

# Methods To Evaluate Lightweight Software Process Assessment Methods Based On Evaluation Theory & Engineering Design Principles

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**PhD Thesis Defense**

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# Agenda

- Problem Statement
- Research Motivations, Goals and Objectives
- Literature Review
- Research Methodology
- Comparing lightweight SPA methods
- Evaluation theory Concepts
- Top-down Evaluation Method
- Bottom-up Evaluation Method
- Research Process Verification
- Research Contributions
- Conclusions and Future Work
- Publications

## Problem Statement

- Software process assessment is an effective tool to understand organizations' process quality and improvement opportunities
- Large portion of the organizations in the IT sector are small and very small in their size
- For small organizations, pursuing a software process improvement (SPI) initiative and discovering that its objectives have not been achieved is a significant waste of their limited resources

## Problem Statement - Continued

- the comprehensive and rigor assessments provided by well-known SPI approaches are considered by many small software development firms to be too expensive
- The designers of lightweight assessment methods typically claim that their assessment methods are successful based on few case studies
- While the success, reliability and effectiveness of comprehensive assessment methods such as CMMI and ISO 15504 compliant SPA methods have been studied by different researchers, such studies, unfortunately, are not available for lightweight assessment methods

## Research Motivations

- There is no independent evaluation of SPA designers' claims that their assessment methods are successful.
- There is no systematic attempt to synthesize and organize the available experiences in the literature regarding the design and implementation of SPA methods.
- There is no research in the evaluation of assessment methods to date refer to any theoretical justification based on the evaluation theory concepts.

# Research Goal and Objectives

- Accordingly, the research goal can be summarized as:

**Evaluate the success of lightweight software process assessment methods.**

- To achieve the specified goal, two objectives for this research project have been selected:
  1. To develop a method to evaluate, from an engineering design viewpoint, lightweight SPA methods, referred to as the top-down approach.
  2. To develop a method to evaluate, based on success evidences found in the literature, lightweight SPA methods, referred to as the bottom-up approach.

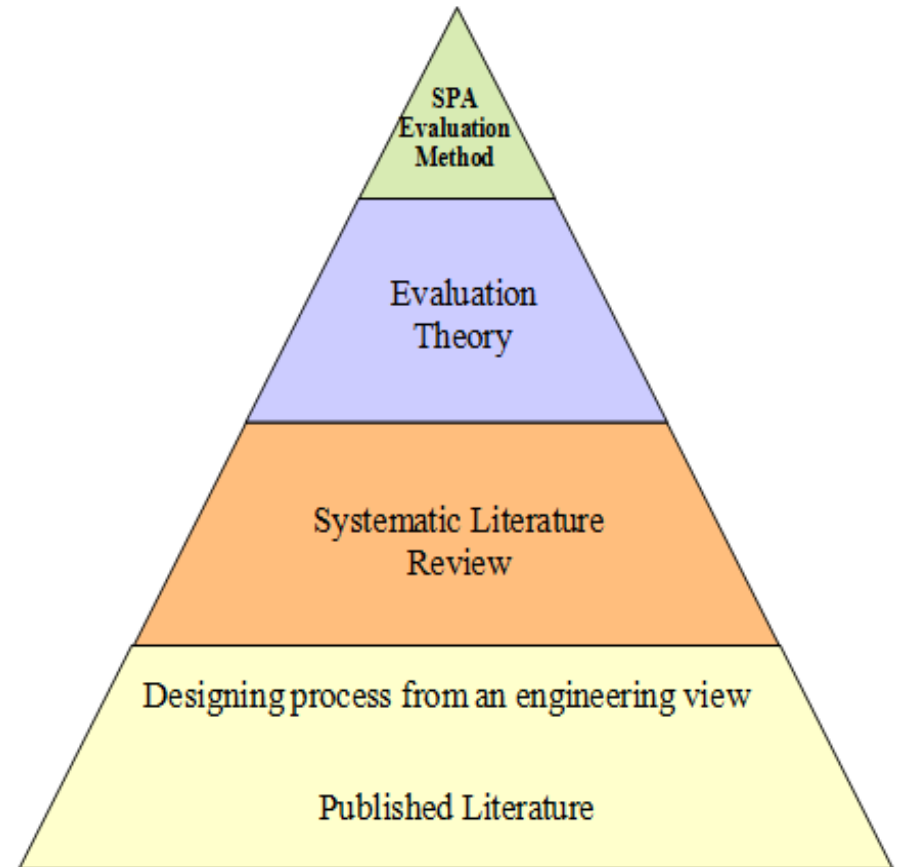
# Literature Review

1. When discussing the assessment methods, one can recognize two main streams in this research field:
  - a. Comprehensive or heavyweight assessment methods used mainly by large organizations.
  - b. Tailored or lightweight assessment methods used by “non large organizations” including SME and VSE.
2. Heavyweight SPA methods include: SCAMPI or CMMi, ISO 15504 compliant assessment methods.
3. Lightweight SPA methods include: MARES, RAPID, Micro-Evaluation, TOPS, FAME, EAP, SPM.

