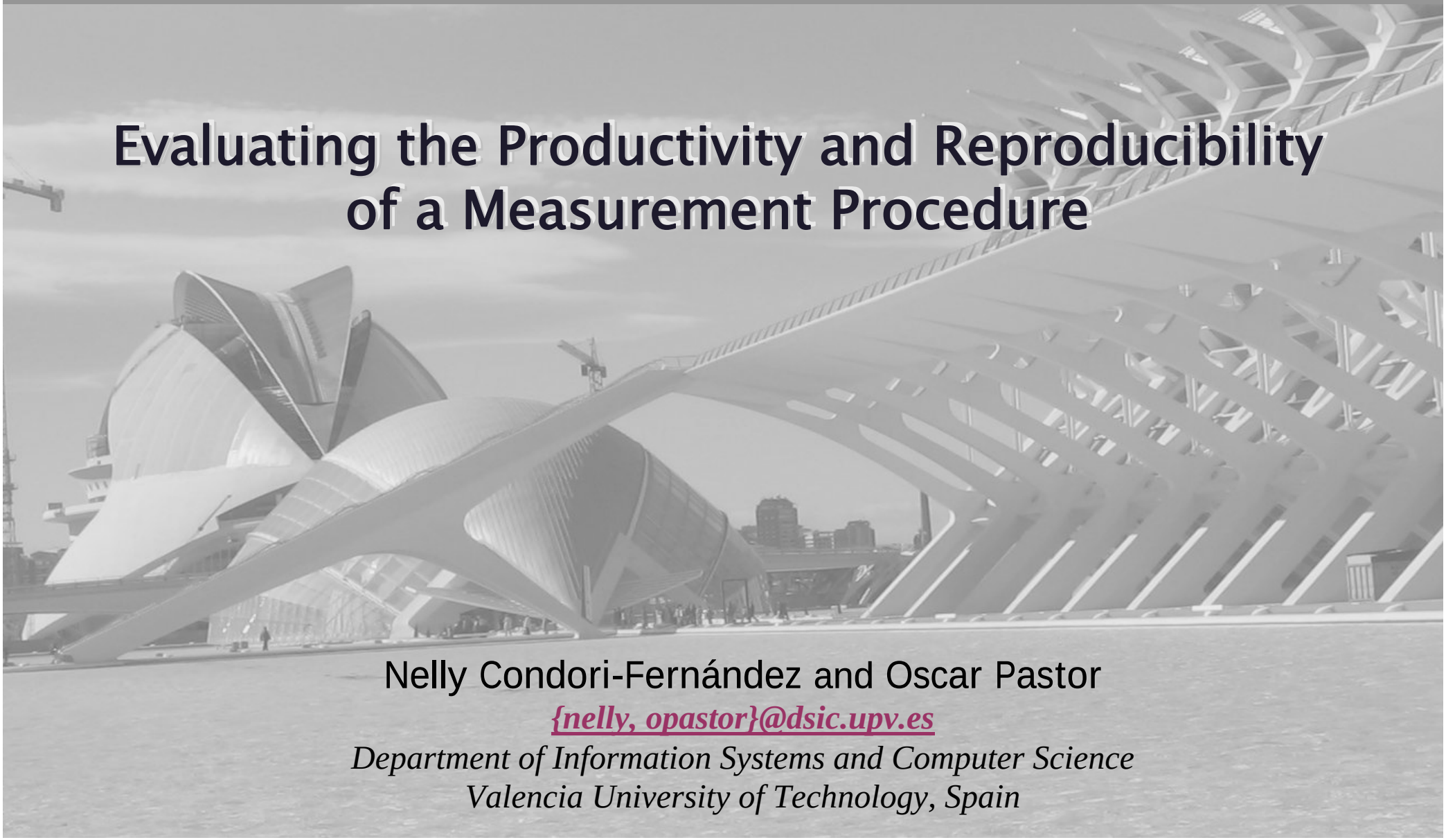

Evaluating the Productivity and Reproducibility of a Measurement Procedure

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Research environment

- This research has been carried out within the **OO-Method** Research Group
- supported by the Ministry of Science and Technology under the DESTINO project
- in close collaboration with the company **CARE Technologies S.A** (Denia, Valencia province).

