

# FIRST: Common-sense Process Scopes for Starting a Process Improvement Program

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**Abstract.** One of the main challenges for ICT organizations is to initiate a well-structured process improvement program. This is particularly the case when adopting a maturity & capability model (MCM) as it brings with it costs associated with internal appraisals, and the realization that in order to achieve a particular maturity level (ML) a number of processes within the Process Reference Model (PRM) will need to be successfully implemented. Some initiatives have been proposed in the last decade, such as the RAPID initiative, but there is still some resistance to adopting MCMs such as CMMI or SPICE (ISO/IEC). This paper will propose the FIRST (Fast Improvement aSsessment sTep) approach, providing a minimum, common-sense set of processes to be appraised during the initial gap analysis which will form the foundation for the design and deployment of an improvement plan, which will be particularly useful for Small-Medium Enterprises (SMEs) and Very Small Entities (VSEs), that are coherent with ISO Management Systems requirements.

**Keywords:** Process Appraisals, Process Improvement, CMMI, ISO/IEC 15504, FIRST, Appraisal Scope.

## 1 Introduction

During the '90s some publications such as the CHAOS Report [1] focused upon the success rate of IT projects, reporting how project failure may be avoided and the probability for achieving better results improved through adopting improvement activities. This helped to promote, during the same period, the diffusion of 'maturity models' such as the Sw-CMM [2], the first SPICE (ISO/IEC 15504) technical reports [3] and few other process improvement models and initiatives (e.g. Bootstrap [4] and AMI [5]). Unfortunately, ICT organizations mostly perceived maturity & capability models (**MCM**) as an improvement tool for large companies (even though many of the models and frameworks are specific for SMEs/VSEs<sup>1</sup>) requiring a significant

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<sup>1</sup> See ISO/IEC 29110 public site: <http://profs.etsmtl.ca/claporte/english/VSE/VSE.html>

budget for sponsoring such structured initiatives, instead of something simpler based on the continuous improvement quality principle.

Therefore, in order to promote the usage of MCM's there was a need to create appraisals with reduced appraisal scopes, with few premises: low budget, but willing to promote improvement initiatives → limited usage of MCM → design of a reduced scope for process appraisals, focusing upon assessing the 'vital' processes for determining the health of an organization and helping to provide improvement steps based upon the evidence gathered during reduced scope appraisals, moving from the cause-effect relationship of those processes with the other ones described in their own 'full' models/frameworks.

Upon analyzing reduced scope appraisals, some questions arise, such as: 1) is there a unique scope for all companies? 2) are the suggested set of processes the right ones? If not, which modifications could be suggested?

The aim of this paper is to discuss how to improve the usage of MCMs in any type and size of ICT organization, trying to use the 'reduced scope' shortcut as a communication tool for stimulating managers to adopt these models, whilst also proposing a renewed version of such an idea.

The paper is organized as follows: Section 2, shows the most diffused process appraisal methods (PAM), with particular attention to those ones having a reduced appraisal scope and their rationale. Section 3, proposes FIRST (Fast Improvement aSessment sTep), highlighting the need to have different scopes for different information needs and maturity positioning by ICT organizations. Finally, Section 4 provides some conclusions and the next steps for this work.

## 2 Process Appraisals: State-of-the-Art

### 2.1 Process Appraisal Methods (PAMs)

In the ISO world, any MCM has two facets: a PRM (Process Reference Model) and a PAM (Process Assessment Model), the first one describing the processes<sup>2</sup>, the second one the detailed model that is used for the actual assessment<sup>3</sup>. For instance, looking at CMMI constellations, each constellation with its technical report (DEV/ACQ/SVC) describes the PRM, while SCAMPI (Standard CMMI Appraisal Method for Process Improvement) is the process based on ARC (Appraisal Requirements for CMMI), representing its PAM. Looking at SPICE (ISO/IEC 15504 standard), ISO 15504-5 contains the PAM that is based upon the PRM for software ISO/IEC 12207.