# Literature Review - continued

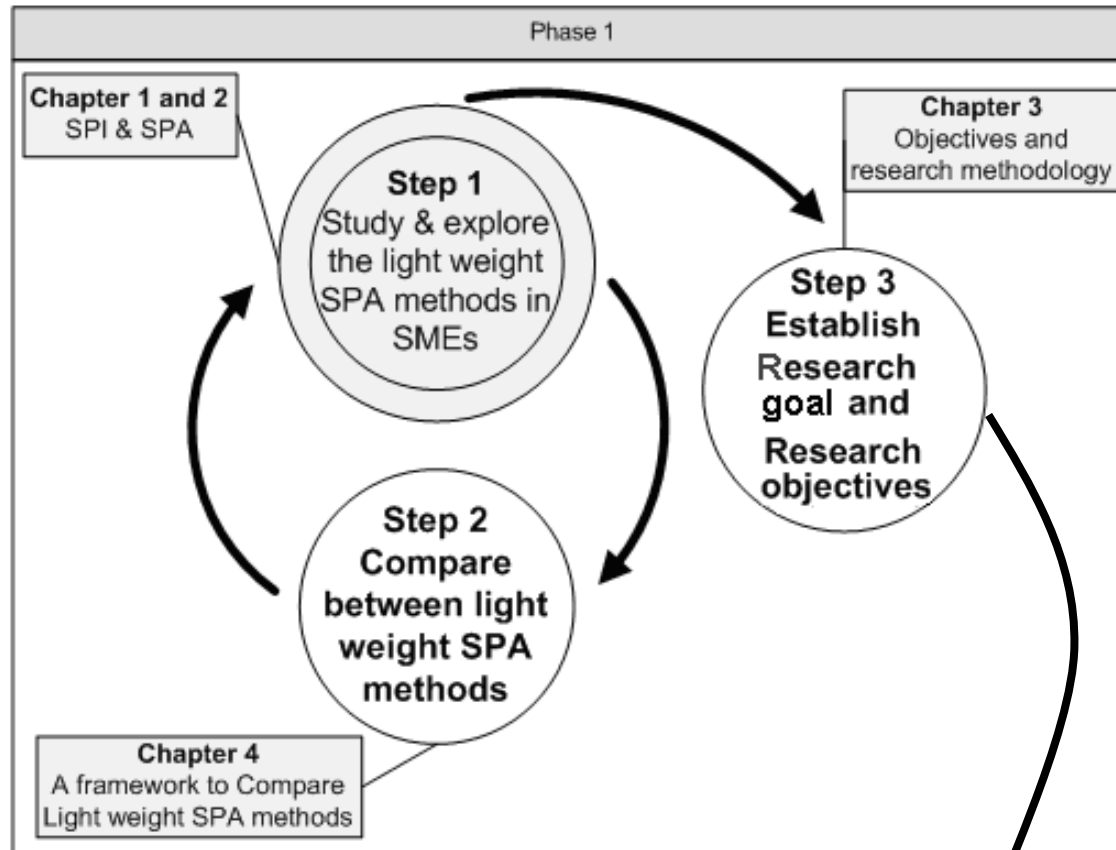
## Reference Disciplines

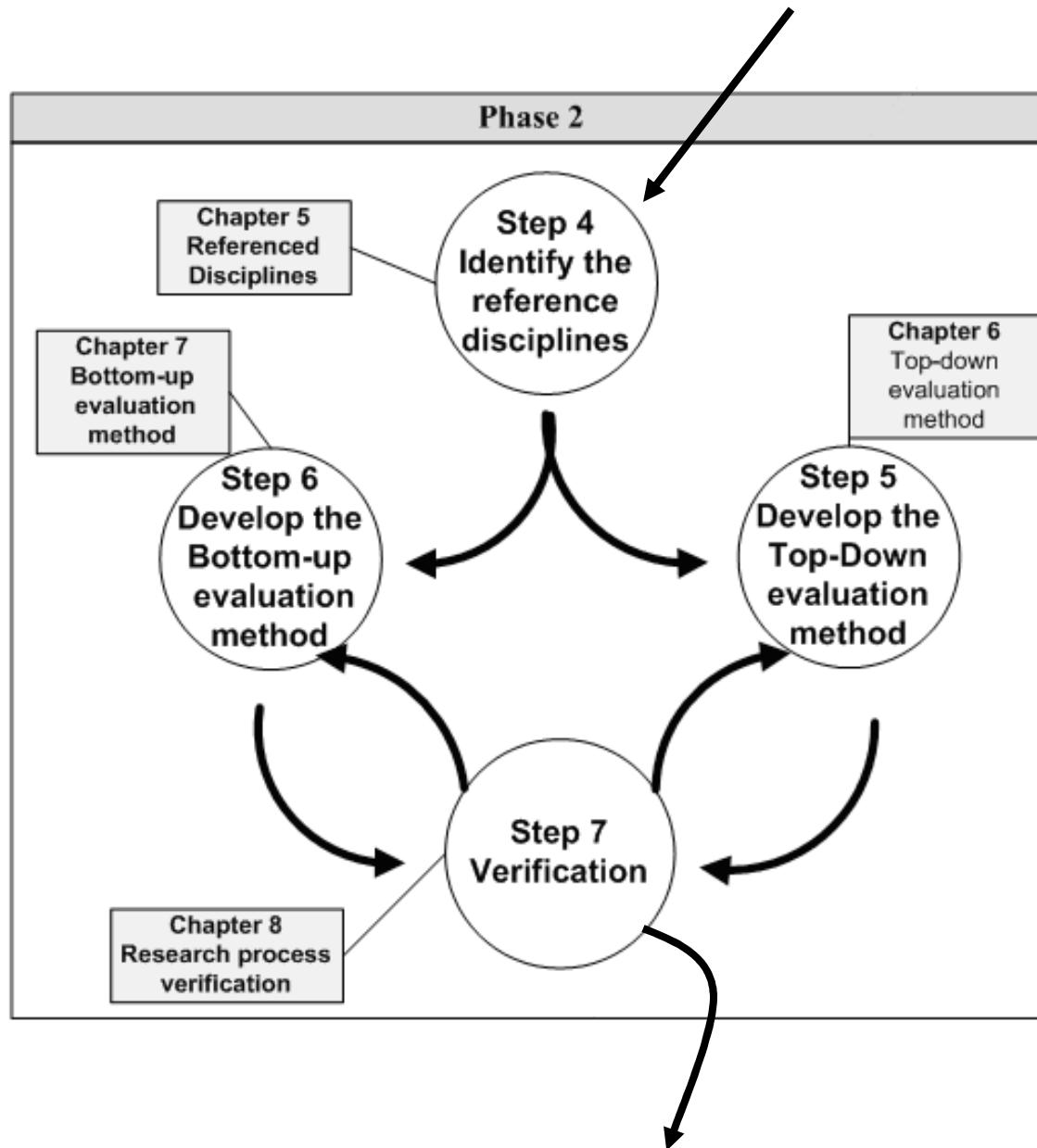
1. Evaluation theory concepts
2. Engineering design principles
3. Systematic Literature review

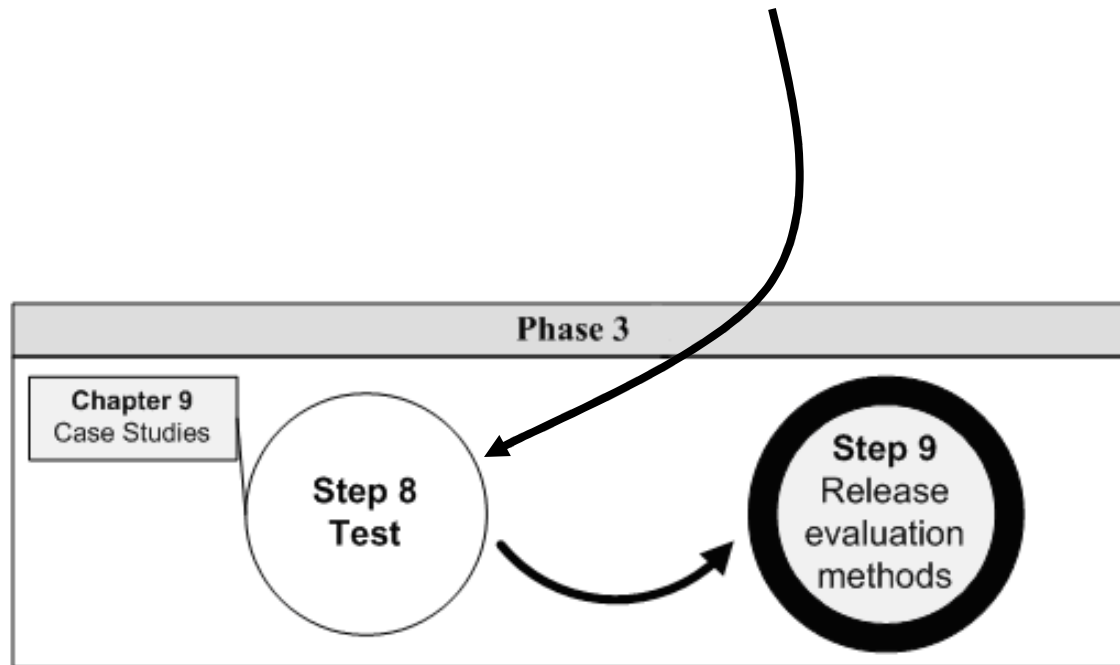




# Research Methodology







## Comparing lightweight SPA methods

- To summarize the findings of the literature review related to lightweight SPA methods, a comparison method has been designed.
- The proposed comparison method includes several characteristics from two main comparison method namely Halvorsen's method and Anacleto's method as well as adding some other characteristics.