CARE S.A

http://www.care-technologies.com

Contents

Introduction

Most critical Tasks

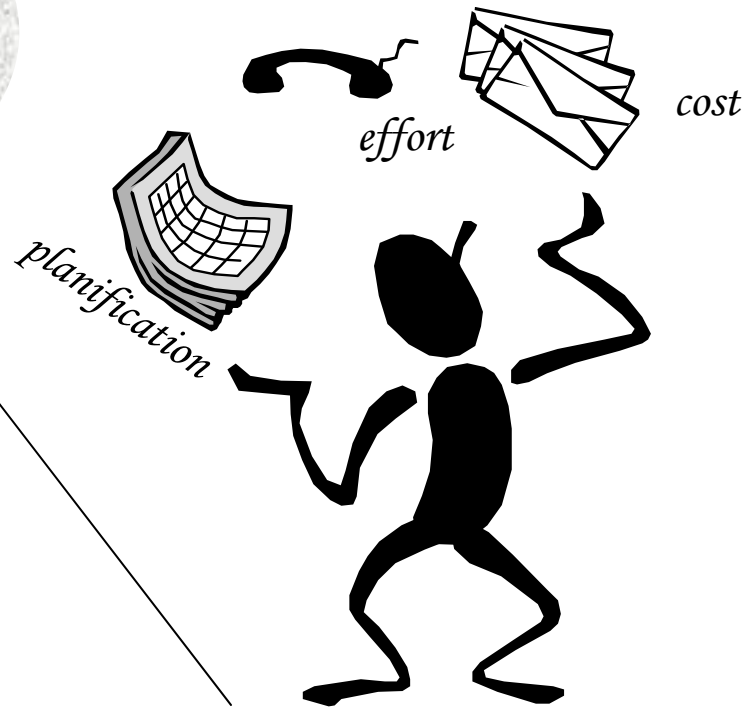
- Requirements Identification
- Requirements Analysis
- Requirements Specification
- Requirements Management

Errors can have an impact

Project Management

To ensure measurement quality

functional size



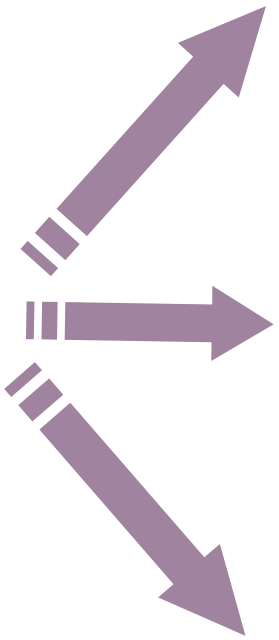
Reliability of estimation models

Contents

- Introduction
- RmFFP: a measurement procedure
  - RmFFP application
  - Measurement process
- Evaluation of the application of RmFFP
  - Experiment planning
  - Data analysis and interpretation
  - Validity evaluation
- Conclusions and Future work

