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On the Contractual Use of Maturity Models

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1 Document Information

1.1 Executive Summary

This document proposes a discussion about the usage of Maturity Models (MM) in ICT contracts, moving from the current state-of-the-art with its pros & cons. The discussion is not strictly focused on a particular model (e.g. CMMI or ISO/IEC 15504) but faces the issue from a bird's eye view, trying to find a way for promoting more and more the habit in applying MM in the ICT community.

1.2 History

Revision	Date	Changes since last revision
1.00	August 12, 2010	• First issue

1.3 Acronyms

Acronym	Description
AKA	Also Known As
ARC	Appraisal Requirements for CMMI
BoK	Body of Knowledge
BPM	Business Process Model
CAR	Causal Analysis & Resolution (CMMI ML5 Process Area)
CL	Capability Level
CMM	Capability Maturity Model
CMMI	Capability Maturity Model Integration (www.sei.cmu.edu/cmmi/)
CMMI-ACQ	CMMI for Acquisition
CMMI-DEV	CMMI for Development
CMMI-SVC	CMMI for Services
CMU	Carnegie Mellon University
COBIT	Control Objectives for Information and related Technology (www.isaca.org/cobit)
COSMIC	Common Software International Consortium (www.cosmicon.com)
CPM	Counting Practice Manual
D-MM	Diagonal MM
DoD	US Department of Defense
EA	European cooperation for Accreditation
FAA	Federal Aviation Administration (www.faa.gov)
FFP	Full Function Points
FP	Function Points
FPA	Function Point Analysis
FSM	Functional Size Measurement
FSMM	FSM Method
FTE	Full Time Equivalent
FUR	Functional User Requirement
HMLA	High-Maturity Lead Appraiser
H-MM	Horizontal MM
ICT	Information & Communication Technology
IEC	International Electrotechnical Committee (www.iec.ch)
IFPUG	International Function Point Users Group (www.ifpug.org)
IS	International Standard
ISBSG	International Software Benchmarking Standard Group (www.isbsg.org)
ISO	International Organization for Standardization (www.iso.org)
ITSM	IT Service Management
JTC	Joint Technical Committee
LA	Lead Appraiser
MA	Measurement & Analysis (CMMI ML2 Process Area)
MIS	Management Information System
ML	Maturity Level
MM	Maturity Model

OU	Organizational Unit
PA	Process Area
PAM	Process Assessment Model
PARS	Published Appraisal ResultS (http://sas.sei.cmu.edu/pars/)
PM2	Process Maturity Model
PMC	Project Monitoring & Control
PMMM	Project Management Maturity Model
PP	Project Planning
PP	Project Planning (CMMI ML2 Process Area)
PRM	Process Reference Model
PSU	Project Size Unit (www.semq.eu/leng/sizestpsu.htm)
Q&A	Questions & Answers
QMS	Quality Management System
RAPID	Rapid Assessment for Process Improvement for software Development
RCA	Root-Cause Analysis
RD	Requirement Development (CMMI ML3 Process Area)
REU	ISO/IEC 15504 Reuse process group
RFP	Request for Proposal
RFQ	Request for Quotation
SA-CMM	Software Acquisition CMM
SCAMPI	Standard CMMI Appraisal Method for Process Improvement
SEI	Software Engineering Institute (www.sei.cmu.edu)
SEVOCAB	Software & Systems Engineering Vocabulary (http://pascal.computer.org/sev_display/index.action)
SLA	SCAMPI Lead Appraiser
SP	Specific Practice
SPICE	Software Process Improvement Capability dEtermination (www.isospice.com)
Sw-CMM	Software CMM
TC	Technical Committee
TMM	Testing Maturity Model
TN	Technical Note
TPI	Testing Process Improvement method
TR	Technical Report
TS	Technical Solution (CMMI ML3 Process Area)
UK	United Kingdom
URL	Unique Reference Locator
USA	United States of America
V-MM	Vertical MM
WG	Working Group

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2 Introduction

2.1 Maturity Models

Maturity models (MM) are becoming a word in common use not only in the Process Improvement domain from a technical viewpoint, but also in the business domain, where it's not so un common hearing someone asking "which is the maturity level of that organization?". This is symptomatic of the current level of use or - at least - attention to MM from the ICT sector, even if still being phased in, according to the typical PLC (Product Life Cycle) phases: introduction, growth, maturity, decline [LEVI65]. Again, among the plenty of existing MM[1], we have to distinguish MM at least in two groups: *horizontal* and *vertical* models. Horizontal MM (H-MM) are those ones containing processes expressing the whole production chain, while Vertical MM (V-MM) are those ones delving into a topic or group of processes [BUGL07][BUGL08].