<b>Halvorsen Characteristics</b>	<b>Anacleto et al. Characteristics</b>	<b>New Characteristics</b>
<ul style="list-style-type: none"> <li>• Geographic origin/spread</li> <li>• Scientific origin</li> <li>• Development/stability</li> <li>• Popularity</li> <li>• Analysis techniques</li> </ul>	<ul style="list-style-type: none"> <li>• Cost</li> <li>• Guidance for process selection</li> <li>• Support for identification of risk and improvement suggestions</li> <li>• Need for specific SE knowledge from the company representative</li> <li>• Tool support</li> <li>• Public availability</li> <li>• Detailed description of assessment process</li> <li>• Detailed definition of assessment model</li> </ul>	<ul style="list-style-type: none"> <li>• Number of assessed processes</li> <li>• Assessed processes</li> <li>• Number of processes to be improved</li> <li>• Assessment duration</li> </ul>

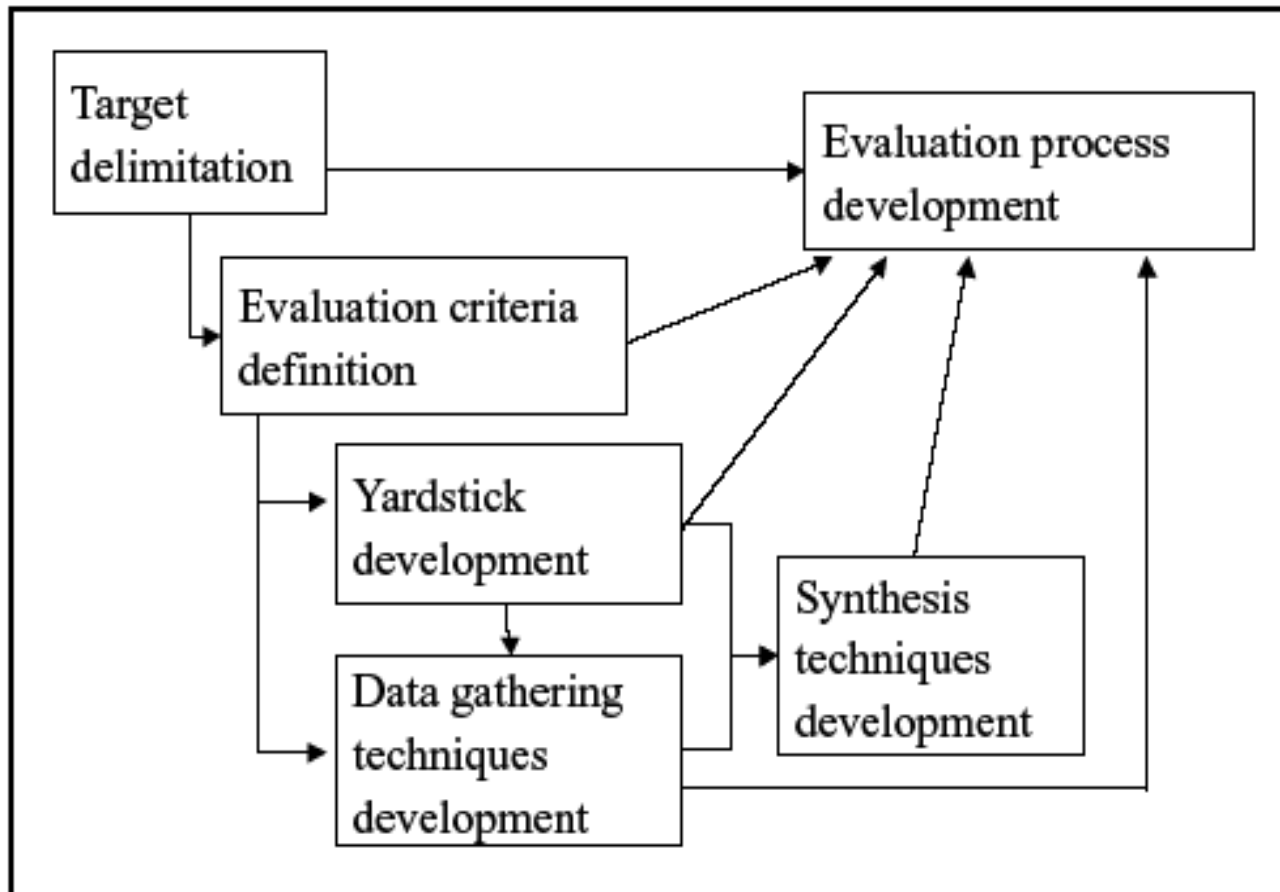
## Comparing lightweight SPA methods - continued

### Sample of the comparison

Criteria	MARES	TOPS	FAME	RAPID	SPM	EAP	Micro-Evaluation
Geographic origin/Spread	Brazil	Italy	Germany	Australia	Ireland	Ireland	Belgium
Scientific origin	ISO 15504	ISO 15504	ISO 15504/ Bootstrap	ISO 15504	Quality Function Deployment	CMMI Compliant with the ARC 1.1	OWPL
Cost	Low	Low	NA	Low	Low	Low	Low
Development/ Stability	NA	NA	NA	Since 1999	Since 1999	Since 2003	Since 1998
Application region	Regional	Regional	Regional	Regional	Regional	NA	Belgium/ Quebec/ France
Analysis techniques	Interview	Interview	Interview	Interview	Questionnaire	Interview	Short Interview
Provide detailed description of assessment process	Totally	Partially	NA	Partially	NA	Yes	Partially
Provide detailed definition of assessment model	Yes	No	Yes	No	NA	Partially/ Make reference to CMMI	Yes
Number of processes assessed	26	3	4	8	47 Process with 135 practices	6	6
Number of processes to be improved	2-3	3	4	8	Max. 10 practices	6	6
Assessment duration	1 day	Half a day	NA	1 day	NA	1 day	Half an hour