RmFFP: Our measurement procedure

RmFFP



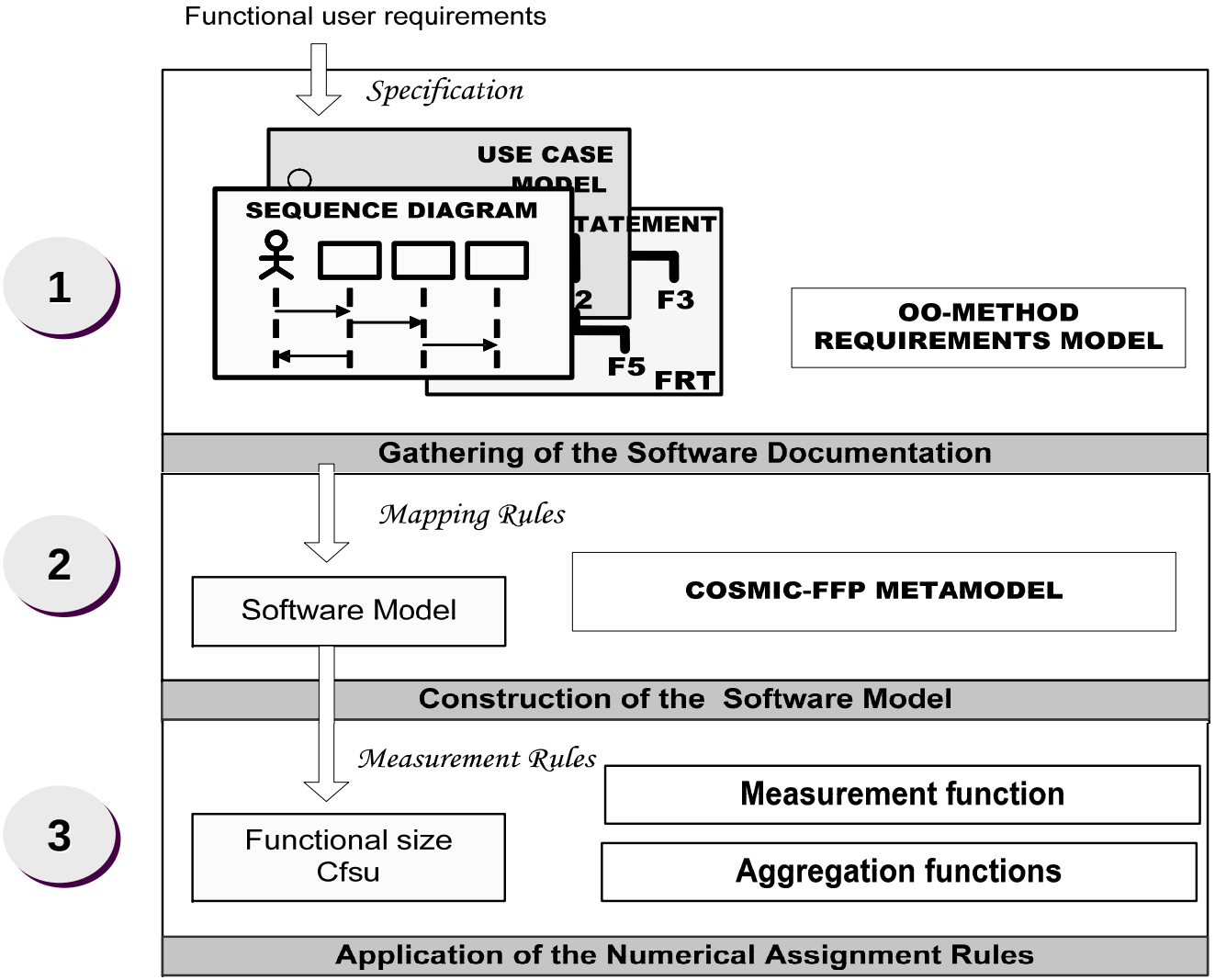
***Origin**: based on the COSMIC-FFP standard method*