Since those PRMs contain many processes, from the late '90s a number of tailored versions for SMEs/VSEs arose, with the two main drivers for achieving

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<sup>2</sup> A PRM is "a model comprising definitions of processes in a life cycle described in terms of process purpose and outcomes, together with an architecture describing the relationships between the processes (ISO/IEC 15504-1:2004 *Information technology -- Process assessment -- Part 1: Concepts and vocabulary*, 3.48)"

<sup>3</sup> A PAM is: "a model suitable for the purpose of assessing process capability, based on one or more process reference models (ISO/IEC 15504-1:2004 *Information technology -- Process assessment -- Part 1: Concepts and vocabulary*, 3.3)"

improvements at lower costs were: a) reduce the PRM scope, with lighter PRMs (less processes); b) simplify processes in terms of actions and WPs to be used. Just to name a few, for the SPICE world: MARES [6], MPS.BR<sup>4</sup>, MoProSoft<sup>5</sup>, SPIRE [7] and FAME [8], etc.; for the Sw-CMM/CMMI world: IPSS [9], Dynamic CMM [10], etc.

## 2.2 PAM Scope

Irrespective of the appraisal method, the common-sense criteria applied is mostly to design the appraisal scope by prioritizing those processes that – if properly managed and controlled – could enable an organization to obtain valuable information for planning and running focused improvement actions.

For instance, the assessment/appraisal ‘scope’, in the CMMI world, ARC asks “*The method documentation shall provide requirements and/or guidance for identifying the scope of the model(s) to be investigated in the appraisal, including the process areas and capability levels, as appropriate for the model representation.*” (requirement 4.1.3) [11], while for the SPICE world, ISO/IEC 15504-2:2003 states that “*A Process Assessment Model shall declare its scope of coverage in the terms of: a) the selected Process Reference Model(s); b) the selected processes taken from the Process Reference Model(s); c) the capability levels selected from the Measurement Framework.*” (Clause 6.3.2.3) [3]

In both cases, there is not a well-established list of criteria for shaping the PRM/PAM scope, leaving each organization to cope with technical constraints and to choose what could be subjectively important for them. Of course, when few organizations following the same criteria this decreases the potential to provide external, competitive benchmarking.

## 2.3 Reducing the appraisal scope: some experiences

### 2.3.1 RAPID

RAPID (Rapid Assessment for Process Improvement for software Development) [12][13] was one of the most diffused methods based on ISO/IEC 15504, applying a reduced appraisal scope. Proposed in 2000, referring to the SPICE TR documents, it was updated lately in 2006 to reflect updates to the 15504 IS (International Standard) references, as described in Table 1. Eight (8) processes are taken into account out of a full set of forty-eight (48) ISO/IEC 15504 processes.

**Table 1.** RAPID processes and process categories.

Process		Process Category	ISO/IEC TR 15504	ISO/IEC IS 15504
RE	Req. Elicitation	Customer-Supplier	CUS.3	ENG.1
SD	Software Development	Engineering	ENG.1	ENG.x
CM	Configuration Mgmt	Support	SUP.2	SUP.8
QA	Quality Assurance	Support	SUP.3	SUP.1

<sup>4</sup> <http://www.softex.br/mpsbr>

<sup>5</sup> <http://www.comunidadmoprosoft.org.mx/>

PM	Project Management	Management	MAN.2	MAN.3
PR	Problem Resolution	Support	SUP.8	SUP.9
RM	Risk Management	Management	MAN.4	MAN.5
PE	Process Establishment	Organization	ORG.2.1	PIM.1

### 2.3.2 Express Process Appraisal (EPA)

The Express Process Appraisal (EPA) method [14] was developed in 2003 to reduce the scope of the CMMI<sup>®</sup> model [15] to focus upon only the foundational processes that would bring the most benefit to SMEs. The EPA complies with the ARC 1.1 [16] requirements for a class-C methods. The EPA was therefore based upon only 6 process areas of the continuous representation of the CMMI<sup>®</sup> model as opposed to the full 25 process areas. The processes included in the EPA are listed below in table 2. The EPA does not provide any form of rating. The EPA method was designed to assess software processes within software development companies with little or no previous experience of software process improvement programs, and so it was decided not to assess the generic practices for each of the process areas. Therefore the EPA method is currently limited to appraising the specific practices for each of the process areas mentioned previously.