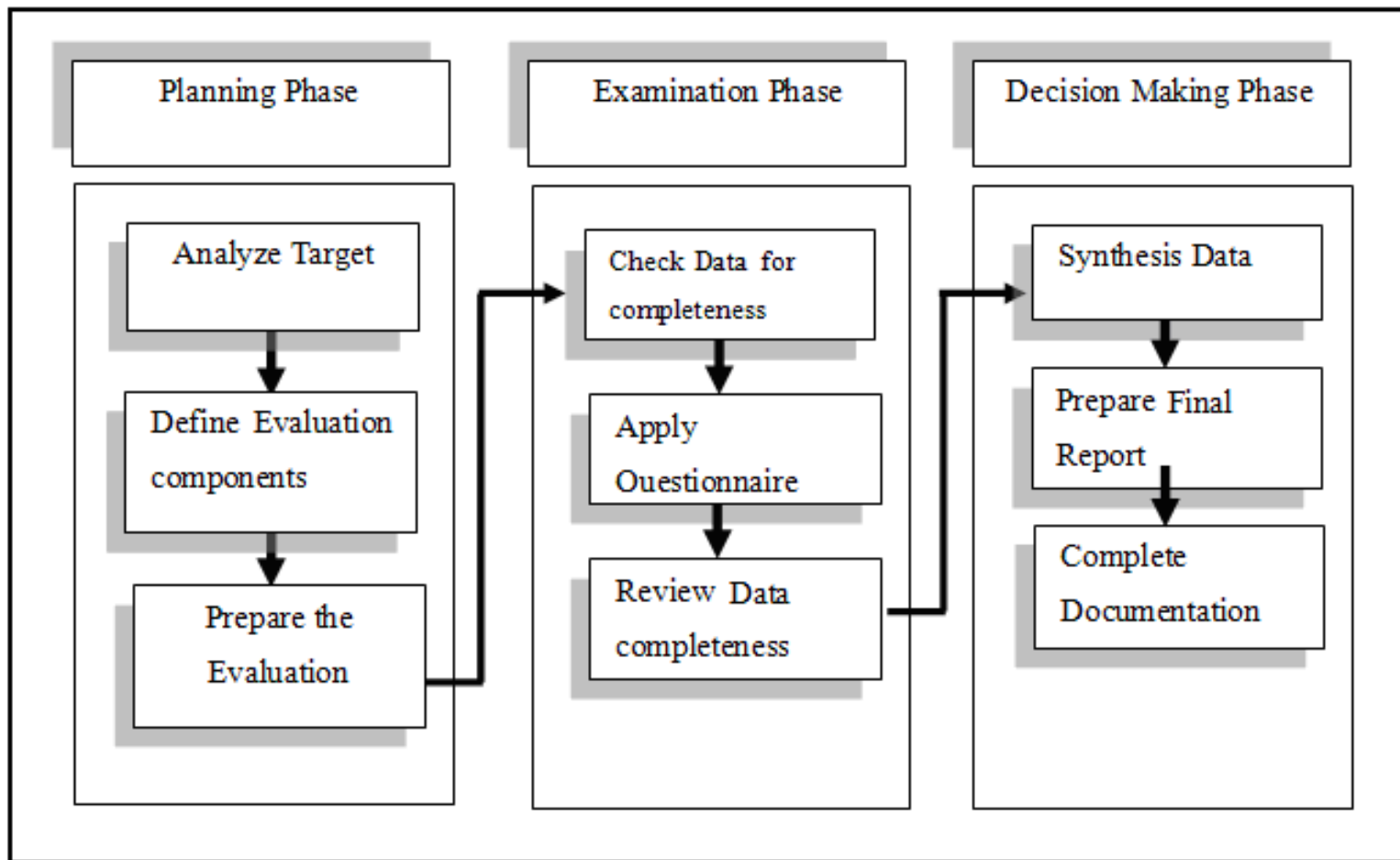
# Evaluation Theory Concepts

Evaluation theory components and their relationships



## Evaluation Theory Concepts - continued

Detailed activities for the proposed evaluation process phases



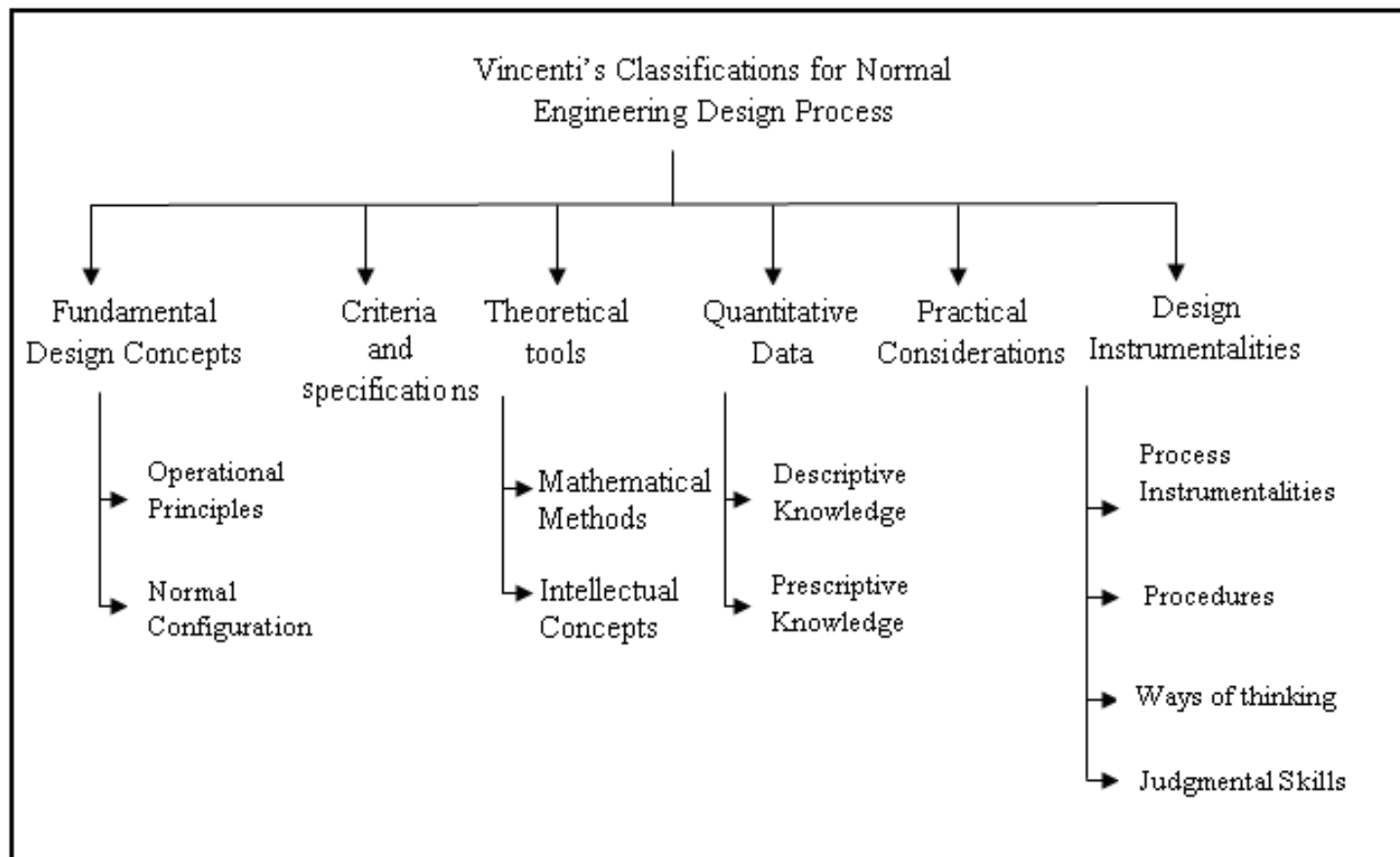
## Top-down Evaluation Method

- “For software engineering to be fully known as a legitimate engineering discipline and a recognized profession, consensus on a core body of knowledge is imperative” (SWEBOK 2004).
- On the other side, from the engineering viewpoint, Vincenti has a conformant viewpoint that considers the technology as a body of knowledge relatively independent from scientific knowledge.

