Multi-Level Compliance Measurements for Software Process Appraisal

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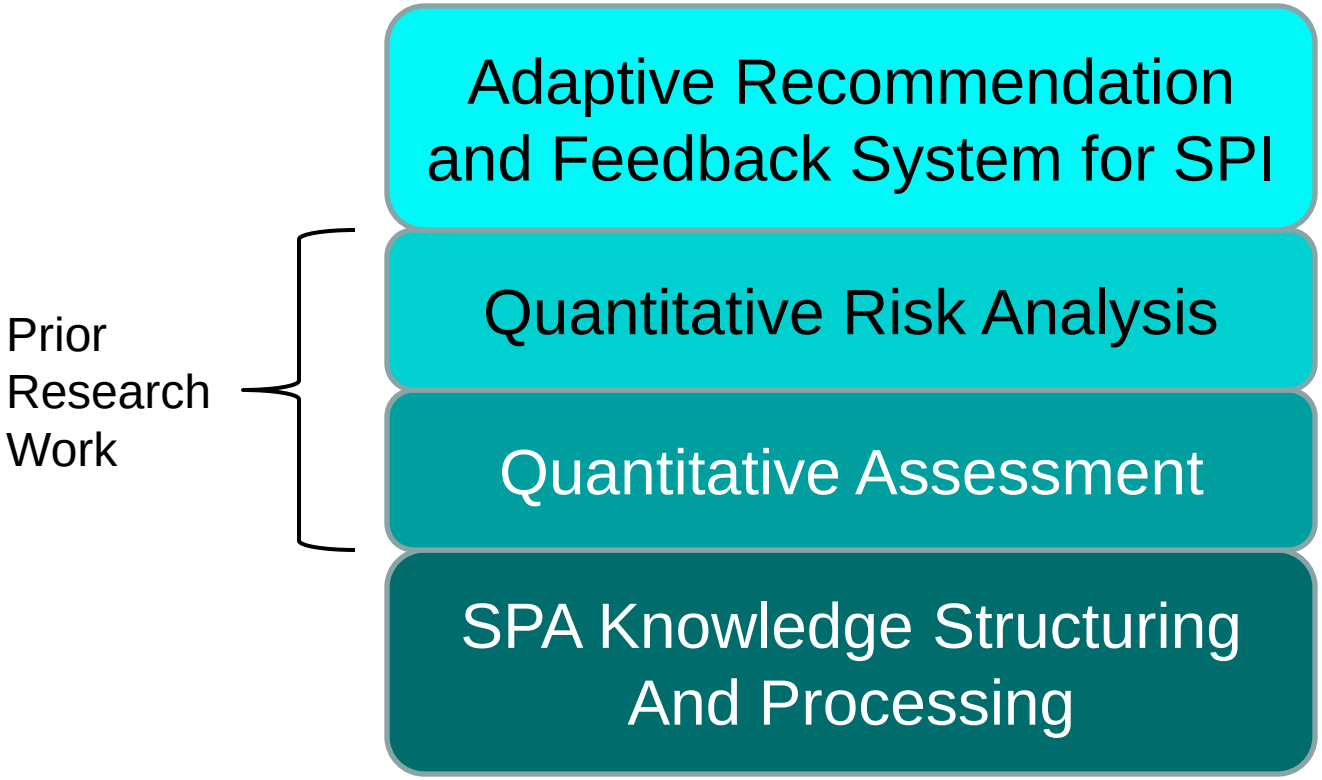
Presentation Layout

- Introduction to
  Software Process Appraisal (SPA)
- Multi-Level Compliance Measurements
- Illustrative Example
- Conclusions and On-going Works

Appraisal Framework

ICT MUSE Research Project

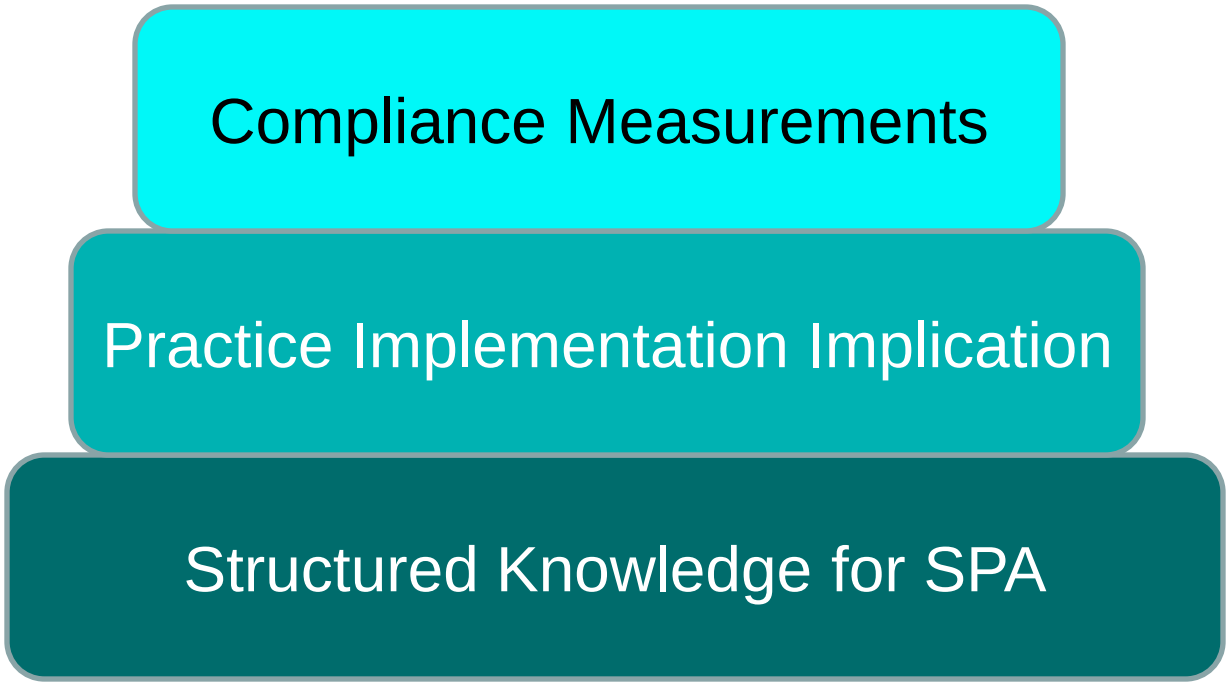
Automated Quantitative Self-Assessment and Self-Learning Framework
For Software Process Improvement (SPI)