Table 2. EPA process areas

Process Area	Process Category	Maturity Level	
REQM	Requirements Management	Engineering	2
PP	Project Planning	Project Management	2
CM	Configuration Management	Support	2
PMC	Project Monitoring & Control	Project Management	2
PPQA	Process & Product Quality Assurance	Support	2
MA	Measurement & Analysis	Support	2

### 2.3.3 Adept

The Adept method [17] was developed in 2007 and was based upon the EPA method. It however differed from the EPA in that it extended the scope of the assessment to include 12 process areas (out of 25 processes within the CMMI model) as opposed to 6 process areas. It was developed based upon experiences from the EPA and therefore four of the fundamental process areas that were included in the EPA were deemed to be mandatory and the remaining 8 process areas optional. The Adept method, like the EPA was designed so that 6 process areas could be assessed, with 4 being mandatory this meant that the sponsor company could select 2 of the remaining 8 processes for inclusion within the assessment. The four mandatory processes were those that were deemed to provide the most benefit to companies when the EPA method was implemented [18], these were *Requirements Management*; *Configuration Management*; *Project Planning*; *Project Monitoring & Control*. Table 3 provides details of the Adept process areas.

**Table 3.** Adept process areas

Process Area		Process Category	Maturity Level	Mandatory/Optional
<b>REQM</b>	Requirements Management	Engineering	2	<b>Mandatory</b>
<b>PP</b>	Project Planning	Project Management	2	<b>Mandatory</b>
<b>CM</b>	Configuration Management	Support	2	<b>Mandatory</b>
<b>PMC</b>	Project Monitoring & Control	Project Management	2	<b>Mandatory</b>
<b>PPQA</b>	Process & Product Quality Assurance	Support	2	<i>Optional</i>
<b>MA</b>	Measurement & Analysis	Support	2	<i>Optional</i>
<b>RD</b>	Requirements Development	Engineering	3	<i>Optional</i>
<b>TS</b>	Technical Solution	Engineering	3	<i>Optional</i>
<b>PI</b>	Product Integration	Engineering	3	<i>Optional</i>
<b>VER</b>	Verification	Engineering	3	<i>Optional</i>
<b>VAL</b>	Validation	Engineering	3	<i>Optional</i>
<b>RSKM</b>	Risk Management	Project Management	3	<i>Optional</i>

### 2.3.4 MARES

MARES [6] is an ISO/IEC 15504-conformant assessment method for small software companies developed in 2004. The first version of the method defined a context-process model. Process profile patterns are used to indicate the process capability's relevance to the organization's characteristics and a set of heuristics are used for adapting the patterns to a specific organization. Within the method a SWOT analysis is performed in order to identify strengths and weaknesses by analyzing processes' importance to the organization's context and goals and their estimated capability. Although the initial version of MARES does not provide a minimum set of processes, the experience of its application [19] has led to its extension in 2006 to facilitate VSEs assessments, with the inclusion of a set of 17 processes taken from ISO/IEC 15504-5. Some processes may not be assessed when considered irrelevant to the organizational context, for instance, if a company has not yet reached the stage of providing support.

**Table 4.** MARES processes

Process Area		Process Category	Capability Level	Mandatory/Optional
<b>SPL.1</b>	Supply	Support	3	<i>Optional</i>
<b>SPL.2</b>	Software release	Support	3	<i>Optional</i>
<b>SPL.3</b>	Software acceptance support	Support	3	<i>Optional</i>
<b>OPE.2</b>	Customer support	Support	3	<i>Optional</i>
<b>ENG.4</b>	Software Requirements Analysis	Engineering	3	<b>Mandatory</b>
<b>ENG.5</b>	Software Design	Engineering	3	<b>Mandatory</b>
<b>ENG.6</b>	Software construction	Engineering	3	<b>Mandatory</b>
<b>ENG.7</b>	Software integration	Engineering	3	<b>Mandatory</b>
<b>ENG.8</b>	Software test	Engineering	3	<b>Mandatory</b>
<b>ENG.11</b>	Software installation	Engineering	3	<b>Mandatory</b>
<b>ENG.12</b>	Software Maintenance	Engineering	3	<b>Mandatory</b>

<b>CFG.1</b>	Documentation	Support	3	<b>Mandatory</b>
<b>CFG.2</b>	Configuration Management	Support	3	<b>Mandatory</b>
<b>CFG.4</b>	Change request management	Support	3	<b>Mandatory</b>
<b>MAN.3</b>	Project management	Project Management	3	<b>Mandatory</b>
<b>MAN.4</b>	Quality Management	Project Management	3	<b>Mandatory</b>
<b>MAN.5</b>	Risk Management	Project Management	3	<b>Mandatory</b>

### 2.3.5 ISO/IEC TR 15504-7:2008 – Appendix A

Last but not least in this short list of experiences, there is Part 7 of the ISO/IEC 15504 standard, recently released [20]. This technical report describes how to determine organizational maturity, and proposes a predefined sequence of processes by maturity levels (ML), similar to the CMMI staged representation.