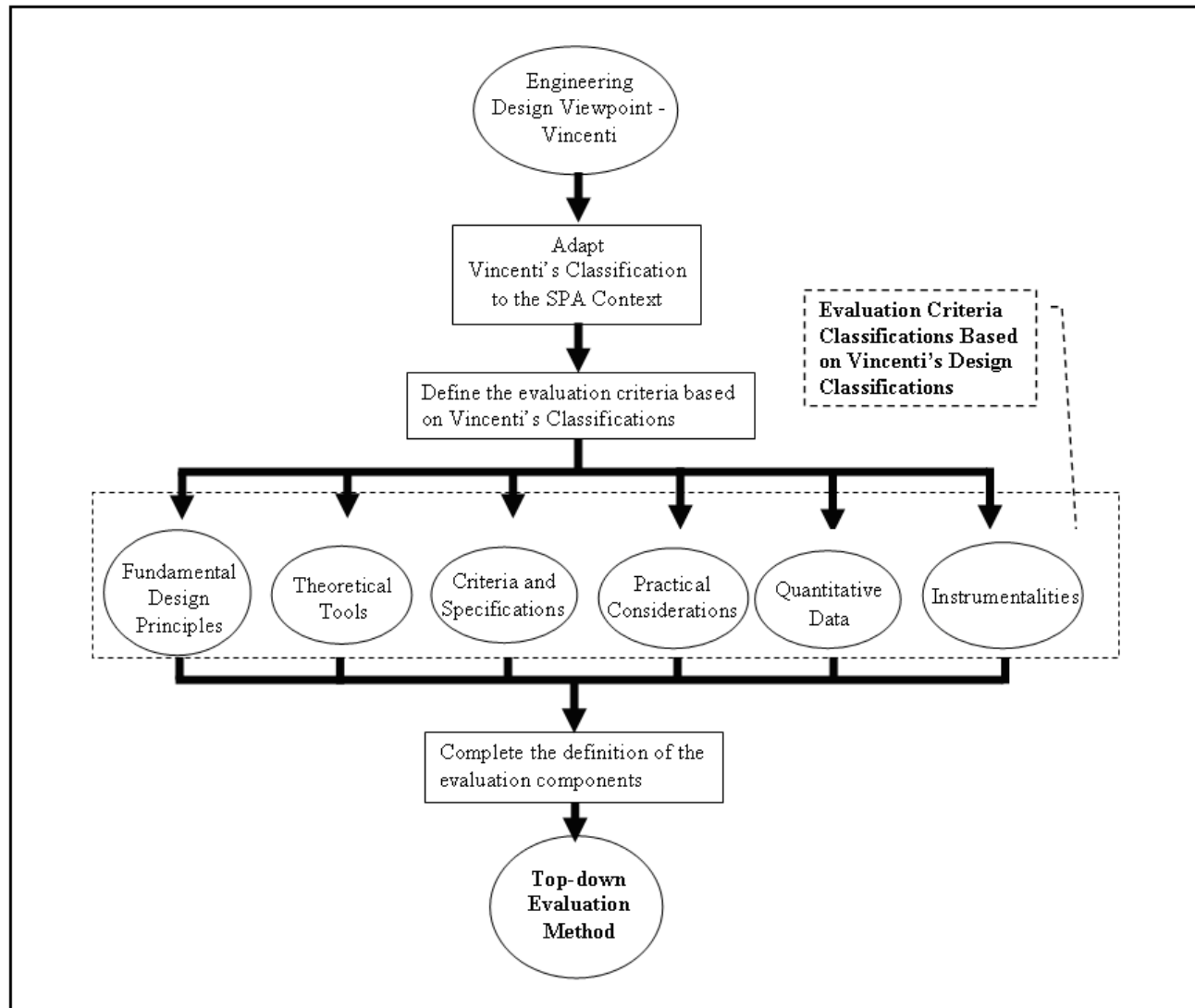


## Top-down Evaluation Method - continued

- Vincenti proposed a taxonomy of engineering design knowledge and classified it into six categories



# Top-down Evaluation Method - continued



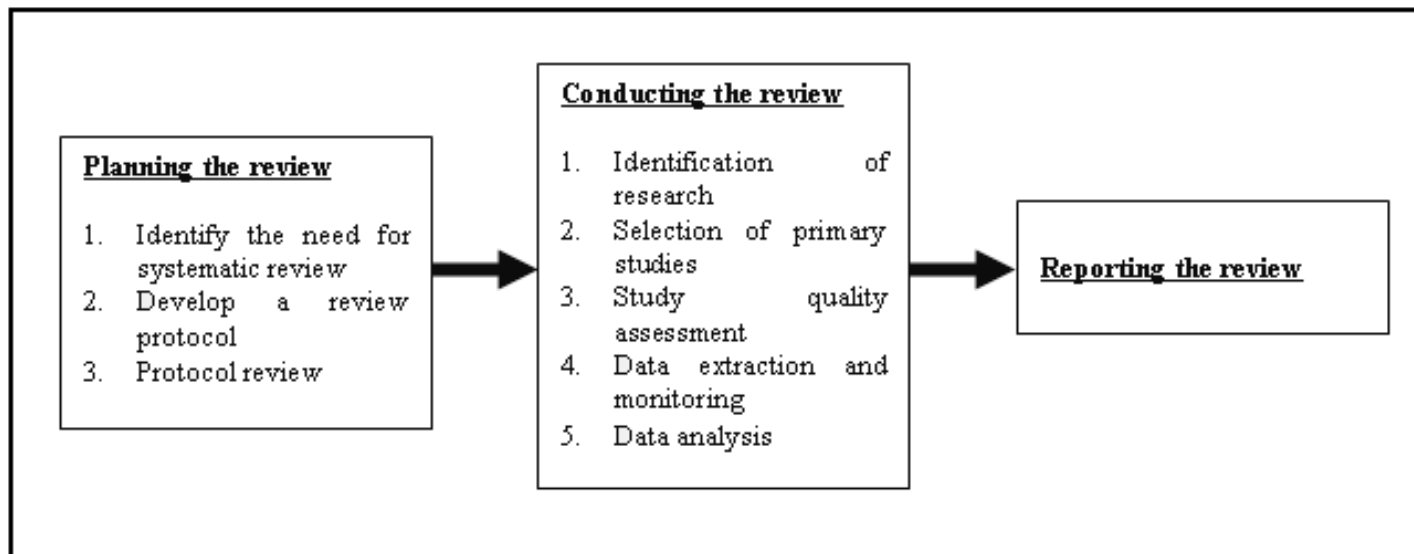
## Top-down Evaluation Method - continued

Sample of the evaluation method

SPA Process Evaluation Criteria based on Fundamental Design Principles		
No.	Criteria	Answer
SPA-FQ1	What process reference model is the SPA method based on?	
SPA-FQ2	What process assessment model is the SPA method based on?	
SPA-FQ3	Does the SPA method define the business need before the assessment?	
SPA-FQ4	Does the SPA method make use of previous assessment reports?	
SPA-FQ5	Does the SPA method refer to the organizational documents and reports while preparing for the assessment?	
SPA-FQ6	Does the assessment method make use of assessment tools through different phases of the assessment?	