***Domain**: designed for the information systems management*

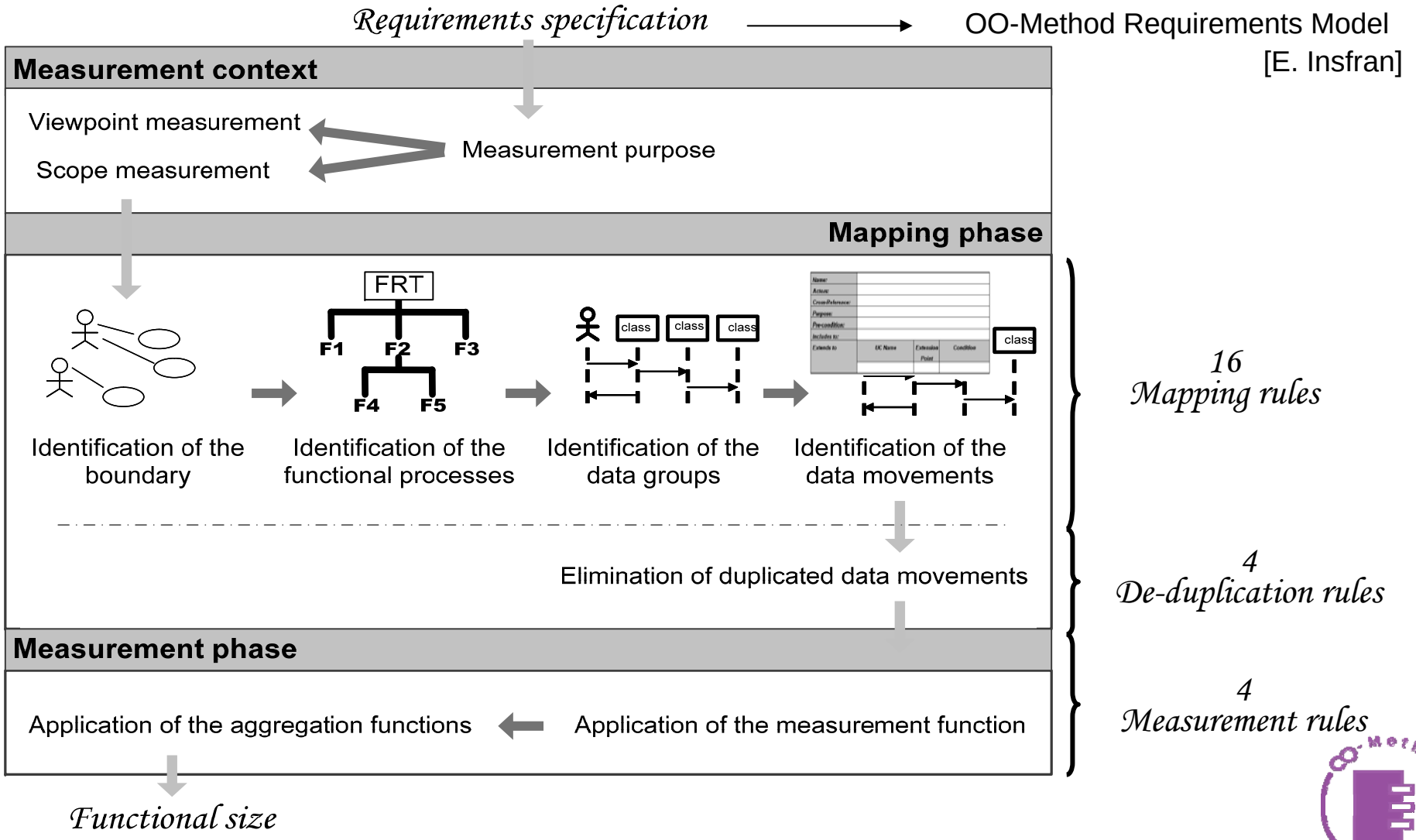
***Purpose**: measurement of the functional size of the applications generated with OO-Method from requirement specifications*

***Artefact**: Sequence diagram (signal, service, query, connect)*

Application of RmFFP



RmFFP: measurement process



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Evaluation of the application of RmFFP

Experiment planning

To analyze	RmFFP
for the purpose of	evaluating the user's productivity and the reproducibility of RmFFP
from the viewpoint of	the researcher
in the context of	computer science students measuring the OO-Method Requirements specification

Goal/Question/Metric (GQM)

[Basili&Rombach,1998]

RQ1: are the users productive using RmFFP?

RQ2: Is RmFFP reproducible?

Evaluation of the application of RmFFP

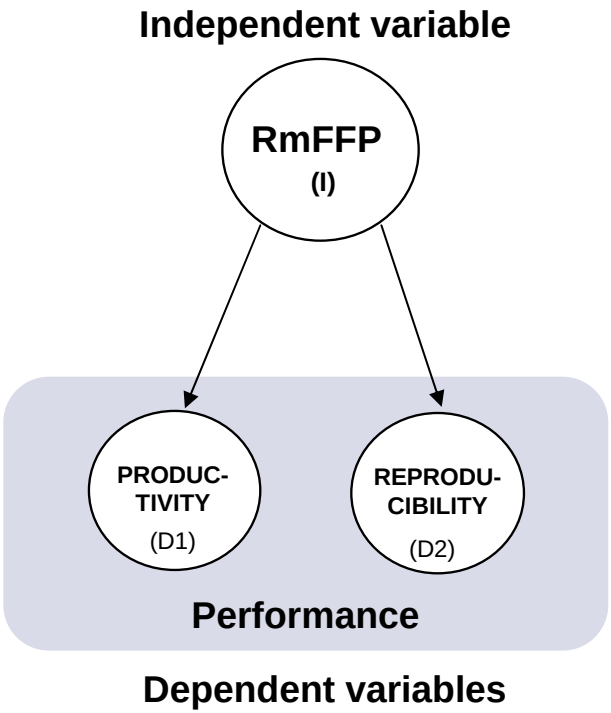
Experiment planning

- **Subjects**
  - 35 computer science students at the Valencia University of Technology who had similar backgrounds in the use of the OO-Method Requirements Model.
  - These subjects were students enrolled in the “Software Development Environments” course (February until June of 2005).
- **Experimental objects**
  - Requirements specifications using OO-Method

