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DEVELOPMENT OF COSMIC SCALING FACTORS USING CLASSIFICATION OF FUNCTIONAL REQUIREMENTS

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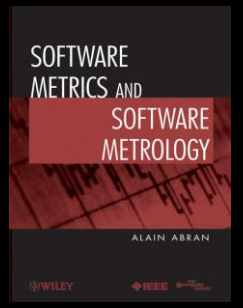
AUTHORS BACKGROUND

Alain Abran

20 years + 20 years

- Development
- Maintenance
- Process Improvement

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



Shaghayegh Vedadi

Master Student:

Engineering Project Management

Research area:

ISO 19761

AI

LIST OF TOPICS

- Challenges
- COSMIC Size Measurement: ISO 19761 & ISO IEEE 29148
- Software iceberg analogy
- Case Study 1: Course Registration (CRS)
- Scaling factors of Requirements and Results
- Summary & Future Work

CHALLENGE IN FUNCTION POINT SIZING

Early measurement is needed in the software development life cycle when:

- Requirements are incomplete
- Some functionalities are unknown or not detailed enough
- No clear understanding of the level of information

COSMIC: ISO 19761

- COSMIC method is designed to be applicable to measure the functionality of software from different domains.

- COSMIC unit of measurement:
  - 1 CFP = 1 data movement of 1 data group (Entry, Exit, Read, Write)
  - Minimum size of a change = 1 CFP

ISO IEEE 29148

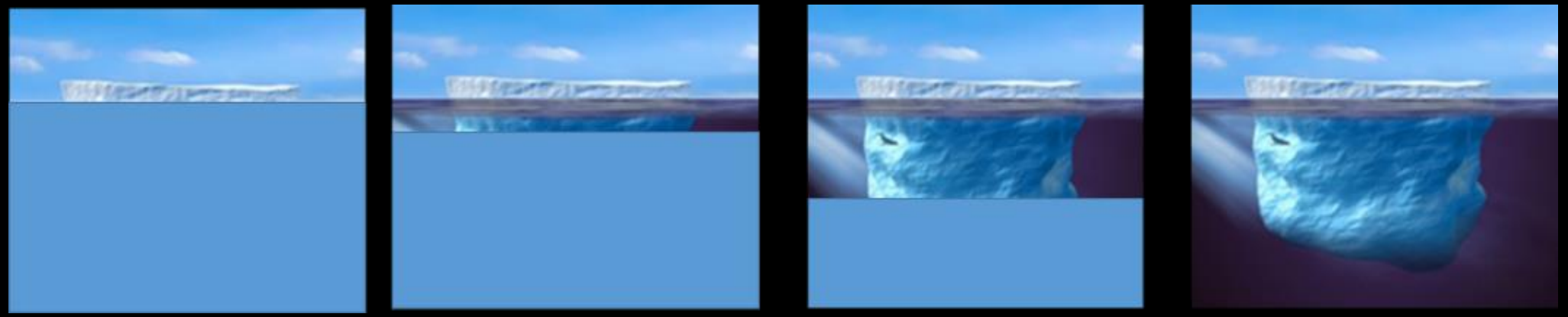
- The ISO-IEEE 29148 on requirements engineering presents a number of concepts related to the sources, types and levels of detail of the requirements throughout the system and software life cycle.

- The initial set of requirements originates from two sets of sources:

COSMIC-BASED SIZE ESTIMATION TECHNIQUES

1. Average functional process
2. Fixed size classification
3. Equal size bands
4. Average use case
5. Functional size measurement patterns
6. Early and quick COSMIC sizing
7. Easy function points
8. **Software-Iceberg analogy classification**

THE ICEBERG ANALOGY



Initially visible requirements

Visibility increases

Additional sizing is required

COSMIC CASE STUDIES

- Course Registration System (CRS) version 2.0.1
- Restaurant Management System version 1.1

The concepts from ISO 29148 are used with these COSMIC case studies to:

- ➢Identify types of requirements & when they become visible
- ➢Identify COSMIC size ratios by types of requirements & phases
- ➢Develop extrapolation ratios for future size estimation by phases and levels of documentation

COURSE REGISTRATION SYSTEM - CRS

Level 1. Business functions (system functions)