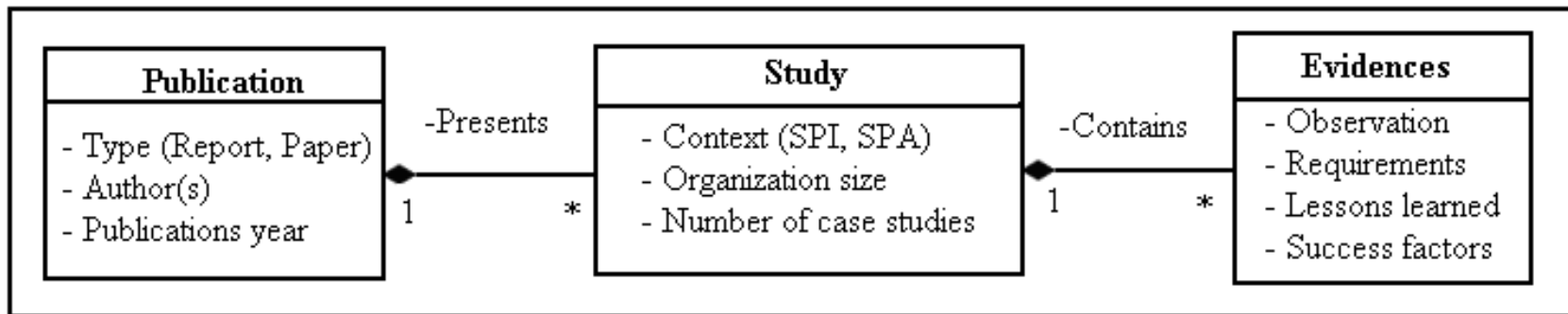
# Bottom-up Evaluation Method

## Systematic Review



## Bottom-up Evaluation Method - continued

### Data Extraction model



1. In the first phase more than 250 publication have been reviewed based on their titles and abstracts.
2. In the second phase a total of 29 publication have selected based on reading the whole article.
3. 207 success evidences have been collected, filtered down into 38 distinct success evidences grouped into five main classes

# Bottom-up Evaluation Method - continued

## Success Evidences resulted from SR and their frequencies

Frequency of <b>method success evidences</b> out of the total number of evidences (207)		
Evidence	Freq.	%
Data from interviews.	3	1.4
Data from documents.	2	1.0
Accuracy of assessment findings (data collected)	3	1.4
Flexible and customizable method focusing on principal high-priority processes.	13	6.3
Coverage of the process reference model.	1	0.5
Identification of strengths, weaknesses, risks and improvement opportunities.	5	2.4
The improvement action plan should be feasible and address the special needs of the company.	4	1.9
Available and usable for on-site assessment and self-assessment.	2	1.0
Comply with formal assessment method.	3	1.4
Simple well-structured questionnaire with no more than 150.	12	5.8
Duration of the interview should be minimum 2 hours.	3	1.4
Reliability and repeatability of the assessment result.	6	2.9
Completeness.	1	0.5

Frequency of <b>supportive tools success evidences</b> out of the total number of evidences (207)		
Evidence	Freq.	%
Usable support tools which cover the different phases of the assessment process	19	9.2
Build and use database of historical SPA data.	5	2.4
(Semi-) Automatic assessment-report generation.	1	0.5
Adaptability/Flexibility.	2	1.0
Support confidentiality of assessment	2	1.0
Ensure repeatability of results.	1	0.5

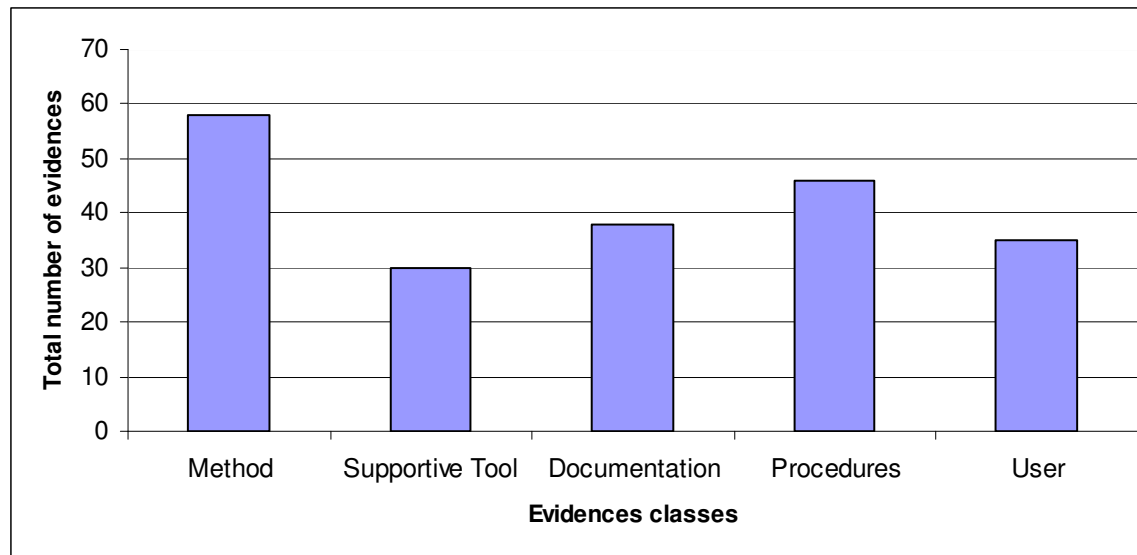
Frequency of <b>procedure related success evidences</b> out of the total number of evidences (207)		
Evidence	Freq.	%
Preparation of the assessment	25	12.1
Build confidence and trust relationships with participants	4	1.9
Produce assessment report delivered to the organization	3	1.4
Ensure confidentiality	6	2.9
Hold feedback session after each assessment.	8	3.9

Frequency of <b>documentation success evidences</b> out of the total number of evidences (207)		
Evidence	Freq.	%
Guidance for identifying assessment purpose, objectives and logistics	2	1.0
Guidance for identifying organizational unit	1	0.5
Guidance for assessment team	7	3.4
Guidance for ensuring confidentiality.	2	1.0
Providing document templates	4	1.9
Documentation of the assessment method and its implementation in practice	16	7.7
Documentation of results of data collection and ratings	5	2.4
Guidance to the follow-up assessors	1	0.5