Evaluation of the application of RmFFP

Experiment planning

- **Selection of variables**



- **Formulation of Hypotheses**

Hypothesis 1: Users' **productivity** when applying RmFFP is higher than results found in the literature.

Hypothesis 2: Functional size measures are **reproducible** when applying RmFFP under changed measurement conditions.

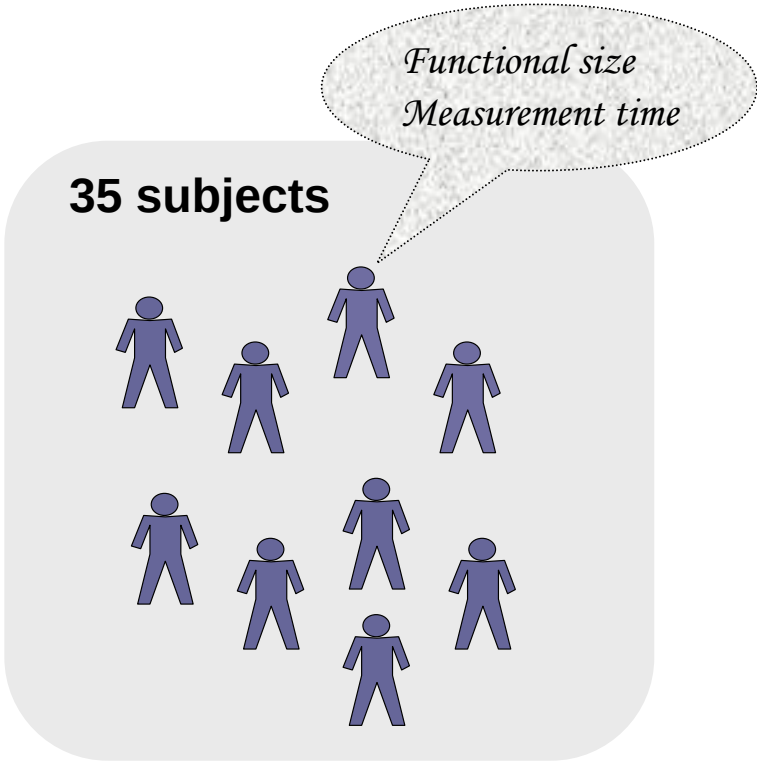
Evaluation of the application of RmFFP

Experiment operation

- **Data recording and verification**

Data recorded:

- Functional size of the specification given.
- Time used to carried out a measurement.



Evaluation of the application of RmFFP

Experiment operation

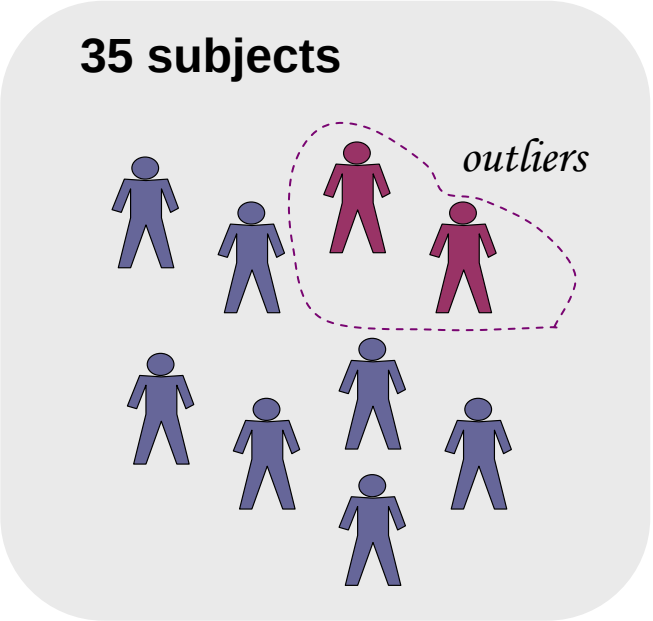
- **Data recording and validation**

Data recorded:

- ❑ Functional size of the specification given
- ❑ Time used to carried out a measurement.