Research Motivation

- SPA is knowledge incentive task, which uses
  - Experience
  - Expertise
  - Tacit knowledge
- There are no software process appraisal assistant tool concerning with knowledge processing.
- The understanding in the semantic linkage between each area of knowledge involved in an appraisal process could pave a way for the automation of the examination and determination processes.

SPA Knowledge Structuring and Processing



This talk

Roongsangjan 2017 [3]

My talk in APSEC 2017

Definition

A process of measuring a software development process

Sommerville 2011, Software Engineering 9th Ed [4]

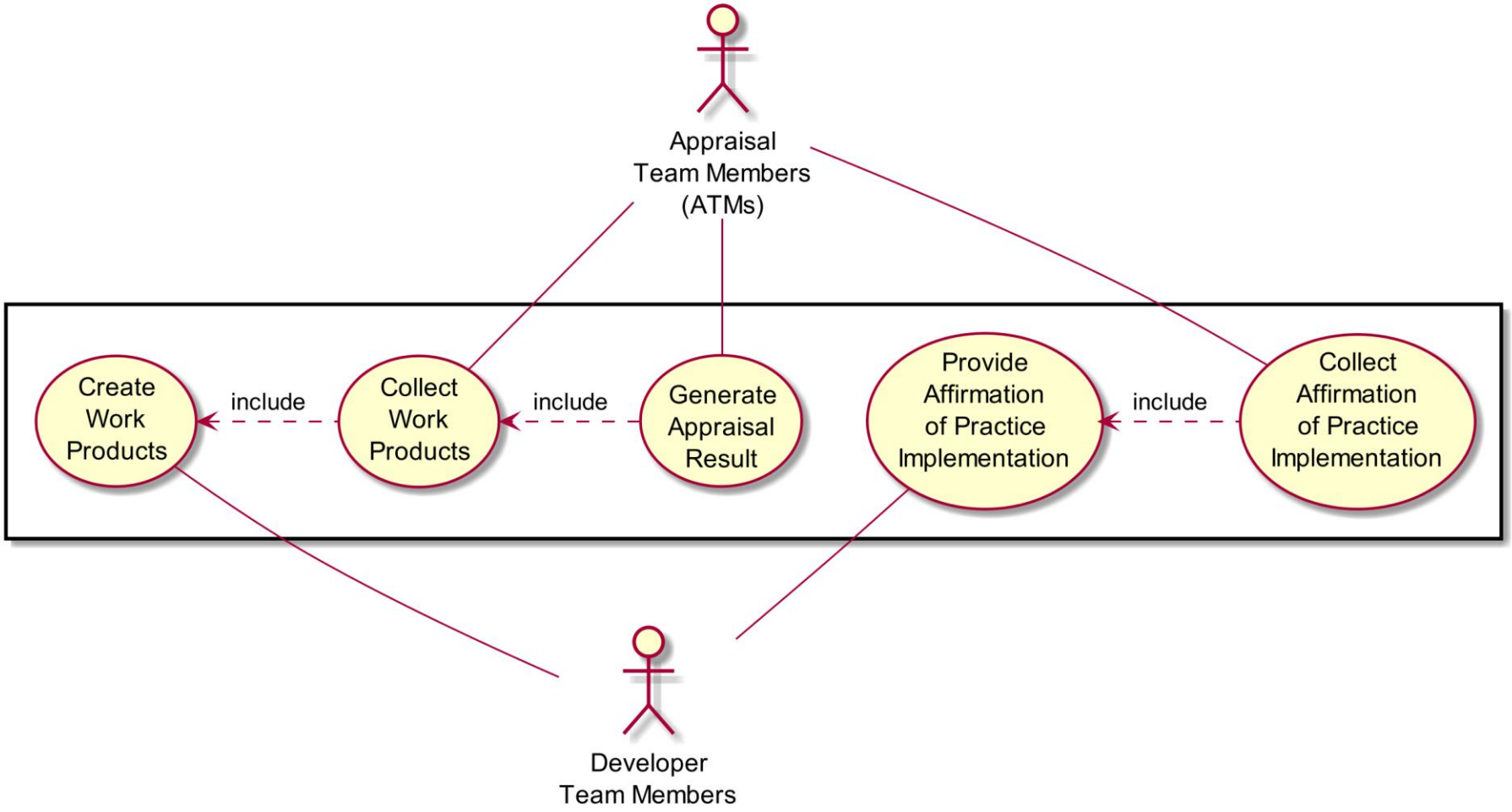
An examination of one or more processes by a trained team of professionals using an appraisal reference model as the basis for determining, at a minimum, strengths and weaknesses.