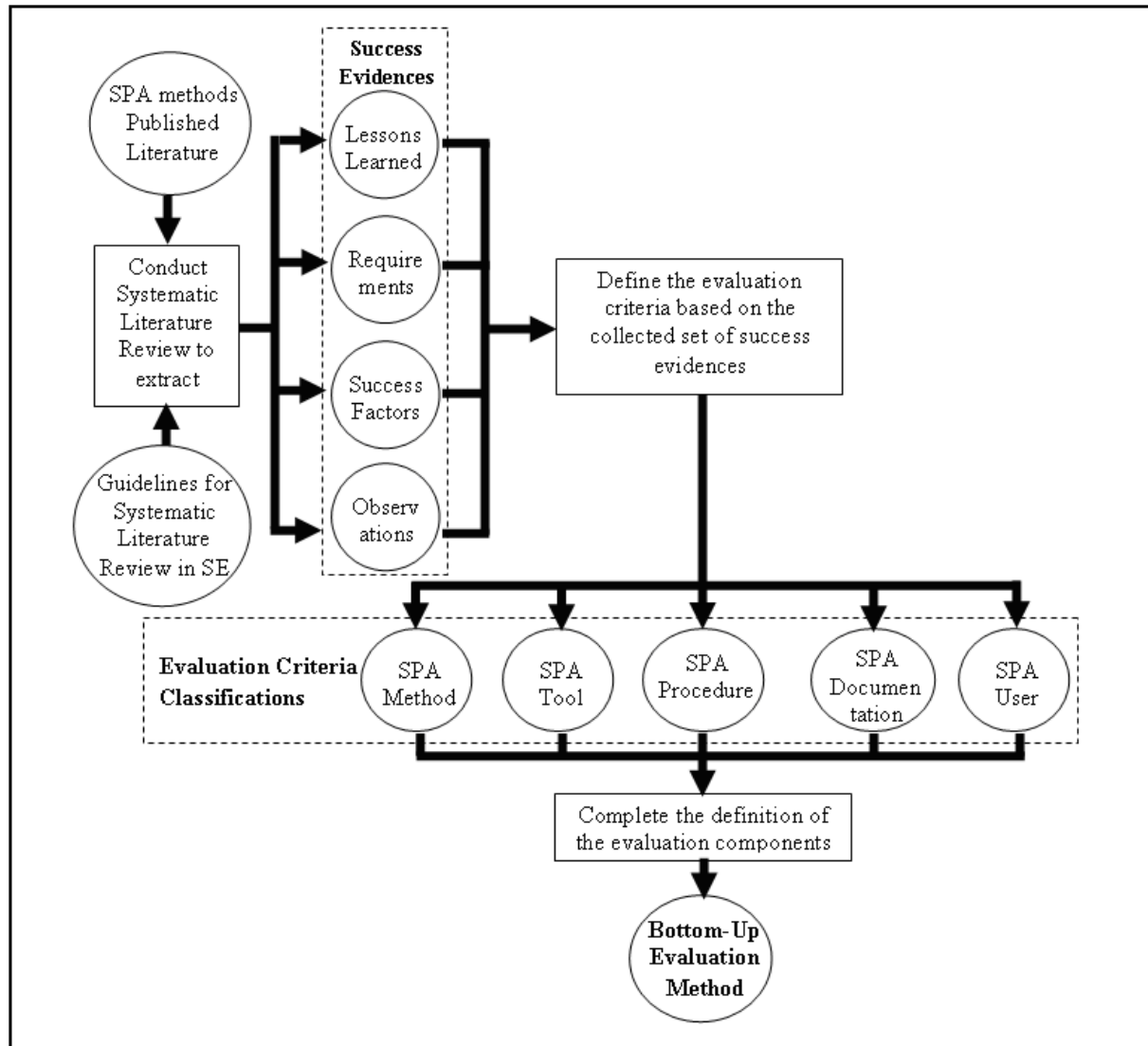
Frequency of <b>users success evidences</b> out of the total number of evidences (207)		
Evidence	Freq.	%
Organization participants' responsibilities.	6	2.9
Assessment team credentials and responsibilities.	5	2.4
Senior management and other staff members Involvement.	7	3.4
Commitment.	8	3.9
Benefits: the participants should feel the benefits of the assessment.	5	2.4
Credibility: the sponsor and staff should believe that the assessment will give a result.	4	1.9

# Bottom-up Evaluation Method - continued

Frequencies of evidences per class



# Bottom-up Evaluation Method - continued





## Bottom-up Evaluation Method - continued

Sample of the evaluation method

SPA Method Evaluation			
No.	Question	Answer	Comments
SPA-MQ1	Does the method acquire assessment data from interviews?	<input type="radio"/> F <input type="radio"/> P <input type="radio"/> N	
SPA-MQ2	Does the method acquire assessment data from documents?	<input type="radio"/> F <input type="radio"/> P <input type="radio"/> N	
SPA-MQ3	Does the method ensure the accuracy of findings	<input type="radio"/> F <input type="radio"/> P <input type="radio"/> N	
SPA-MQ4	Is the method flexible and customizable (i.e. possibility of adding new axes) by focusing on high priority processes using certain mechanism?	<input type="radio"/> F <input type="radio"/> P <input type="radio"/> N	
SPA-MQ5	Does the method provide coverage to a process reference model?	<input type="radio"/> F <input type="radio"/> P <input type="radio"/> N	
SPA-MQ6	Does the method identify strengths, weaknesses, risks and improvement opportunities?	<input type="radio"/> F <input type="radio"/> P <input type="radio"/> N	

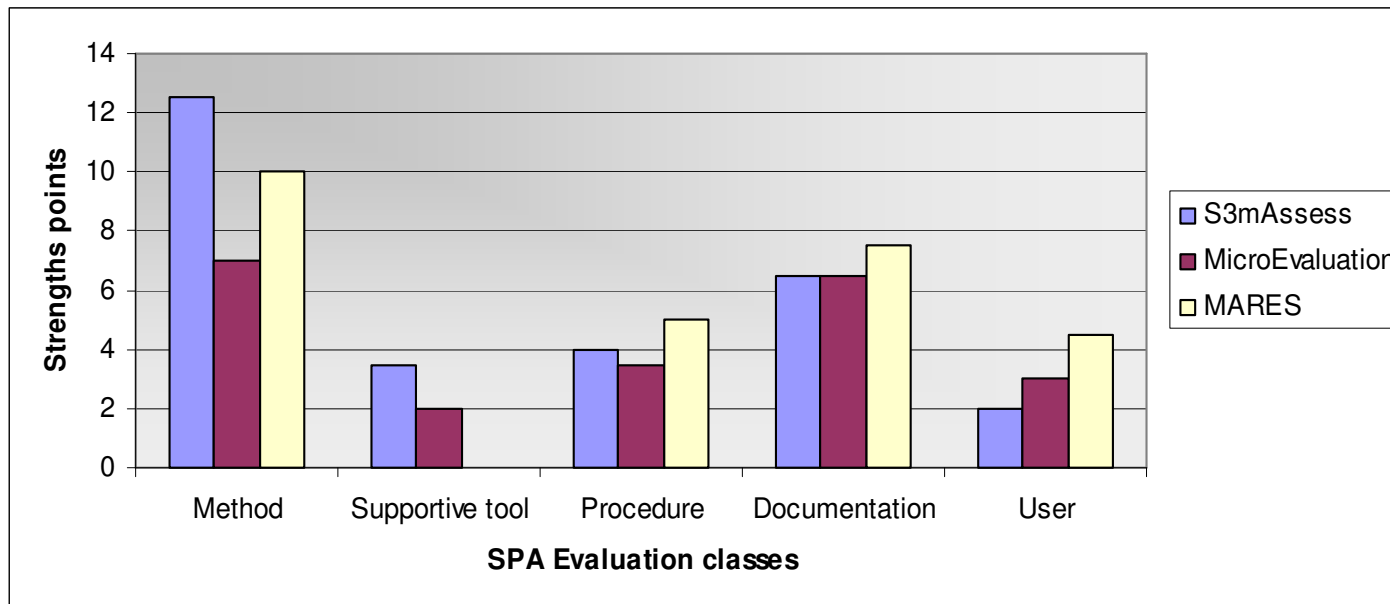
# Research Approach Verification

- The verification techniques used as the basis for the verification process include:
  - Situating the project: the literature review
  - Project design
  - Sampling
  - Bracketing
  - Methodology coherence