Verification of the results:

Two students confused the concepts of INCLUDE and EXTEND (relationships between use cases) for the application of the aggregation functions.



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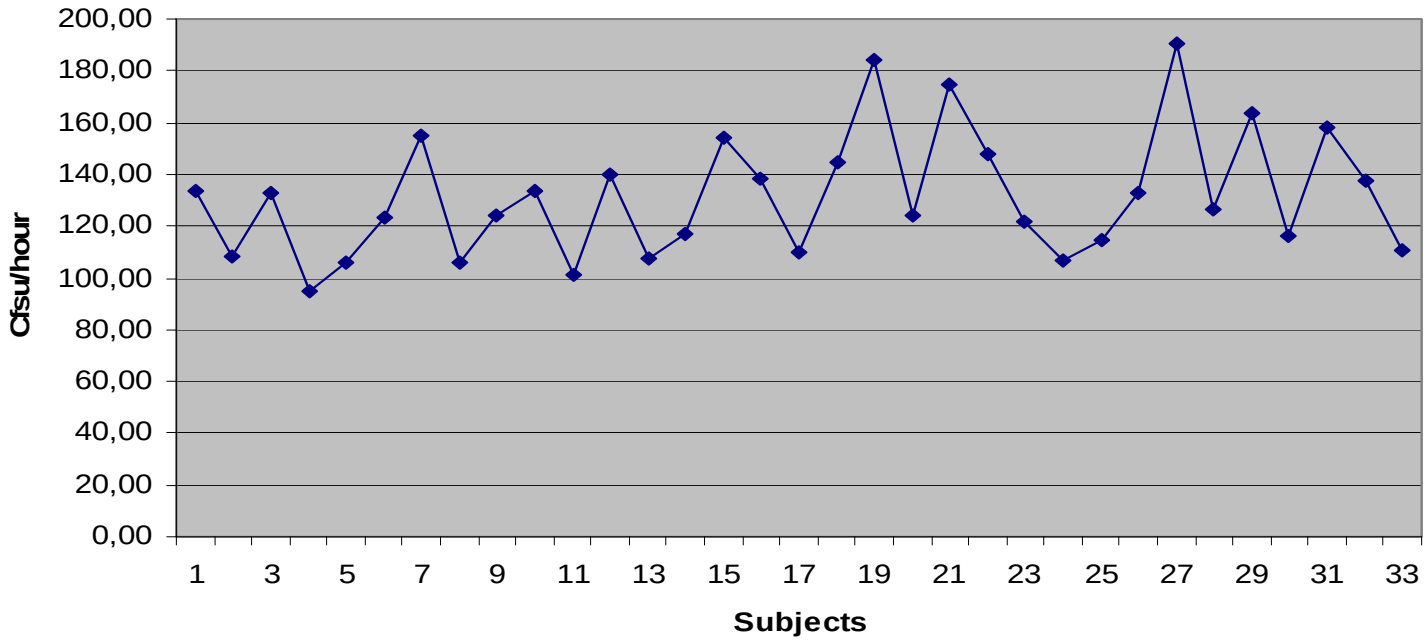
Evaluation of the application of RmFFP

