= x	Add, multiply, divide	Entity count

It fails primary school maths!

Feel-Good Placebos

Agenda

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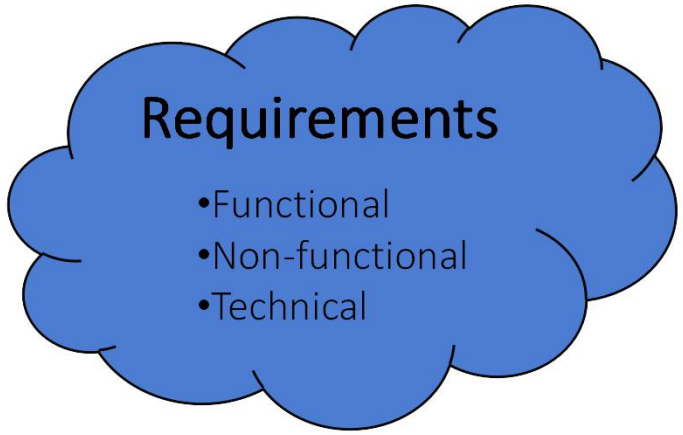
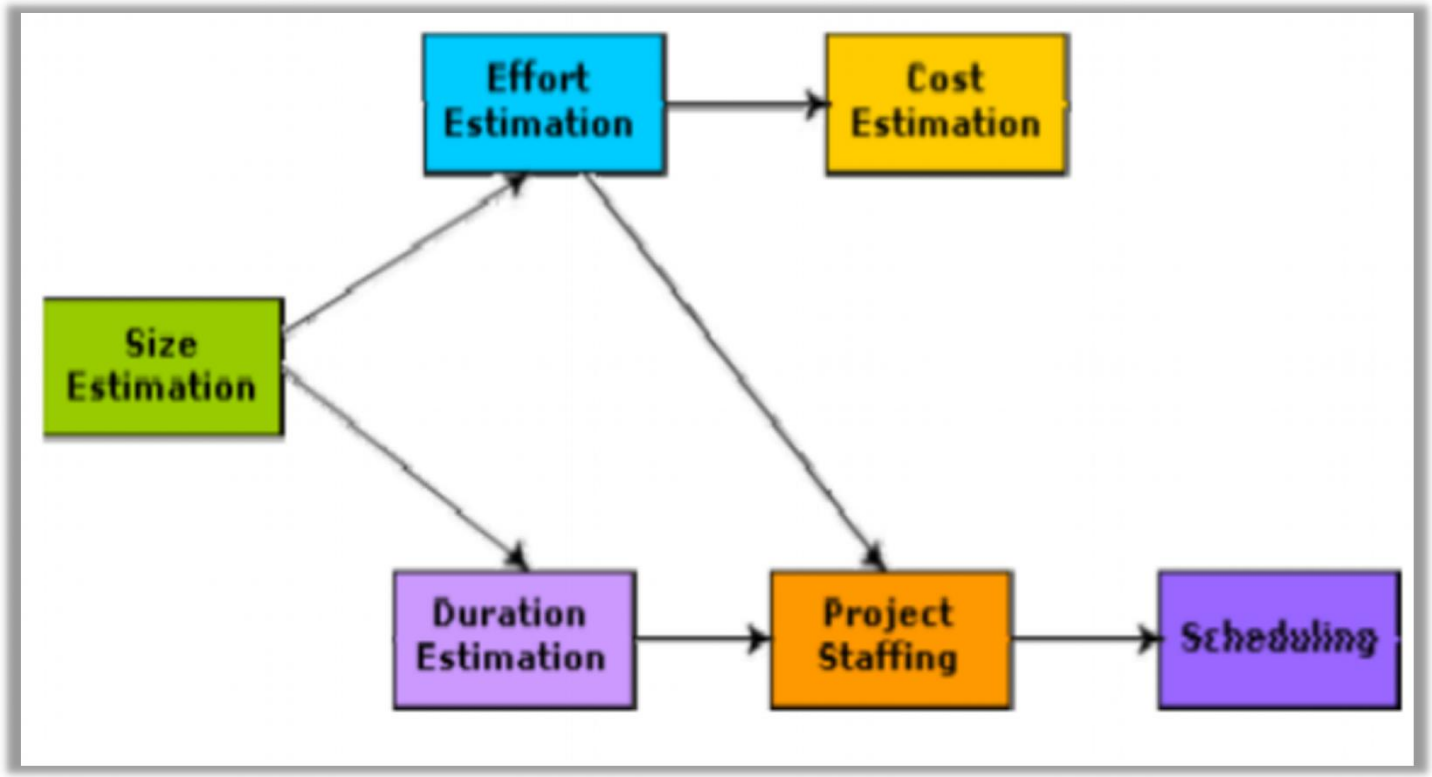
2. **A key concept for estimation: simple productivity-based estimation models for monitoring & control**
3. Size estimation: The foundation for Effort Estimation

The general estimation process

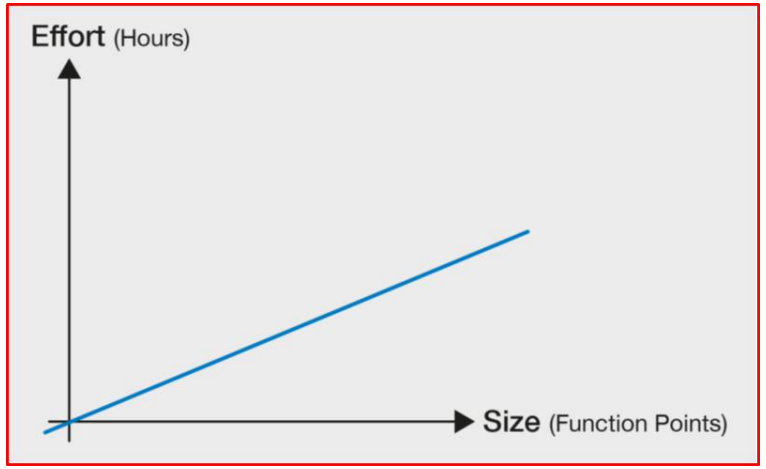




Source: Adapted from [Kharagpur 2010]