Compared to ISO/IEC 15504-5 PRM, the main difference is that there is greater flexibility for selecting the appraisal scope. Appendix A, describes an exemplar organizational maturity model, proposing different sets of processes for each ML: (a) full set, (b) minimum set, (c) eventual additional processes to the minimum set, as shown in Table 5.

**Table 5.** ISO/IEC TR 15504-7 – Full set, minimum set, additional processes<sup>6</sup> by ML

	<b>ML</b>	<b>Full Set</b>	<b>Minimum Set</b>	<b>Additional processes</b>
Basic processes	<b>1</b>	ENG.1-12 SPL.2	ENG.1, ENG.4, ENG.5, ENG.6, ENG.7, ENG.8, SPL.2	ENG.2, ENG.3, ENG.9, ENG.10, ENG.11, ENG.12
	<b>2</b>	SUP.1-4, SUP.7-10 MAN.3, MAN.5, ACQ.3-5, SPL.3	SUP.1-2, SUP.7-10 MAN.3, MAN.5	SUP.3-4, ACQ.3-5, SPL.3
Extended processes	<b>3</b>	RIN.1-4, PIM.1-3 MAN.2, MAN.4, MAN.6 SUP.5, REU.1-3	RIN.1-4, PIM.1-3 MAN.2, MAN.4, MAN.6, SUP.5	REU.1-3
	<b>4</b>	QNT.1	---	---
	<b>5</b>	QNT.2	---	---

<sup>6</sup> Just for sake of paper length, not included in this table the conditions for additional processes.

### 3 FIRST, Keep It Simple!

**FIRST** (Fast Improvement assessment step) is our proposal for starting an improvement initiative, and it will be described in the following sections.

#### 3.1 (Re)shaping appraisal scopes: Criteria

In order to (re)design a possible appraisal scope, the following requirements should be considered:

- a) Processes to be included in the appraisal scope: relationships should be determined between other processes in the process model. In this way it may be possible to derive information on related processes without having to assess ALL those processes.
- b) Mapping elements: represent mapping tables between two (or more) models (e.g. CMMI-DEV vs ISO 9001:2008). Any model provides a single representation of the intended reality. Thus, at least two descriptions from different viewpoints could complement each other, providing more details and enabling a more realistic and affordable evaluation to be performed, with related corrective and improvement actions.
- c) Types and number of appraisal scopes: there is typically more than one single scope, it's a better approach that may adapted according to an organization's current maturity level or their target maturity level. The rationale for the scope of each appraisal should be determined by a causal relationship so that effort and costs could be minimized without impacting the overall informative value for the assessed organization in terms of WPs that are verified within the organization.
- d) Balancing processes by category: a further criterion for selecting a reduced set of processes for appraisal can be their distribution by process category/group [21]. E.g. in CMMI-DEV there are four categories (Process Management, Project Management, Engineering, Support), while in ISO/IEC 15504-5 there are nine groups (from 'Acquisition' to 'Reuse'). In such a way improvement actions will be derived through cross checking objective evidence (OEs). This reduces the probability of making the wrong decision.
- e) Map organizational software quality requirements to processes. This consists of discovering the organization's relevant software quality requirements and mapping them to relevant processes. An adapted version of the QFD (Quality Function Deployment) technique may be used to systematically map the organizational quality needs to the relevant processes [22].

#### 3.2 (Re)shaping appraisal scopes: Content

In the previous sections two main questions arise: 1) is there a unique scope for all types (and sizes) of companies? 2) are the suggested set of processes the right ones? If not, which modifications could be suggested?