Analysis and Interpretation

- **Productivity**



Máx. = 190,36 **Mean =** 131.48

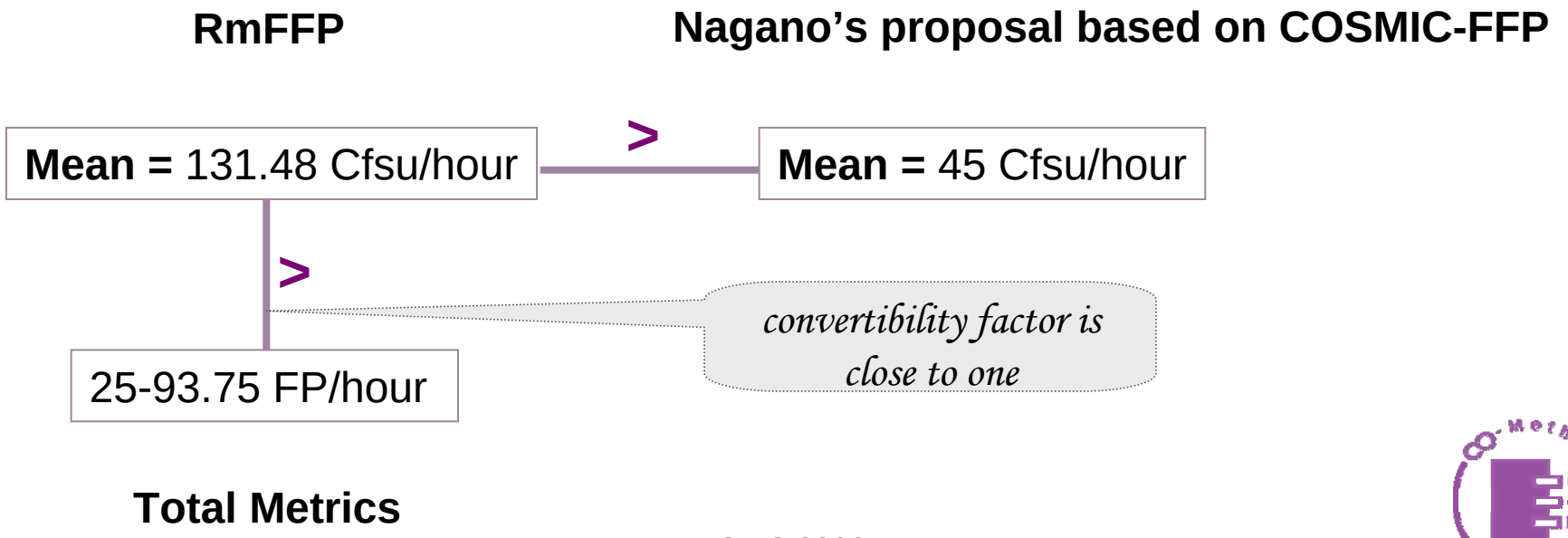
Min. = 94,67 **Desv. =** 24.24

Evaluation of the application of RmFFP

Analysis and Interpretation

- **Productivity:**

RQ1: are the users productive using RmFFP?



Evaluation of the application of RmFFP

Analysis and Interpretation

- **Productivity:**

RmFFP

Mean = 131.48 Cfsu/hour

3x

Nagano's proposal based on COSMIC-FFP

Mean = 45 Cfsu/hour

- We used the **OO-Method Requirements Model**, which is based on UML notation.
- The mapping rules defined allowed the **reduction of the generality** of COSMIC-FFP.
- The subjects were **well-versed** in the OO-Method Requirements Model and RmFFP.
- Nagano used the **natural language** for the functional specification of the switching systems.
- Nagano applied directly the **generic rules** of COSMIC-FFP.
- The subjects **were trained** to apply COSMIC-FFP.

Evaluation of the application of RmFFP

Analysis and Interpretation

- **Productivity:**

RmFFP

Mean = 131.48 Cfsu/hour

Total Metrics

25-93.75 FP/hour

- Complexity
- Level of exp

litions

we cannot yet draw definite conclusions about the measurement productivity obtained with RmFFP

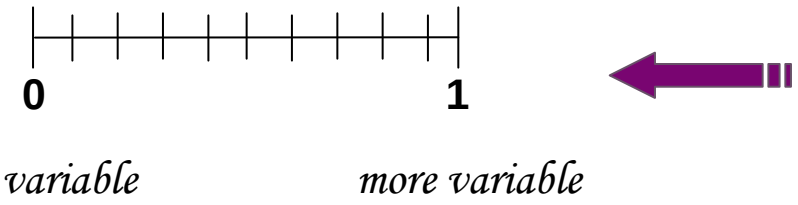
Evaluation of the application of RmFFP

Analysis and Interpretation

- **Reproducibility:**

Closeness of the agreement between results of measurements of the same measurand carried out under changed conditions of measurement.