Productivity

Productivity = Outputs / Inputs

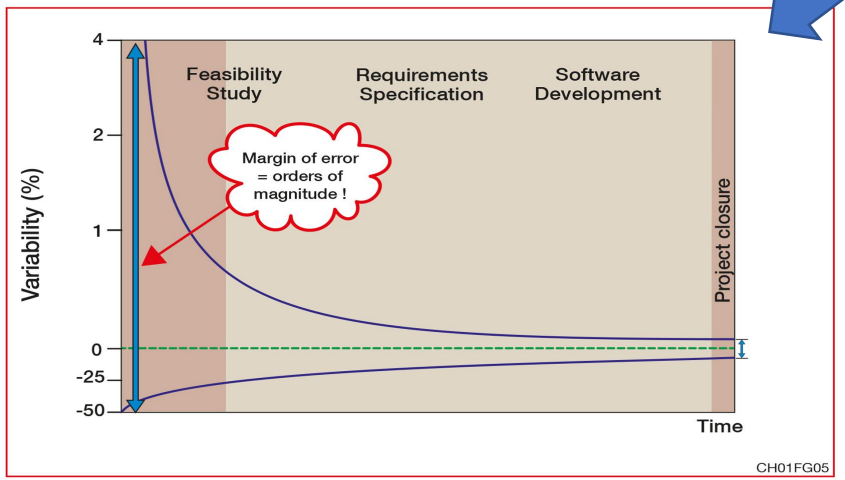


Number of functions delivered
Size in CFP, FP, LOC

Number of worked hours
(Effort in PM or PersonHour)

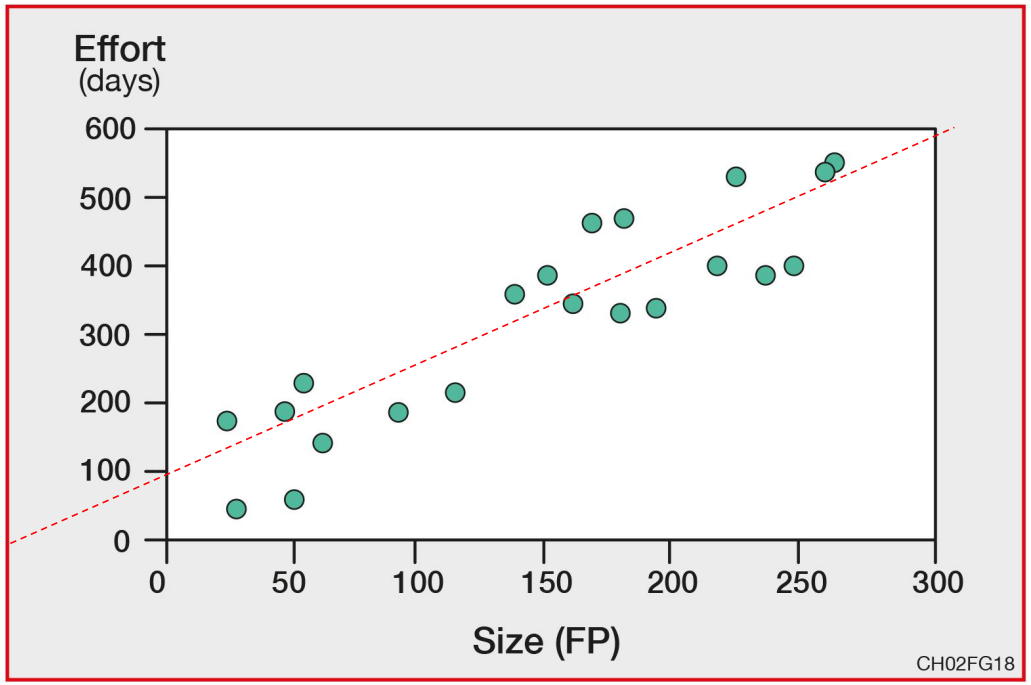
Example: A team developed a software with a size of 100 COSMIC Function Points (CFP) in 5 person month

Productivity = 100 CFP / 5 PersonMonth = 20 CFP/PersonMonth



Organization Data Repository

Software Size as the dominant factor well-managed organizations

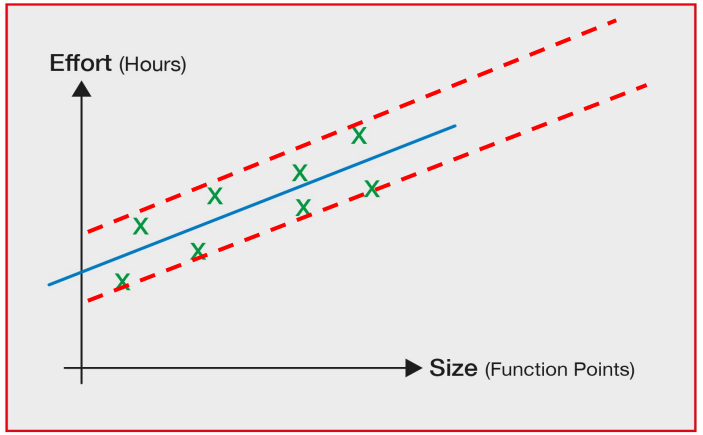


Homogeneous dataset of 21 projects (Abran 1994)

Software Size versus all Other Factors

In well-managed organizations:

- ✓ The increases in functional size explain 80% to 90% of the increases in effort.
  - ➢ All other factors together explain only 10% to 20% of the variations.