- Information is available at Vision time or Feasibility phase

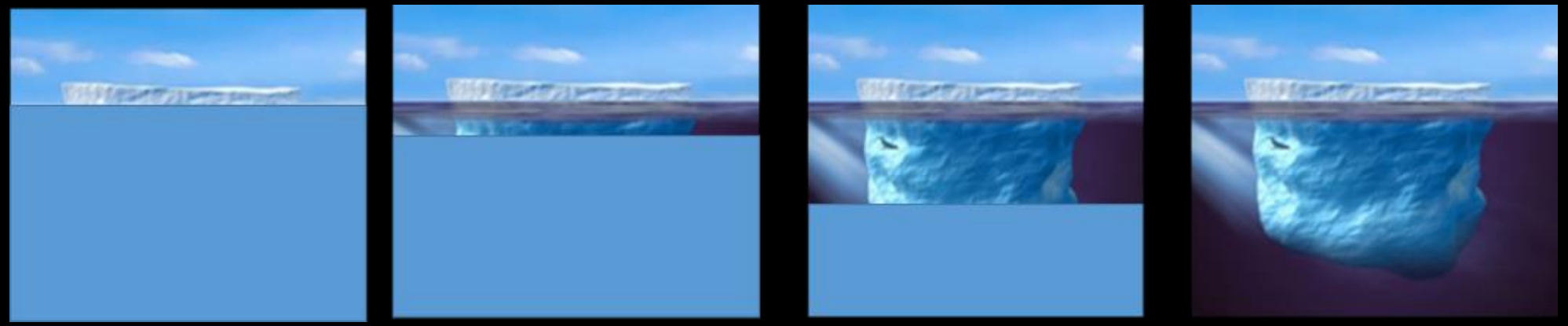
Level 2. Business functions allocated to software functional processes (software functions)

- Often available early in the specification phase

Level 3. Detailed functionality allocated to each software functional process

- At the coding phase, up to final testing

THE ICEBERG ANALOGY IN THE CRS CASE STUDY



Level 1: Business functions → Level 2: Functions allocated to software → Level 3: Detailed Functionality ex. Quality & NFR

LEVEL 1: BUSINESS FUNCTIONS - CRS

NO	Business function
1	Maintain professor information (by the registrar)
2	Maintain student information (by the registrar)
3	Maintain courses to teach (by professor)
4	Maintain student schedule (by students)
5	Close registration (by the registrar)
6	Submit grades (by professor)
7	Enquire report card (by students)

LEVEL 2: SOFTWARE FUNCTIONS – CRS

NO	Functional process
1	Add a professor
2	Modify a professor
3	Delete professor
4	Enquire on a professor
5	Add a student
6	Modify a student
7	Delete a student
8	Enquire on student
9	Add courses to teach
10	Modify a course to teach
11	Delete courses to teach
12	Enquire courses to teach
13	Enquire on course to teach details
14	Add courses
15	Modify a course
16	Delete a course
17	Enquire on courses
18	Enquire on course details
19	Close registration
20	Submit grades
21	Enquire on a report card

LEVEL 3: DETAILED FUNCIONALITY

LEVEL 1: MAINTAIN PROFESSOR INFORMATION (BY THE REGISTRAR)

Functional process	Functional user	Level 3 Sub-process description	Data group	DM type	CFP
Level 2 Add a professor	Registrar/ professor	Registrar enters information for the professor	Professor data	E	1
		The system validates the entered data and checks if a professor of the same name exists already	Professor data	R	1
		The system creates a new professor	Professor data	W	1
	Registrar/ professor	Display the system generated professor ID number	Professor ID	X	1
	Registrar/ messages	Display error message	Messages	X	1

CLASSIFICATION

Functionality from business requirements

Functionality with more details from business requirements

Operational functionality for implementing in practice the business requirements functionality

Functionality derived from system Quality & NFR requirements

Functionality related to an interface to other software applications

CLASSIFICATION RESULTS – CRS CASE STUDY

Direct business function	Business details	Operational business	Quality NFR	Interface
21 CFP	9 CFP	42 CFP	30 CFP	1 CFP
Percentage over total size				
20 %	**9 %**	**41 %**	**30 %**	**-**

Total functional size: 102 CFP

CLASSIFICATION RESULTS

- 20 % system functions
- 9 % detail functions
- 41 % operational functionality
- 30 % implementation of quality (data integrity)

TRANSFORMATION INTO SCALING FACTORS OF REQUIREMENTS

- System functions: 20% leads to a 1:5 scaling factor
  - ✓ Example: a size of 10 FP would lead to 10x5= 50 CFP when fully specified, including operational functions and data integrity functions.
- Detail functions: 20%+9% (= 29%) leads to a 1:3.4 scaling factor
  - ✓ a size of 20 CFP would lead to 20CFP x 3.4 = 68 CFP
- operational functionality: 20%+9%+41%= 70% leads to a 1:1.43 scaling factor
  - ✓ a size of 20 CFP would lead to 20CFP x 1.43 = 29 CFP

SCALING FACTORS ADDED TO REQUIREMENTS

Level 1. Business functions (system functions)

- Information is available at Vision time or Feasibility phase – **Scaling: 1:5**

Level 2. Business functions allocated to software functional processes (software functions)

- Often available early in the specification phase - **Scaling: 1:3.4**

Level 3. Detailed functionality allocated to each software functional process

- At the coding phase, up to final testing - **Scaling: 1:1.43**

Note: excluding the data integrity functions that most of the time are not documented in detail since they are part of 'the way to do things in this organization' – customized way of doing by all.