Probably the answer should be 'no' for the first question and it could be 'it depends' for the second one. In the case when we answer 'no' to the second one, it

could be possible to argue that there are at least three main issues for improving the way to design a ‘reduced’ assessment/appraisal scope, whilst being able to assure retrieval of the useful elements needed for assuring a substantial process improvement, whatever the organizational size, this would be the ‘FIRST’ step:

- **Project Management is not Measurement** [23]: without assessing the measurement process, it’s not possible to determine if what an organization metrics are balanced, correct and fit with its informative needs. Project Management (Planning + Monitoring & Control, in the CMMI model) only plans and tracks project progress, typically against time and cost, but does not determine if we’re measuring the right things for that organization. Therefore we feel that the measurement process should be included in the assessment scope<sup>7</sup>.
- **Root-Cause Analysis (RCA)**: a fundamental criterion for understanding the real thoughts of an organization in relation to improvement is to verify how it performs (or not) root-cause analysis. For example, within the ISO 9000:2005 quality management principles (§0.2) [24], one of the eight principles relates to the “system approach to management”, requesting “*identifying, understanding and managing interrelated processes as a system contributes to the organization’s effectiveness and efficiency in achieving its objectives*”. Since there is a common understanding that an ISO 9001 certified company (approximately equates to between a CMMI ML2 and ML3 organisation, meaning that such a principle should also be included in a smaller appraisal scope. Observing CMMI-DEV and ISO 9001 [25], there is a well-known and accepted mapping table by Mutafelija & Stromberg [26] which compares the two models (even if CMMI is a process model, while ISO 9001 is a requirement model). This may be taken into account for translating the ‘whats’ (ISO requirements) into the ‘hows’ (CMMI processes and related tasks and suggested practices)<sup>8</sup>. Further rationale and details in [27][28] → **consequence**: include CAR (Causal Analysis & Resolution) (in CMMI) or SUP.5 (in SPICE).
- **Historical data**: another ISO 9000:2005 quality management principle concerns the “factual approach to decision making”, where “*effective decisions are based on the analysis of data and information*”. Again, such a goal could be satisfied – in CMMI terms – by OPD (Organizational Process Definition) through the so-called ‘Process Asset Libraries’ (PAL – SP 1.5) and the ‘Measurement Repository’ (SP 1.4) and MA (Measurement & Analysis) through the setup of those repositories (SG1) and the related data gathering (SG2). In SPICE terms, it requires the assessment also of REU.2 (Reuse Program Management), looking at all the data repositories supporting what is required in REU.2.BP7 (Collect and Manage Learning), as well as specific WPs such as the Information and the Experience Repository (related to PA2.1 – Performance Management) and the Knowledge Management System (related to PA2.2 – Process Deployment).

<sup>7</sup> E.g. MAN.6 (Measurement) is not included and it’s not Project Management; being assessed, it’d reveal a plenty of information that would – yet from a ML2 viewpoint – be helpful for suggesting focused and well-pointed improvements knowing the causal relationships among processes in a certain process model (CMMI, SPICE or another one) → **consequence**: include MAN.6 (or MA in CMMI). See also [29]. Furthermore, it’s one of the few ISO 12207 processes deployed as separated standard [34].

<sup>8</sup> An excerpt with mapping tables is available from the CMMI website: <http://goo.gl/vG5Rx>.