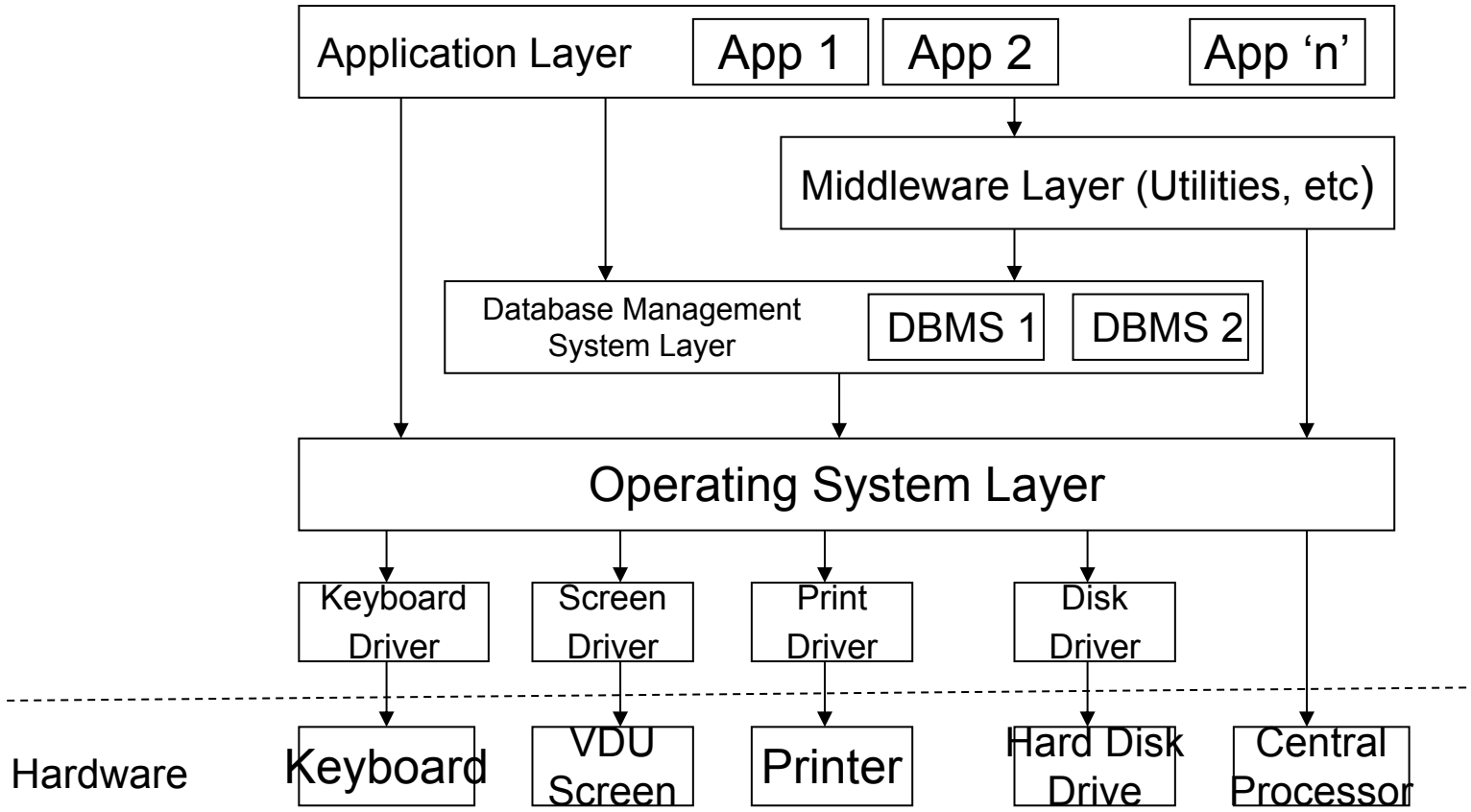


Examples of other factors:

External Interfaces

Non-Functional & Quality

1. Usability requirements
2. Performance requirements
3. Logical database requirements
4. Design constraints
5. Standards compliance
6. Software system attributes



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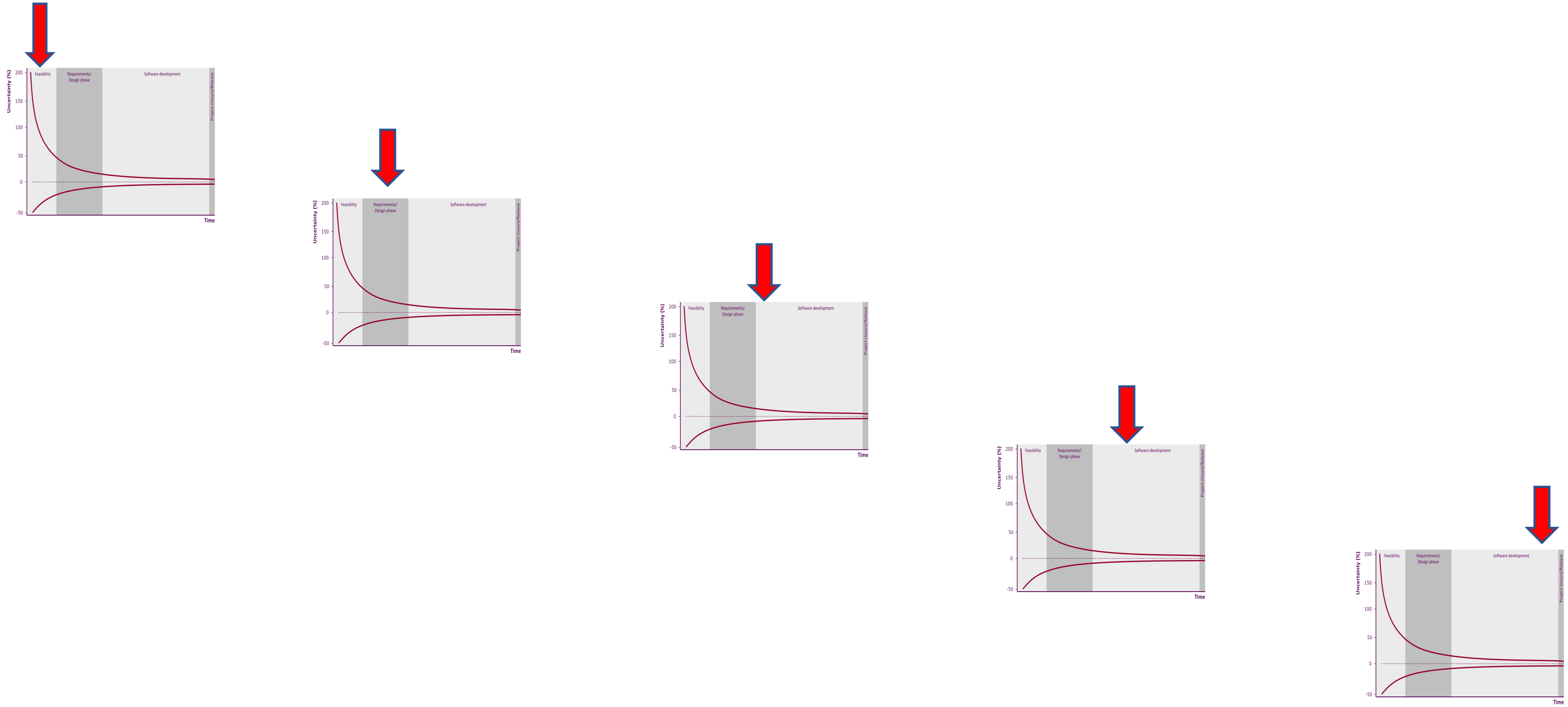
Size & Estimation throughout the lifecycle