BUSINESS FUNCTIONS - SCALING

NO	Business function
1	Maintain professor information (by the registrar)
2	Maintain student information (by the registrar)
3	Maintain courses to teach (by professor)
4	Maintain student schedule (by students)
5	Close registration (by the registrar)
6	Submit grades (by professor)
7	Enquire report card (by students)

Scaling: 1:5

LEVEL 2: SOFTWARE FUNCTIONS

NO	Functional process
1	Add a professor
2	Modify a professor
3	Delete professor
4	Enquire on a professor
5	Add a student
6	Modify a student
7	Delete a student
8	Enquire on student
9	Add courses to teach
10	Modify a course to teach
11	Delete courses to teach
12	Enquire courses to teach
13	Enquire on course to teach details
14	Add courses
15	Modify a course
16	Delete a course
17	Enquire on courses
18	Enquire on course details
19	Close registration
20	Submit grades
21	Enquire on a report card

Scaling: 1:3.4

Example 1:
If at this stage, a size of 30 CFP are measured based strictly on the 'text as is', then knowing that operational details will be documented later, and data integrity functions are to be added as well without document them, this 1:3.4 scaling factor means that these 30 CFP specified at this point in time will become 102 CFP once fully implemented in the software.

Example 2:
If at this stage, a size of 50 CFP are measured based strictly on the 'text as is', then the 1:3.4 scaling factor means that these 50 CFP specified at this point in time will become 170 CFP once fully implemented in the software.
Note: in many organizations light on documenting requirements, these 100 additional CFP may never be specified, but would still be delivered to the users.

LEVEL 3: DETAILED FUNCIONALITY

Sub-process description
Registrar enters information for the professor
The system validates the entered data and checks if a professor of the same name exists already
The system creates a new professor
Display the system generated professor ID number
Display error message

Scaling: 1:1.43

CRS AND RESTOSYS

Classification	Course Registration System	Restaurant Management System
Direct business function	20 %	26 %
Business details	9 %	2 %
Operational business	41 %	42 %
Quality NFR	30 %	24 %
Interface	-	6 %
	Total size= 102 CFP	Total size= 151 CFP

SUMMARY

- This research used the ISO-IEEE 21948 standard on requirements engineering to identify sources of requirements & related levels of documentation for system & software functionality.
- It used a COSMIC case study to calculate ratios of COSMIC sizes measured as the documentation progressed.
- These size ratios were next transformed into corresponding size **scaling factors** according to the levels of details in the documentation of the requirements.

SUMMARY

- Such set of scaling factors should be added in the description of requirements as a 'best practice' in requirements engineering.
- Scaling ratios, with successive levels of documentation, can be used in future projects as project progress through the lifecycle.
- These scaling factors can provide also information on the levels of completeness of the documentation of the requirements.

FUTURE WORK

- Case studies available on COSMIC website

Other domains

- Other domains such as real-time provide additional types and sources of functionality

THANK YOU

Q & A

FUNCTION POINTS

- 5 ISO standards

  - ISO 20926 : IFPUG
  - ISO 24570 : NESMA
  - ISO 20968 : MRKII
  - ISO 29881 : FISMA

  → 1st generation

  - ISO 19761 : COSMIC → 2nd generation

FUNCTION POINT SIZING

- Quantifies the functional size of software for:
  - Effort estimation
  - Project planning & monitoring
  - Productivity studies & Benchmarking

- Challenges - Early measurement in software development life cycle when:
  - Requirements are incomplete
  - Some functionalities are unknown or not detailed enough
  - No clear understanding of the level of information

CLASSIFICATION RESULTS – CRS CASE STUDY

	Direct business function	Business details	Operational business	Quality function	Total size
Maintain functions	18 CFP	7 CFP	34 CFP	25 CFP	84 CFP
% in Maintain Functions	22 %	9 %	50 %	30 %	
Other functions	3 CFP	2 CFP	6 CFP	5 CFP	18 CFP
Percentage over total size					
TOTAL	17 %	12 %	36 %	28 %	

RESTOSYS CASE STUDY

- RestoSys is composed of two parts:
  1. Mobile app
  2. Web application

Hardware configuration

RESTOSYS CASE STUDY: LEVEL 1

Level 1: business functions	Level 2: Detailed use cases (N=10)
Logon	FUR1: Logon
Maintain order	FUR2: Maintain order
Logon	FUR3: Logon
Maintain data	FUR4: Maintain user FUR5: Maintain item FUR6: Maintain item family FUR7: Maintain table FUR8: Maintain restaurant menu
Maintain order	FUR9: View the list of orders FUR10: Delete customer order

CLASSIFICATION RESULTS - RESTOSYS CASE STUDY

Number of functional process = 33

Direct business function	Business details	Operational business	Quality NFR	Security NFR	Mobile app total size
7 CFP	0 CFP	13 CFP	8 CFP	5 CFP	**33 CFP**
					Web app total size
33 CFP	3 CFP	50 CFP	28 CFP	4 CFP	**118 CFP**
TOTAL= 40 CFP	**3 CFP**	**63 CFP**	**36 CFP**	**9 CFP**	**TOTAL SIZE = 151 CFP**

Total functional size: 151 CFP

CLASSIFICATION RESULTS - RESTOSYS CASE STUDY

Direct business function	Business details	Operational business	Quality function	Security function
26 %	2 %	42 %	24 %	6 %

- 26 % size functions from the systems-software requirements
- 2 % detail functions
- 42 % operational functionality
- 30 % implementation of quality: 24 % data integrity
  6 % security