## Case Studies

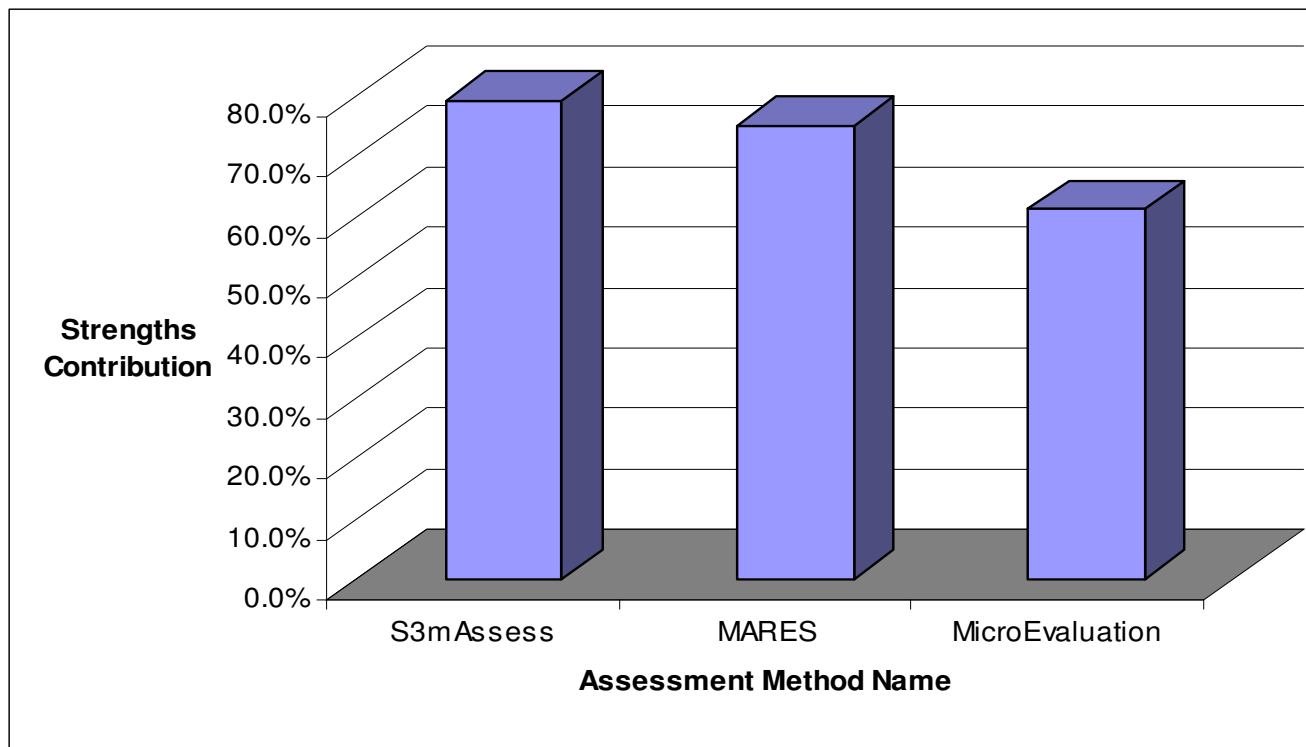
- Three Case studies have been conducted to evaluate SPA methods
- The methods are MARES, Micro-evaluation and S<sup>3m</sup>

Strengths comparisons between the three SPA methods.



## Case Studies - continued

Comparison of strengths contributions among the three SPA methods



## Research Contributions

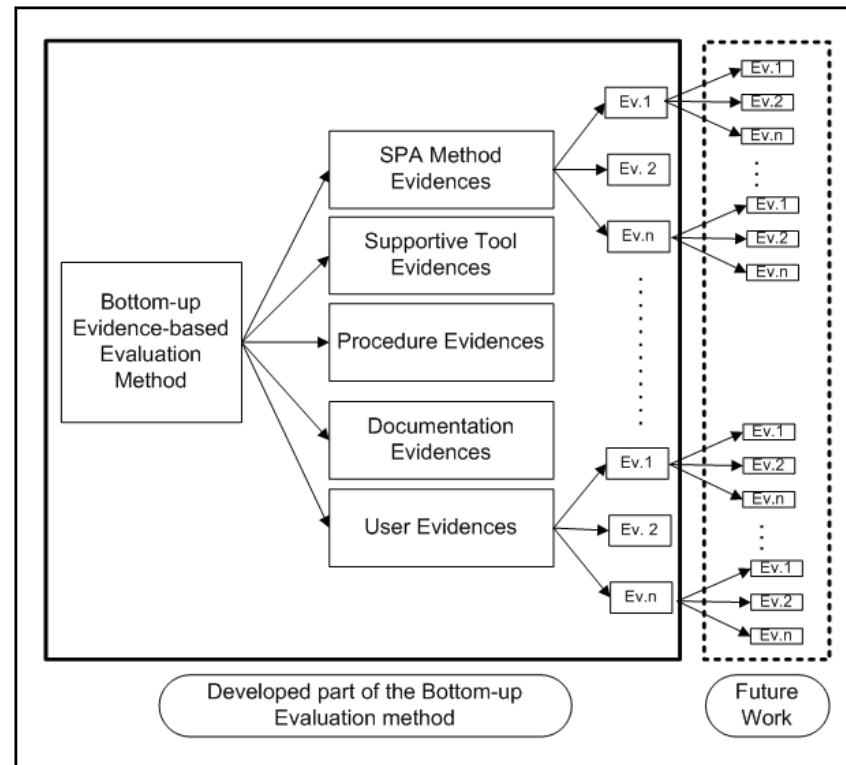
- Identification of comparison criteria that provide useful and informative data suitable for comparison purposes between different lightweight SPA methods.
- Identification of evidences found necessary to conduct a successful assessment method. The success evidences are published as success factors, requirements, observations and lessons learned.
- Application of Vincenti's classifications for engineering design to the design process of the SPA methods. Implementing Vincenti's classifications enhance the alignment of the SPA methods design with engineering design principles.
- Development of evaluation methods of the success of lightweight SPA methods.

## Conclusion

- This research work opens the door to align the design process of SPA methods with engineering design principles
- This research works to build a consensus in the process assessment and improvement community on the evidences necessary to achieve a successful SPA method implementation.
- The two evaluation methods have been formally developed based on evaluation theory concepts.

## Future Work

- Improve the proposed evaluation methods:
  - The bottom-up evaluation method can be improved by adding a new level of specific evidences.



- More work is needed to evaluate other lightweight SPA methods.

## Future Work

- Work with ISO/IEC WG24 to enhance the content of the proposed standard ISO29110-3.
- ISO 15504 parts 2 and 3 needs to be modified to include guidelines for designing SPA methods - not conducting assessments only.



## Publications

- **Evidences supporting the successful design of lightweight software process assessment methods: A systematic review**, submitted to ELSEVIER IST: *journal INFORMATION & SOFTWARE TECHNOLOGY*.
- **A Framework to Compare Software Process Assessment Methods Dedicated to Small and Very Small Organizations**, *the International Conference on the Software Quality - ICSQ'07*, October 16-17, 2007 in Lakewood (Denver) Co. USA.
- **Very Small Enterprises (VSE) Quality Process Assessment** presented at *3rd International Workshop on Quality of Information and Communication Technologies*, Cuba, 2007.



# Q & A