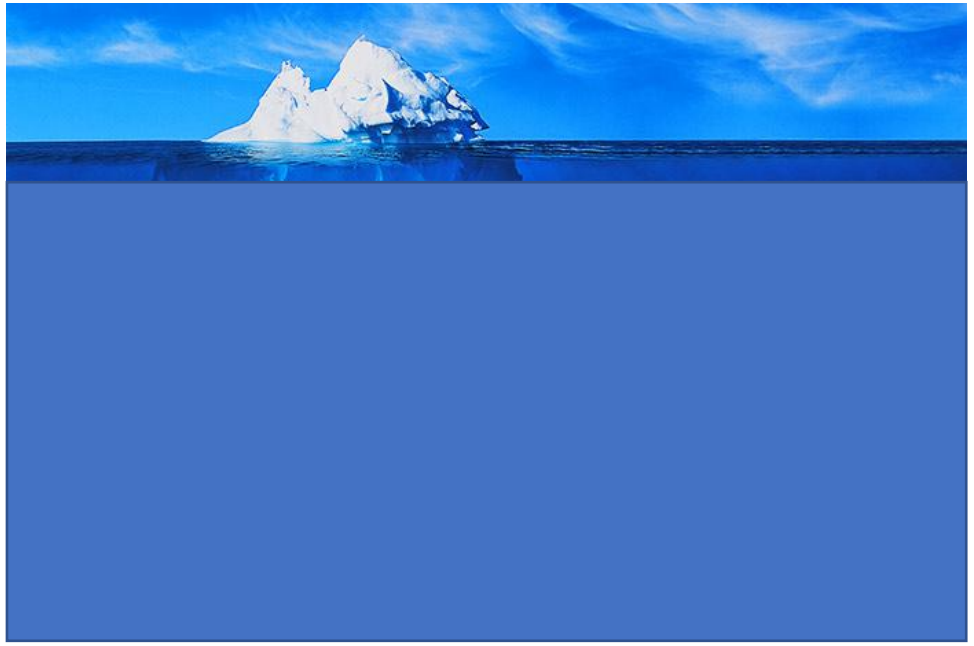
What Size is VISIBLE at Feasibility?

INTERNATIONAL STANDARD **ISO/IEC/ IEEE 29148**
First edition 2011-12-01

Systems and software engineering — Life cycle processes — Requirements engineering

Ingénierie des systèmes et du logiciel — Processus du cycle de vie — Ingénierie des exigences

At feasibility & Early Requirements



What other software functions are not visible yet?

Software Initial Requirements – ISO 29148

Contextual

1. Purpose
2. Scope
3. Product perspective
4. Product functions
5. User characteristics
6. Limitations
7. Assumptions & dependencies
8. Apportioning of requirements
9. Specified requirements

1. Verification
2. Supporting documents

External Interfaces

Functions

Non-Functional & Quality

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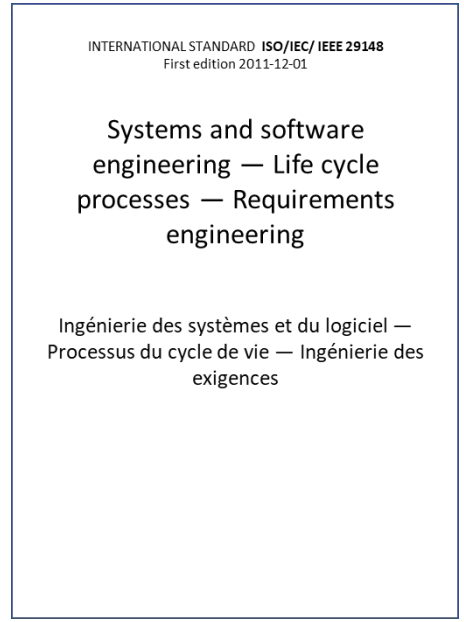
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Software Lifecycle in practice: Early coding

Contextual

1. Purpose
2. Scope
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4. Product functions
5. User characteristics
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7. Assumptions & dependencies
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1. Verification
2. Supporting doc.

External Interfaces

Functions

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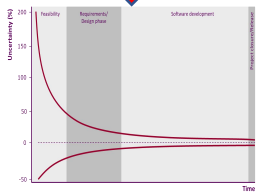

Detailed Software Functions

What Size is still NOT VISIBLE?

Functionality Specified & Approved

What other software functions are not visible yet?