CMMI SM

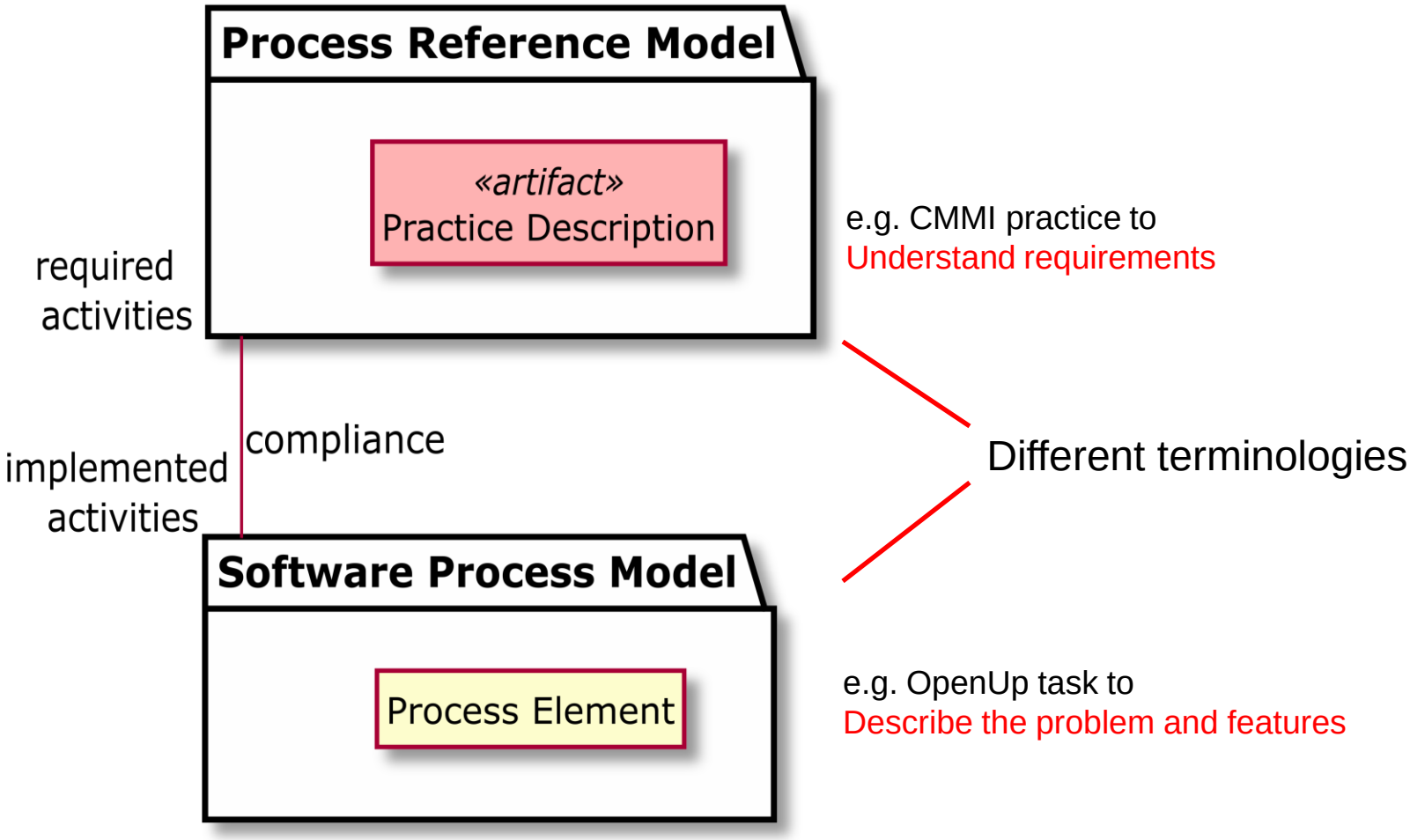
Capability Maturity Model Integration (CMMI) v1.3 [5]