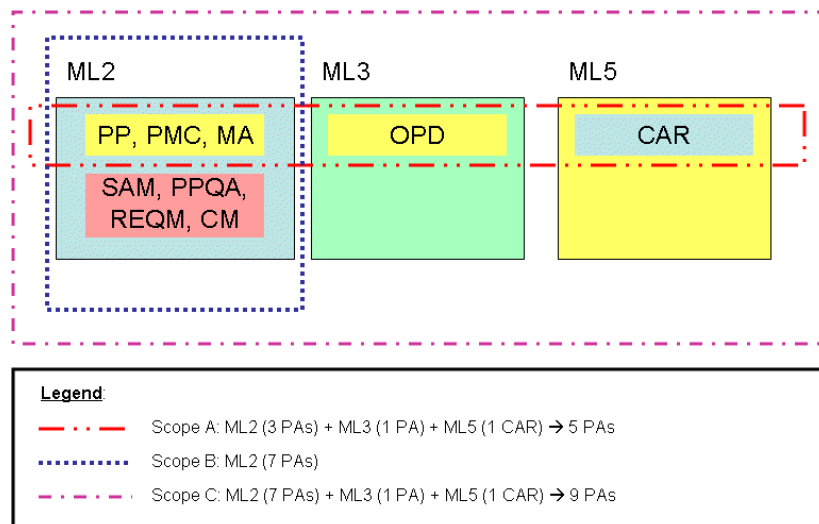


### 3.3 (Re)shaping appraisal scopes: the FIRST proposal

Applying the criteria (described above) and suggestions for which processes (or some elements) should be included, it is possible to develop at least three different scopes, as shown in Table 6, proposing an instantiation both for CMMI-DEV and for ISO/IEC 15504. This is also shown graphically in Figure 1.

**Table 6.** FIRST scopes, suggested audience and processes.

Scope	Suggested audience	CMMI-DEV v1.3	ISO/IEC 15504-5:2006
A	<ul style="list-style-type: none"> <li>• <b>Basic</b> – Crossing MLs, it includes the need of part of the lowest ML plus:                             <ul style="list-style-type: none"> <li>✓ Cause-Effect Analysis – as asked by ISO 9001:2008 principles and requirements</li> <li>✓ Project Historical Data – as asked still by ISO 9001:2008 §8.4</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <b>5</b> (<u>ML2</u>: PP, PMC, MA, <u>ML3</u>: OPD, <u>ML5</u>: CAR)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>4</b> (MAN.3, MAN.6, PIM.1, PIM.3)</li> </ul>
B	<ul style="list-style-type: none"> <li>• <b>Conservative</b> - for those intended to strictly achieve ML2 (exactly all ML2 processes)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>7</b> (<u>ML2</u>: PP, PMC, MA, SAM, PPQA, CM, REQM)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>7</b> (MAN.3, MAN.5, MAN.6, ACQ.3, SUP.1, SUP.8, ENG.4)</li> </ul>
C	<ul style="list-style-type: none"> <li>• <b>Advanced</b> – for those intended to progress from ML2 towards higher MLs, mainly reinforcing Support processes (the pink ones in the figure) plus historical data and cause-effect analysis as a foundation for better estimates and improvement actions yet from ML2 on.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>9</b> (<u>ML2</u>: PP, PMC, MA, SAM, PPQA, CM, REQM; <u>ML3</u>: OPD; <u>ML5</u>: CAR)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>9</b> (MAN.3, MAN.5, MAN.6, ACQ.3, SUP.1, SUP.8, ENG.4, PIM.1, PIM.3)</li> </ul>



**Fig. 1.** Three FIRST possible initial process scopes and related PA using the CMMI schema

In relation to the mapping between CMMI-DEV v1.3 [30] and ISO/IEC 15504-5:2006, as there is not an ‘official’ one provided by either ISO and/or SEI, we re-used the SQI 2001 mapping between CMMI v1.0 and ISO/IEC 15504-2:1998. We then applied to the subsequent evolutions for both models until arriving at the current versions for both models [30]<sup>9</sup>, and also including a more recent 2011 mapping proposed for the Automotive domain using AutomotiveSPICE [33]<sup>10</sup>.

## 4 Conclusions & Next Steps

‘*You cannot control what you cannot measure*’ is an old, well-known motto which may also be applied to process improvement, in terms of process measurements. Since measurement has a cost (it’s not for free), it is not necessary to measure everything (every process) but just what is strictly needed for our own informative goals. Thus, reducing the process scope in appraisals could be feasible and acceptable for speeding up the improvement process and also reducing costs. This would therefore be particularly useful in those organizations with a reduced budget and/or with a medium-small organizational size, and with few resources for performing appraisals.

Different initiatives have been proposed in the past for performing quick process appraisals, but typically each contained just one process scope definition, whatever the type of organization. **FIRST** is our proposal for trying to match this informative need, respecting the allocated budget for process appraisals, but modifying the choice of processes to be assessed based upon priority, in terms of informative value.

Next, we plan to extend this research to pilot our proposal within ICT organizations.

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<sup>9</sup> There are some recent papers/publications formally about such ‘mapping’, but instead proposing other kind of correspondences (e.g. [32])

<sup>10</sup> See Chapter 5.

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