Late at Initial Testing

Contextual

1. Purpose
2. Scope
3. Product perspective
4. Product functions
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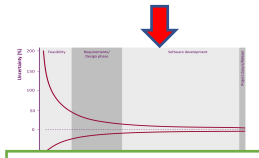
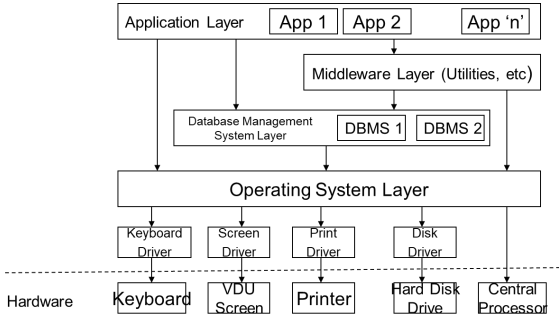
External Interfaces

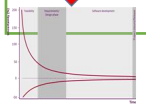


Software Functions



Functions

Detailed Software Functions



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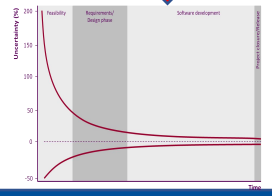
Software Functions



1. Verification
2. Supporting doc.

Very late at Testing & Implementation!

Contextual

1. Purpose
2. Scope
3. Product perspective
4. Product functions
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6. Limitations
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1. Verification
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External Interfaces → **Software Functions** → **Detailed Software Functions**

Functions → **Detailed Software Functions**

Non-Functional & Quality

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2. Performance req.
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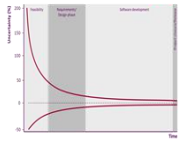
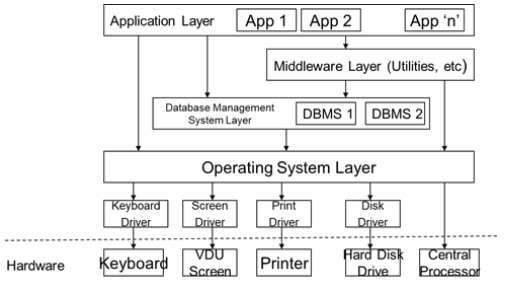
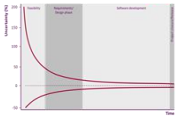
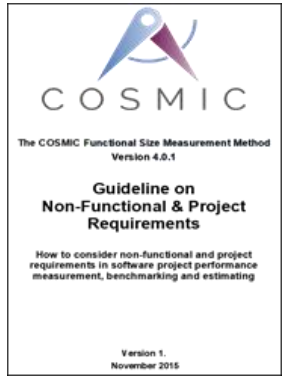
→ **Software Functions** → **Detailed Software Functions**

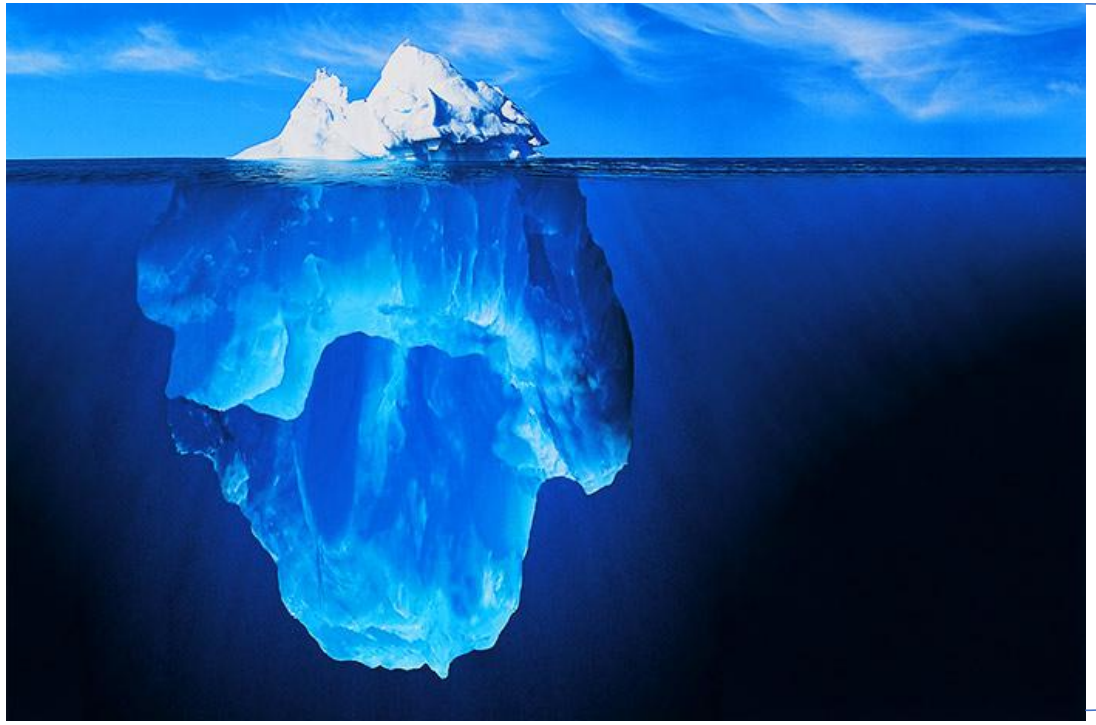






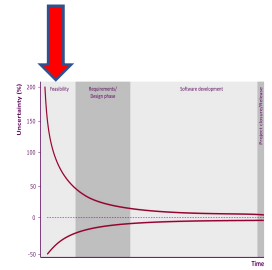


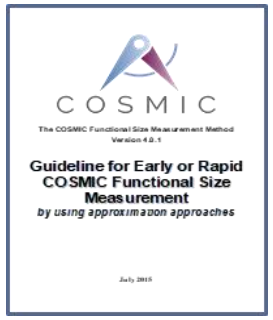
What is VISIBLE at Project Completion?