Icon made by Freepik from www.flaticon.com

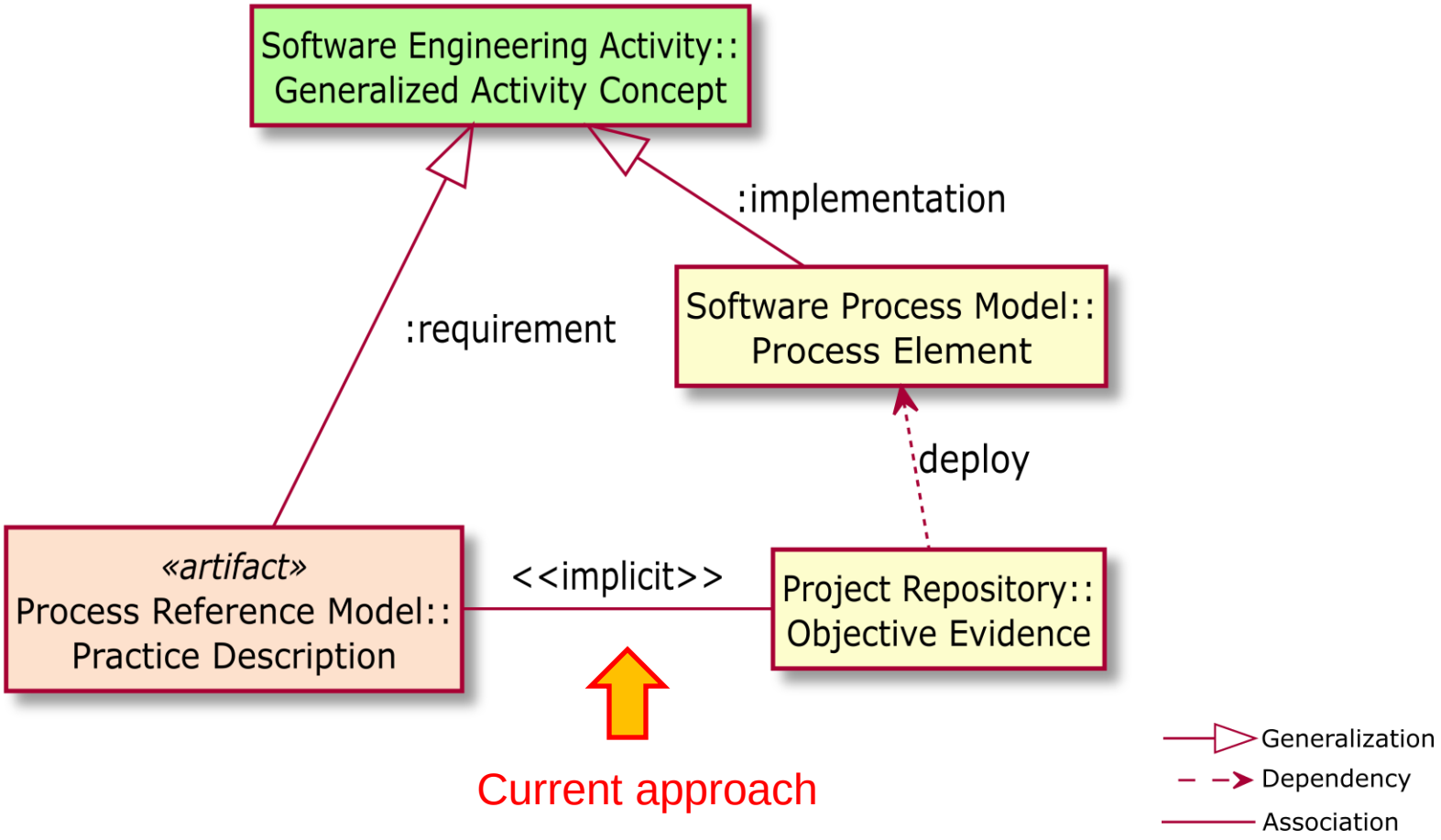
General Appraisal Use Cases



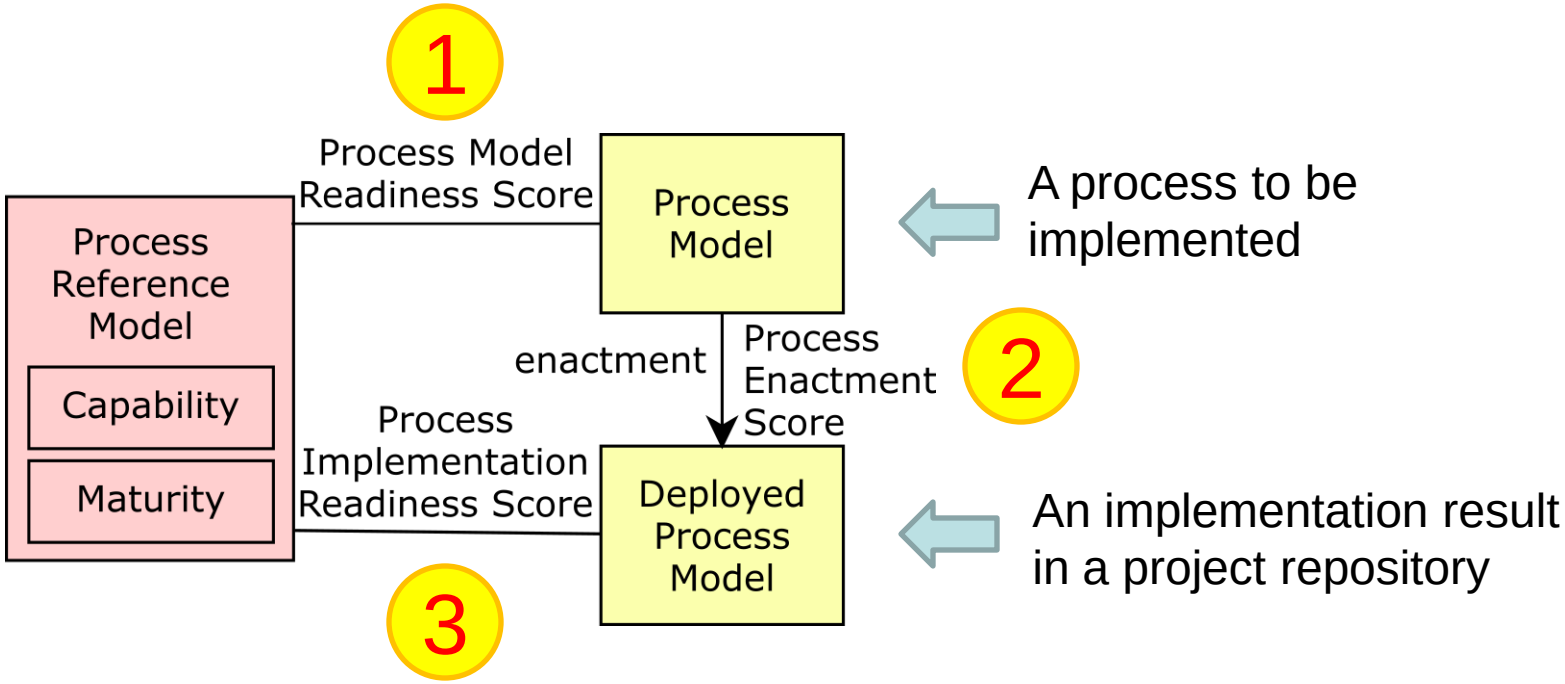
Knowledge Explicitly Involved in an Appraisal