[ISO/IEC 14143-3]



Adapted from Kemerer

$$REP_i = \left| \frac{\sum_{k=1,k\neq i}^{n} \frac{Values_k}{n-1} - Value_i}{\sum_{k=1,k\neq i}^{n} \frac{Values_k}{n-1}} \right|$$

Applied by Abrahao et al.

Evaluation of the application of RmFFP

Analysis and Interpretation

- **Reproducibility:**

33 subjects

Descriptive statistics

Statistics	Reproducibility
Mean	0.051
Standard deviation	0.04164
Min	0.000
Max	0.15

5,1% variability

94,9% reproducibility

Evaluation of the application of RmFFP

Analysis and Interpretation

- **Reproducibility:**

33 subjects

One Sample t-test for the reproducibility.

Statistic	Reproducibility
Mean Difference	0.05091
95% Conf. Interval for the diff.	0.0361 (lower)
	0.0657 (upper)
t	7.024
1-tailed p-value	.000

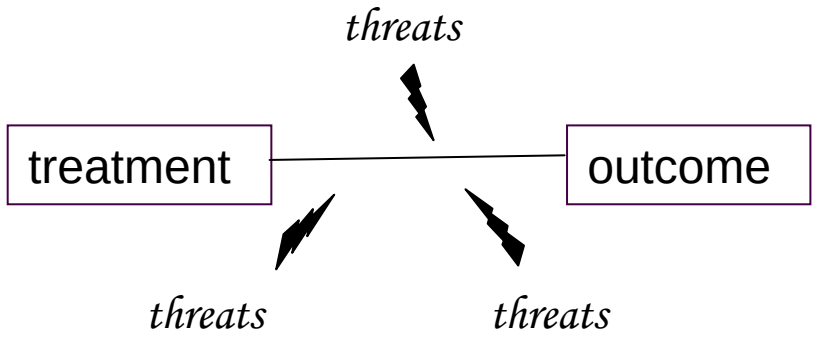
→ *level of significance : very high*

95% confidence that the data obtained would satisfy the hypothesis that RmFFP is reproducible

Evaluation of the application of RmFFP

Validity evaluation

- **Conclusion validity:** issues that affect the ability to draw the correct conclusion:
  - Reliability of the application of RmFFP to subjects: *following a prescribed procedure*
  - Random heterogeneity of subjects: *same level of experience working with the OO-Method Requirements Model.*

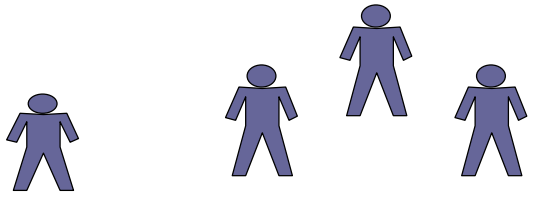


Homogeneity reduces the external validity

Evaluation of the application of RmFFP

Validity evaluation

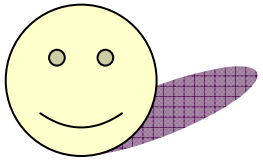
- **External validity:** threats relating to the generalization of results to industrial practice.
  - Effect of not having a representative population in the experiment:
  - Effect of not having representative material in the experiment.



*Larger number of subjects (students and **professionals**)*

Representative requirement specification

Contents



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Conclusions and future work

- This paper describes an empirical study that evaluates the user's productivity and reproducibility of RmFFP
- With respect to productivity analysis:
  - the productivity of the subjects using RmFFP is several times higher than the productivity rate obtained by Nagano.
    - we confirm that, because of its generic character, a measurement method is less efficient than a measurement procedure.
  - We also find that RmFFP productivity is higher than industry rates found with IFPUG FPA (reported by the company Total Metrics).

Conclusions and future work

- With respect to reproducibility analysis:
  - We have corroborated that users of RmFFP produce reproducible assessments.
    - This result can be explained by the training carried out with the subjects.
    - Complementary rules defined to control the duplicity of data movements resolved some of the problems of interpretation of the RmFFP guidelines
- We are aware that it is necessary to carry out more empirical studies with industry professionals in order to confirm our initial results.

Thank you very much for your attention

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