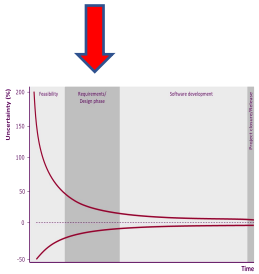


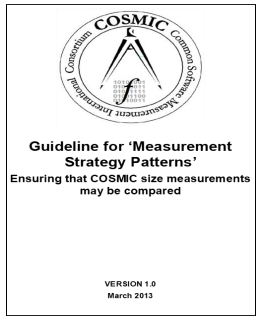
All software functions available for accurate measurement

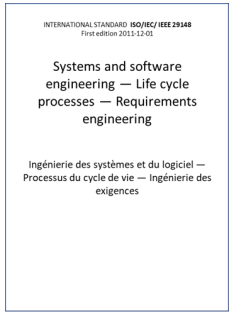
COSMIC Guidelines for Estimation through the lifecycle

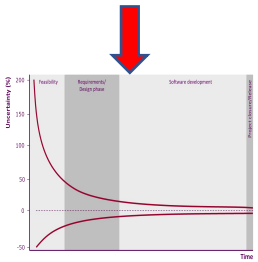


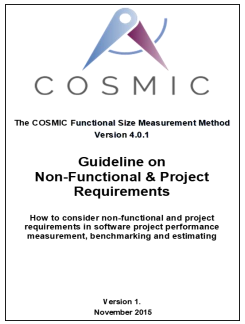


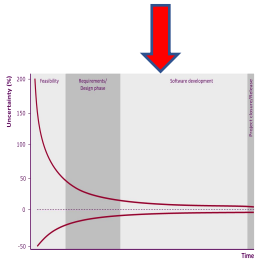


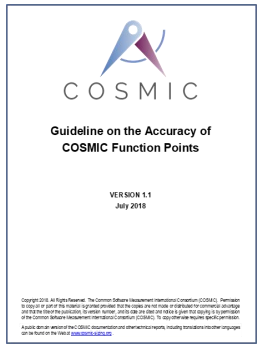


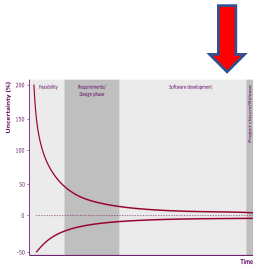




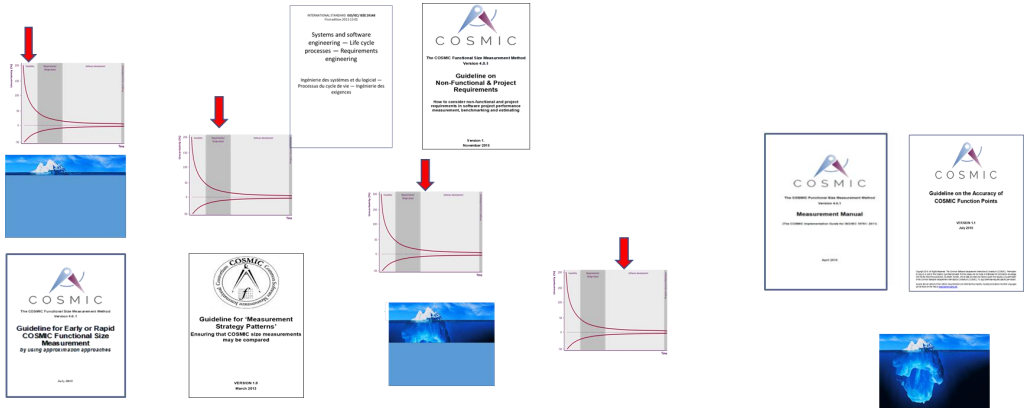






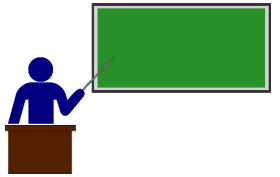


What's next?



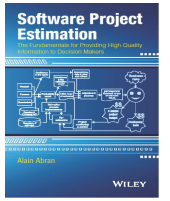
New COSMIC Tutorials at this conference

- Accuracy of Measurements
- COSMIC Size Estimation



Tutorials available

- Effort Estimation Models



Upcoming **Certification**

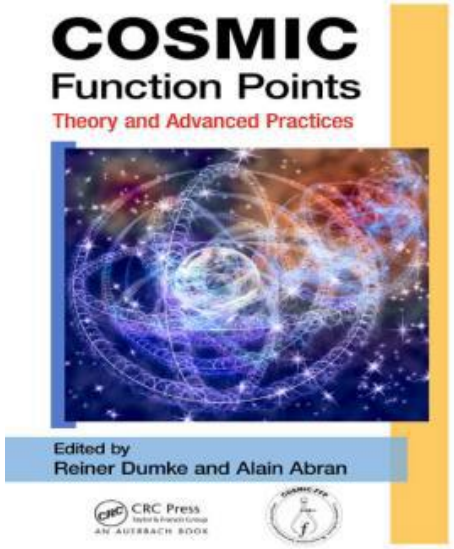
- COSMIC **Size** Estimation
- Effort Estimation Models

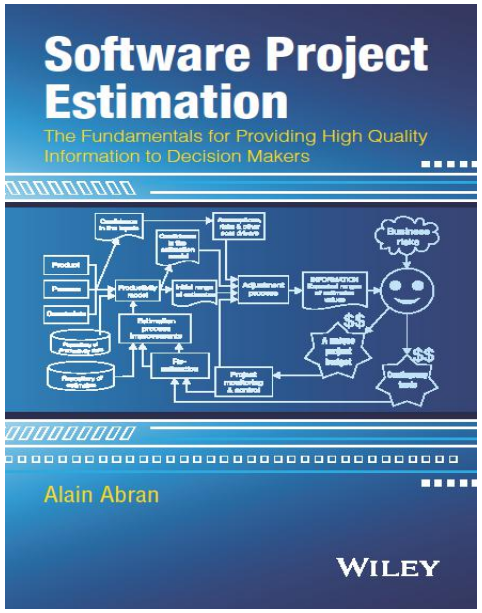
Questions?