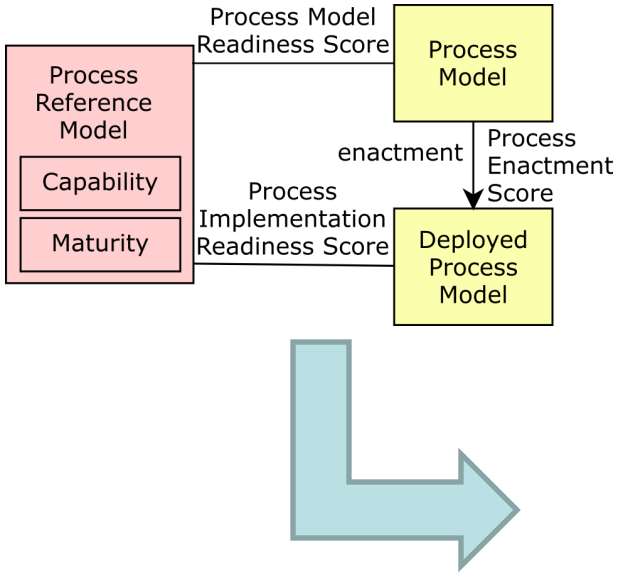
Current and Proposed Approaches

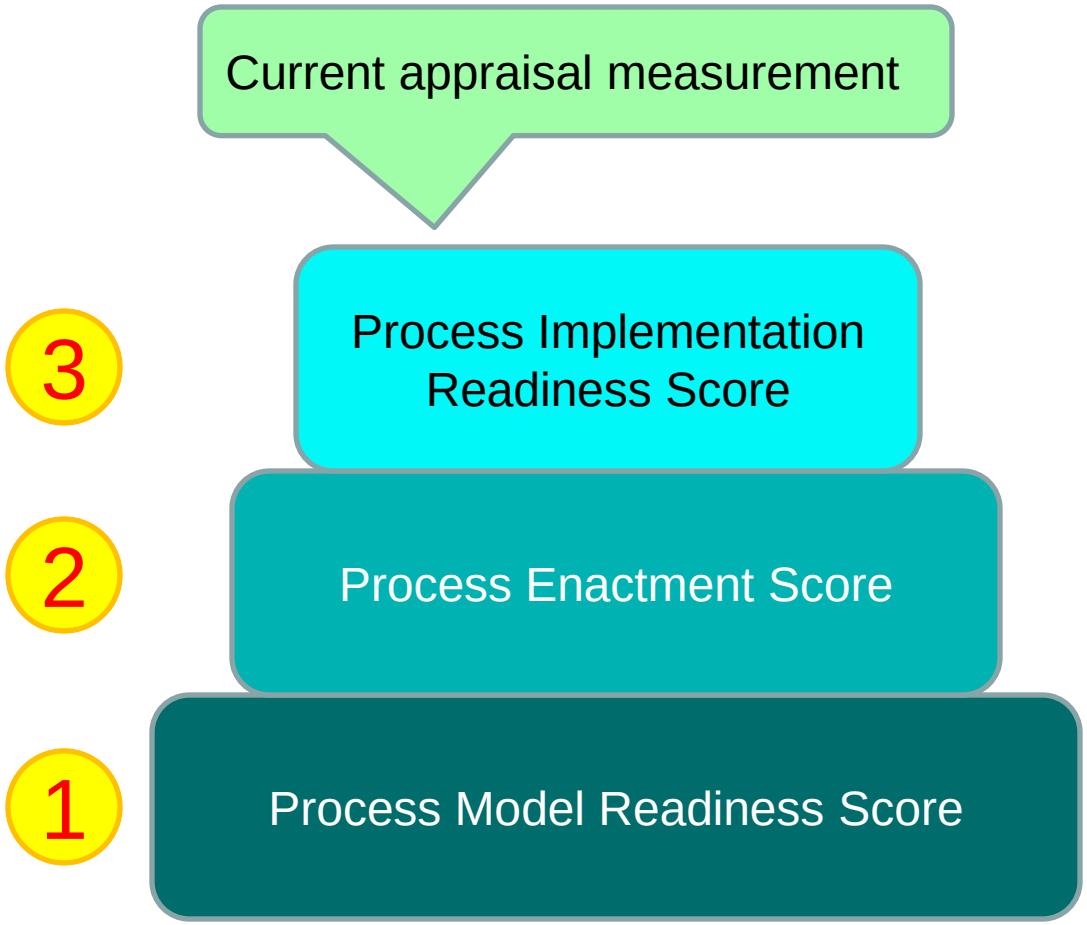


Multi-Level Compliance Measurements



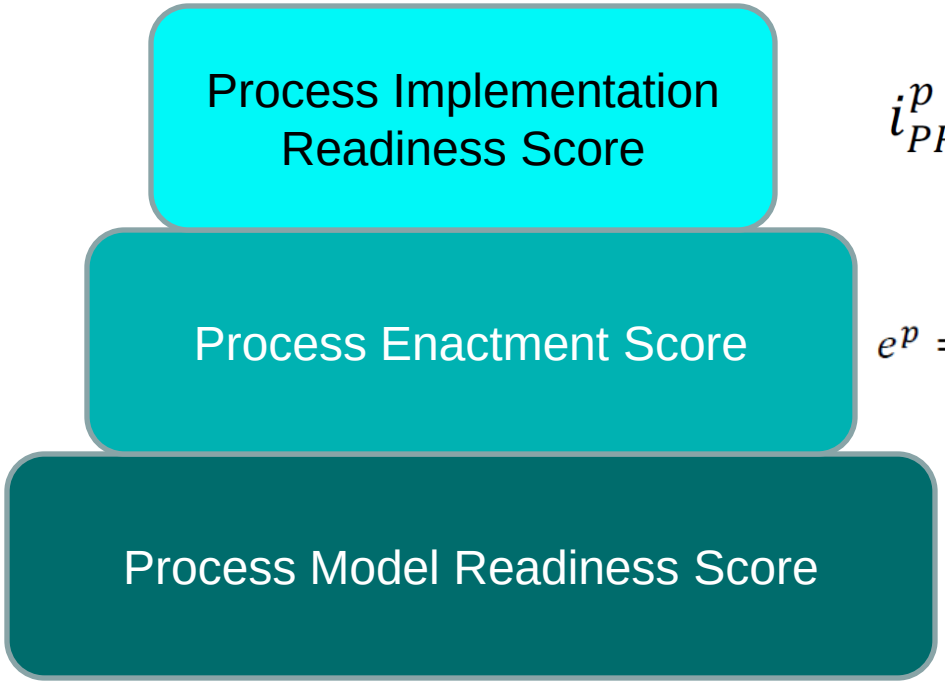
Multi-Level Compliance Measurements





Multi-Level Compliance Measurements

Calculation



$$i^{p}_{PRM} = m^{p}_{PRM}\, e^{p}$$

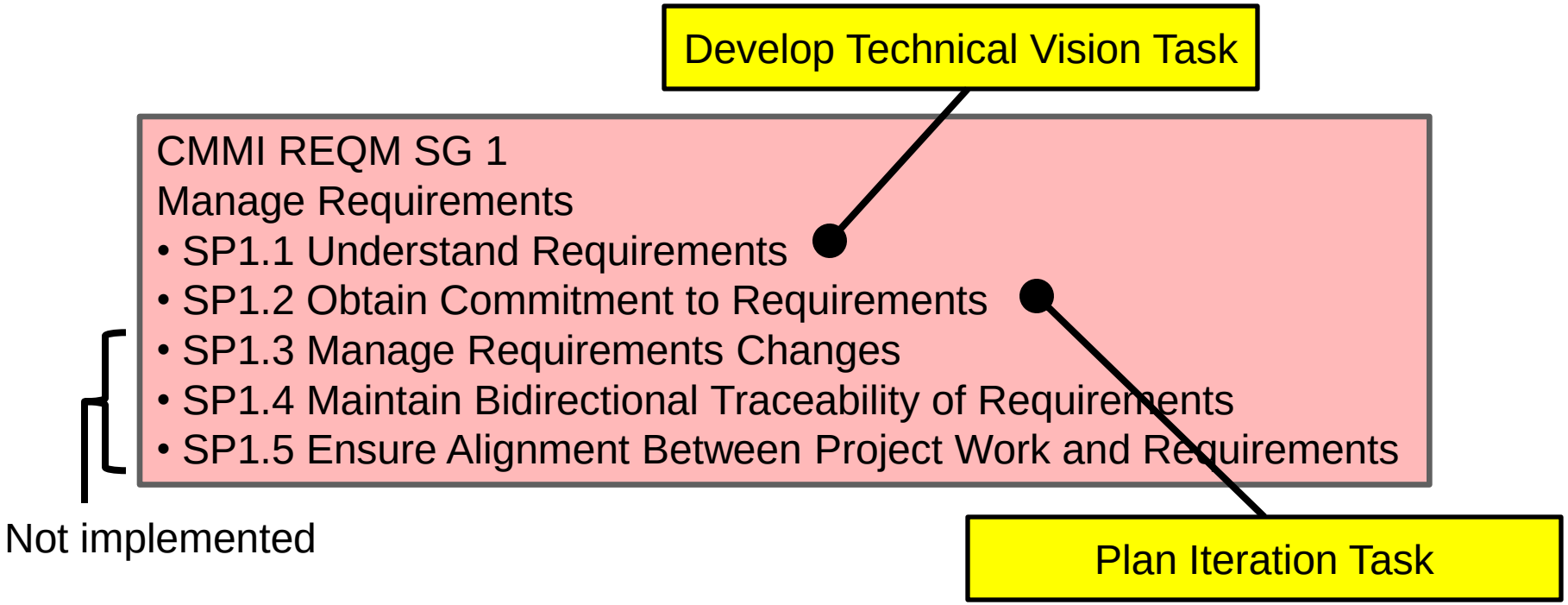
$$e^{p} = \frac{|Deployed\ Tasks^{p}\ | + |Created\ Output\ WPs^{p}|}{|Tasks^{p}| + |Output\ WPs^{p}|}$$