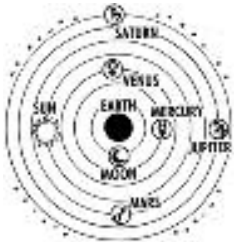

THANK YOU

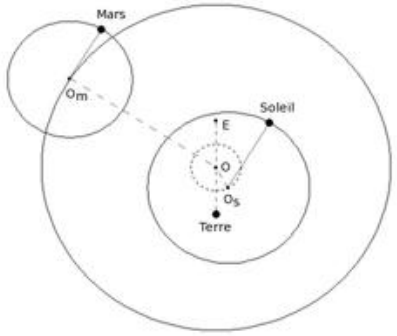
Other sources of COSMIC examples with industry data

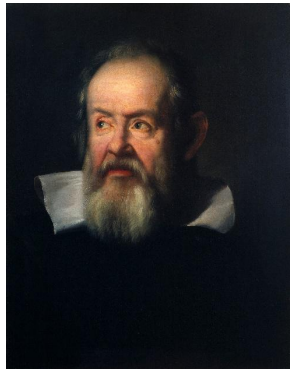
- COSMIC web site at: www.cosmic-sizing.org

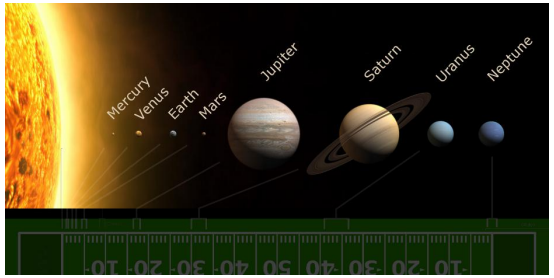


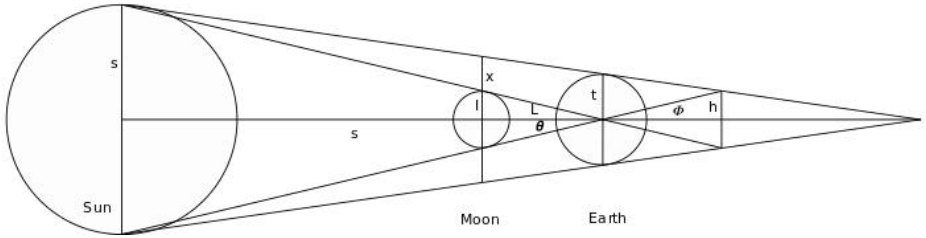


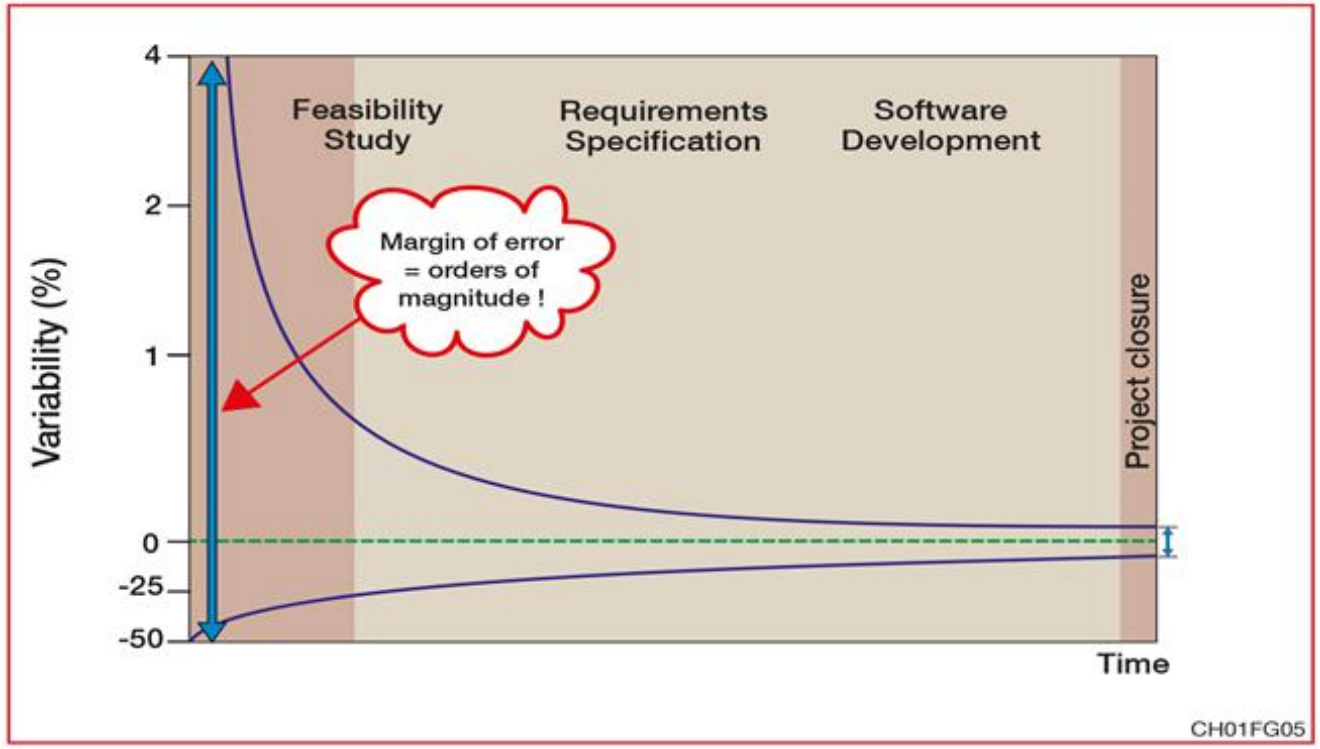


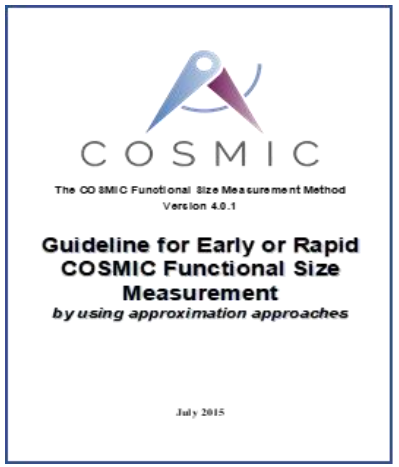


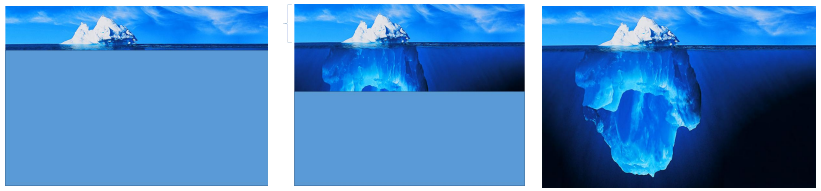


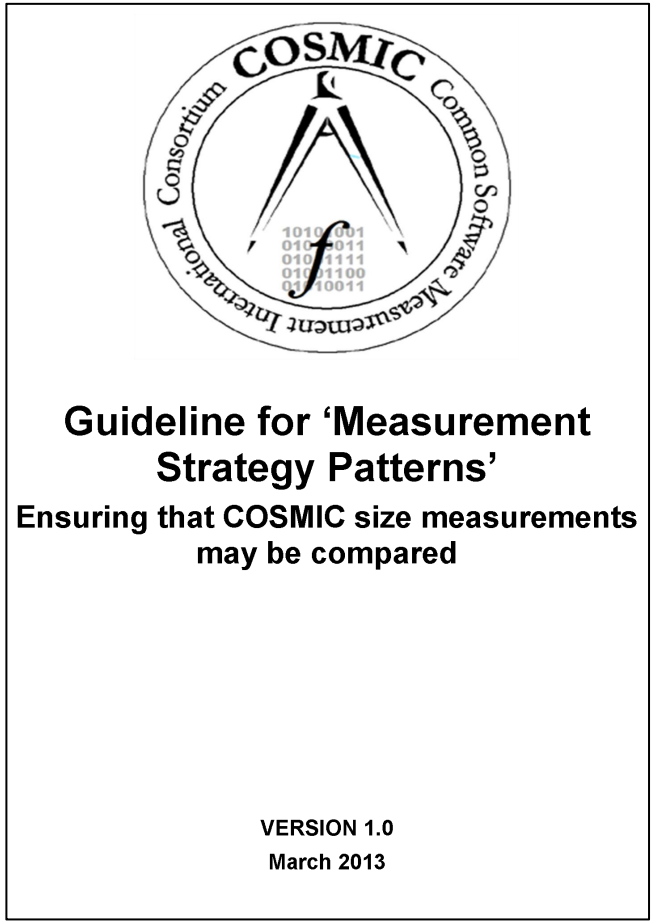


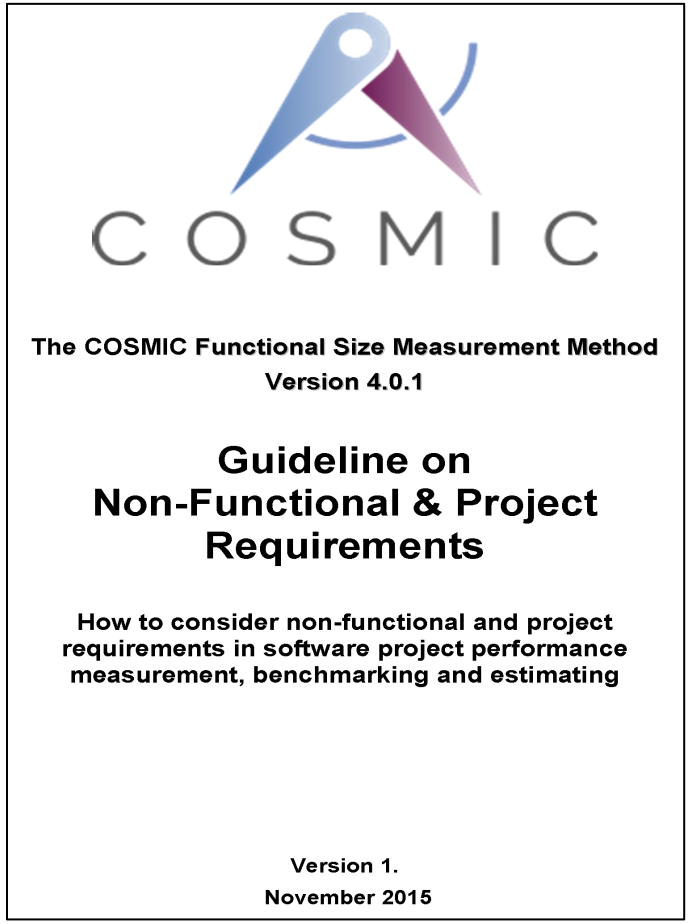












In practice: Very late at Testing & Implementation!

Contextual

1. Purpose
2. Scope
3. Product perspective
4. Product functions
5. User characteristics
6. Limitations
7. Assumptions & dependencies
8. Apportioning of requirements
9. Specified requirements

1. Verification
2. Supporting doc.

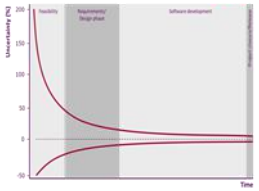
External Interfaces → **Software Functions** → **Detailed Software Functions**

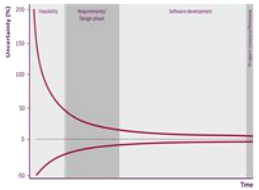
Functions → **Detailed Software Functions**

Non-Functional & Quality

1. Usability req.
2. Performance req.
3. Logical database req.
4. Design constraints
5. Standards compliance
6. Software system attributes

→ **Software Functions** → **Detailed Software Functions**





Phases:
A: Estimation of the Inputs for estimation…
B: Execution of the productivity model