$$m^{p}_{PRM} = \frac{|Implemented\ Practices^{p}_{PRM}|}{|Practices_{PRM}|}$$

Process Model Readiness Score

Example: CMMI vs. OpenUp in EPF

CMMI Requirements Management (REQM) process area



Capability Maturity Model Integration (CMMI)
Specific Goal (SG)
Specific Practice (SP)
Eclipse Process Framework (EPF)

Process Model Readiness Score

Calculation Example for REQM process area

$$c^{p}_{PRM(a)} = \frac{|Implemented\ Practices^{p}_{PRM(a)}|}{|Practices_{PRM(a)}|}$$

SP1.1, SP1.2

$$c^{OpenUp}_{CMMI(REQM)} = \frac{2}{5} = 0.40$$

SP1.1 - SP1.5

The complement of this score represents the effort to achieve full capability of the Requirements Management (REQM) process area.

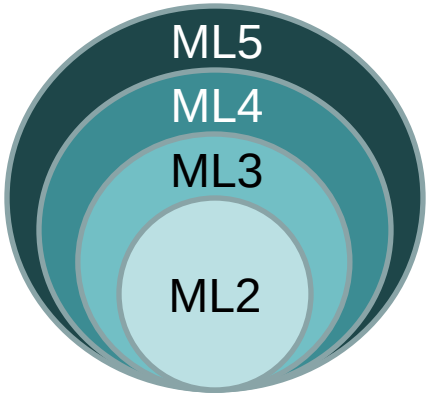
$(c^{OpenUp}_{CMMI(REQM)})^{c}$ = 1 - 0.40 = 0.60

p = OpenUp, *PRM* = CMMI
a = REQM

Process Model Readiness Score

m-Score for each Maturity Level (ML)

m-Score is applicable for the CMMI and ISO/IEC 15504 maturity levels.



$$m^{p}_{PRM(l)} = \frac{|Implemented\ Practices^{p}_{PRM(l)}|}{|Practices_{PRM(l)}|}$$

$$m^{p}_{CMMI(5)} = m^{p}_{CMMI}$$

$$m^{p}_{ISO/IEC\ 15504(5)} = m^{p}_{ISO/IEC\ 15504}$$

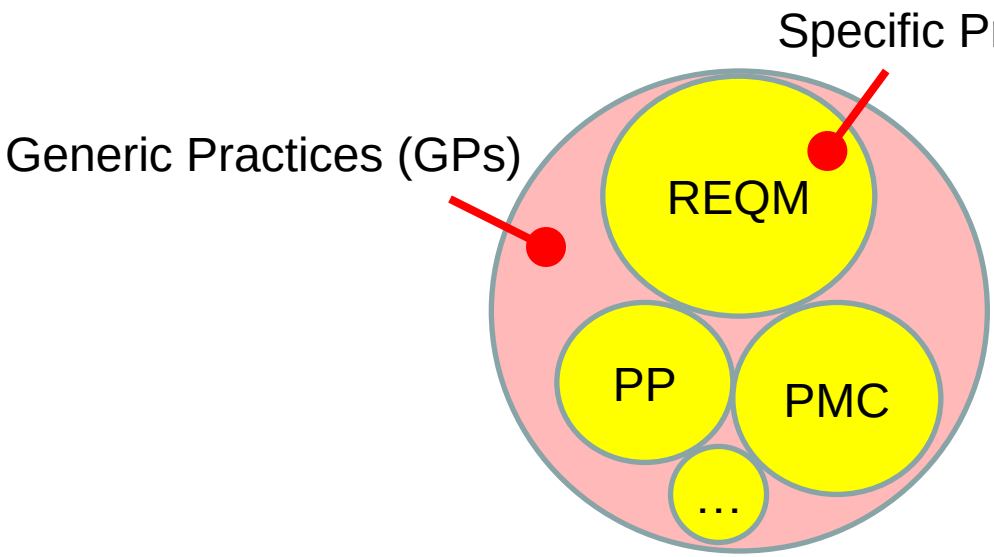
l = Maturity Level

Process Model Readiness Score

m-Score for Generic Practices

m-Score is applicable for the Specific Practices and Generic Practices.

CMMI Practices = SPs in each process area + GPs in every process area



c-Score for every process area,

$$\overline{c^{p}_{PRM}} = \left(\sum_{a \subset PRM} \left(c^{p}_{PRM(a)} \right) \right) / n$$

m-Score for Generic Practices,

$$m^{p}_{PRM(g)} = \overline{c^{p}_{PRM}} - m^{p}_{PRM}$$

Project Planning (PP)
Project Monitoring and Control (PMC)
g = Generic Practices
n = Number of Process Areas

Process Enactment Score

Example 6 tasks in Inception phase in OpenUp process model

		Work Products (WPs)
1.	Develop Technical Vision → Vision, Glossary	(2 WPs)
2.	Plan Iteration → Work Items List, Iteration Plan	(2 WPs)
3.	Identify and Outline Requirements → System-Wide Requirements, Use Case, Use-Case Model, Work Items List, Glossary	(5 WPs)
4.	Detail Use-Case Scenarios → Use Case, Use-Case Model, Glossary	(3 WPs)
5.	Detail System-Wide Requirements → System-Wide Requirements, Glossary	(2 WPs)
6.	Create Test Cases → Test Case	(1 WP) +
	Number of Output WPs^{OpenUp} =	15

Assume that the developer team does not implement the first task,

$$e^p = \frac{|Deployed\ Tasks^p| + |Created\ Output\ WPs^p|}{|Tasks^p| + |Output\ WPs^p|}$$

$$= \frac{(5+13)}{(6+15)} = 0.86$$

Effort to reach the fully enacted process,

$(e^p)^c$ = 1 – 0.86 = 0.14

Process Implementation Readiness Score

$$i^{p}_{PRM} = m^{p}_{PRM}\, e^{p}$$

$$c^{OpenUp}_{CMMI(REQM)}$$

$$i^{OpenUp}_{CMMI(REQM)} = (0.40)(0.86) = 0.34$$

Insight Analysis

by using the proposed measurements

- Process Model Readiness Score. Complement of c-Score

  $(c_{CMMI(REQM)}^{OpenUp})^c$ = 1 – 0.40 = 0.60 It shows effort to reach full capability of REQM process area of a process model.

  to fill this gap, SP 1.3, 1.4, and 1.5 must be satisfied.

  - SP 1.3 requires activity to manage requirements changes.
  - SP 1.4 requires activity to trace requirements.
  - SP 1.5 requires activity to trace requirements and to validate requirements.

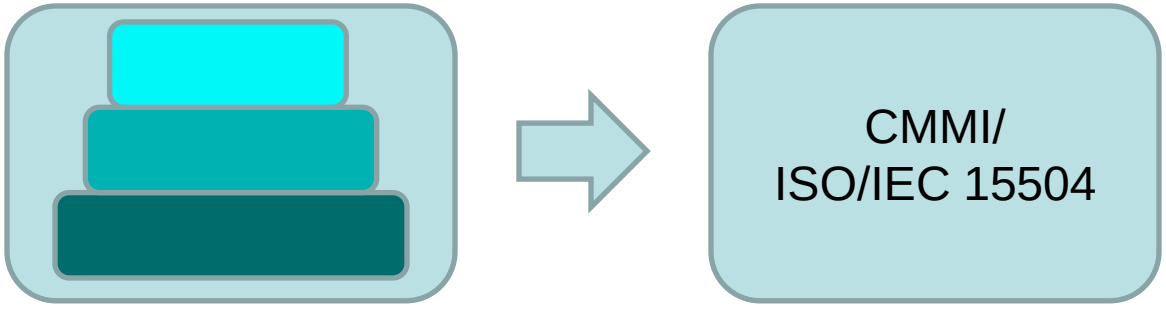
- Complement of Process Enactment Score represents effort to reach the fully enacted process $(e^p)^c$ = 1 – 0.86 = 0.14
  Software development team must implement every task in a process model.

- Complement of Process Implementation Readiness Score represents effort to reach full capability of this process area

$$(i_{CMMI(REQM)}^{OpenUp})^c = 1 - 0.34 = 0.66$$

Conclusions

- The proposed compliance measurements reflect compliance in three levels.
  - Compliance by design
  - Compliance by enactment
  - Compliance by implementation
- They benefit for insight analysis to support self-assessment and formal appraisal process.



Insight Analysis/Self-Assessment

Formal Appraisal

- They do not replace the measurement of the existing appraisal models.

On-Going Works

- Appraisal assistant tool that implements the concept in Roongsangjan 2017 [1] will be created and it will implement these measurements.
- The benefits comparison of using and not using this tool for insight analysis will be conducted.

References

[1] M. Choetkiertikul and T. Sunetnanta, "A risk assessment model for offshoring using CMMI quantitative approach," *Proc. - 5th Int. Conf. Softw. Eng. Adv. ICSEA 2010*, pp. 331–336, 2010.

[2] T. Sunetnanta, N.-O. Nobprapai, and O. Gotel, "Quantitative CMMI Assessment for Offshoring through the Analysis of Project Management Repositories," in *SEAFOOD*, 2009, pp. 32–44.

[3] S. Roongsangjan, T. Sunetnanta, and P. Mongkolwat, "Using FCA Implication to Determine the Compliance of Model Practice Implementation for Software Process," in *Proceedings of the ICMSS 2017*, 2017, pp. 64–70.

[4] I. Sommerville, *Software Engineering*, 9th ed. Harlow, England: Addison-Wesley, 2010.

[5] SEI, "CMMI for Development, Version 1.3 Improving processes for developing better products and services," 2010.