H-MM examples are for instance CMMI, ISO standards such as 12207 [ISO08a] for Software Engineering[2], and 15288 [ISO08b] for System Engineering, Trillium [BELL94], FAA i-CMM [IBRA01] and the new upcoming Enterprise SPICE[3] model, while examples of V-MM can be OPM3, PM2, PMMM for the Project Management domain or TMM and TPI for the Test Management domain and so on[4]. Due to the width of impact of MM, details arising from the mapping of the processes of an MM with those found in your Business Process Model (BPM)[5] are certainly among the most valuable aspects in order to assess and undertake a project for implementing such practices.

One of the main issues when dealing with MM is the way they are used and applied in ICT contracts. The aim of this paper is to analyze value and impacts of a contractual use of MM, observing characteristics, strengths and weaknesses and as a result providing some thoughts and tips for a more valuable use.

2.2 Structure of this document

This is the logical path proposed: Section 3 describes the state-of-the-art about the typical current usage of MM in ICT contracts. Section 4 presents a list of four typical and recurrent questions & answers on MM. Section 5 proposes some thoughts based on SEI's appraised CMMI-DEV data, as a representation of the MM world. Finally, Section 6 draws some conclusions and prospects on this issue from a process improvement and knowledge management viewpoint.

[1] See www.semq.eu/leng/proimpsw.htm#quinto
[2] Used by SPICE (ISO/IEC 15504 standard) [ISO06].
[3] See www.enterprisespice.com/
[4] A frequently updated list of Maturity Models (MM) is available at www.semq.eu/leng/proimpsw.htm, with related URLs.
[5] BPM represents the whole series of processes of an organization, with a wider scope than a QMS (Quality Management System) does. QMS typically describes the solely processes under the ISO 9001 scope.

3 State-of-the-art

Some needed premises: *first*, contractual practices generally implement *de facto* standard (self-evident, but a *de jure* standard should been before a *de facto* standard). Otherwise the risk would be to incorporate factors with potential effects of rejection by suppliers, reducing the number of potential competitors to a RFP (Request for Proposal), RFQ (Request for Quotation), bid or contract notice, no matter if dealing with the private or public sector.

Second, it is needed to have a deep knowledge of the standard method or technique that will be used, suggesting a use in the contract that allows to maximize its goal of use. Otherwise the quality of service/product levels will be not aligned with expectations.

Just a short example: in many contracts for developing and maintaining software systems, Function Points (FP) – created by Albrecht in 1979 [ALBR79] - are used by more than 20 years. In particular the IFPUG method is nowadays the most used, since it's the the first and most common, so useful to have a larger amount of data feedback for benchmarking, as with the repository ISBSG [ISBS09], and also become a *de jure* standard, recently confirmed also with the new v4.3 CPM version (ISO/IEC 20926 [ISO09]).

In such case, reading RFP/tenders, however, often do not fully exploit the information that these measures could provide, stopping at a mere use of "accounting" for the economic balance-sheets. In fact, to know the number of FP without additional project attributes (project type, effort distribution coming from functional and non-functional requirements, effort distribution among the different SLC phases, programming language, development environment, etc ....) is likely to represent an incomplete picture of that project. For instance, 200 FP to deploy for a MIS system do not correspond in terms of effort and costs to another project of the same functional size but referred to the customization of an ERP/COTS software (e.g. SAP) [BUGL10]. This is due to the fact that enhancement projects count fewer functional size units than those for development from scratch. Furthermore, the number of non-functional requirements (including implicit ones, referring to organizational and support processes) is generally higher than expected, making wider and wider the gap between the software functional size (FP) and its related effort and costs, both at the forecast as well as at the project closure.

The reason is simple: FP represent a possible size of the software product (not for the project), measuring only its functional side (what the end user perceives, not also architectural, usability or management issues). Therefore the solely usage of FP for estimating efforts and costs for a software project can often lead to low statistical significances. Furthermore, even considering the functional aspects, if the company/local authority wishes to measure the software with a FSM (Functional Size Measurement) method, e.g. real-time, telecom or embedded, the solution might be to choose a more appropriate variant for that context from the technical viewpoint such as COSMIC [ABRA09]. But despite COSMIC has already become an ISO standard (ISO/IEC 19761:2003 [ISO03]) and has more than 300 projects stored in the latest version of the

ISBSG database with a growth rate higher than other FSMM, it needs some more time before having a larger diffusion in contractual practices, due to its youth[6].

Possible effects for a customer can be expressed by estimates often far from actuals, with a huge on-going work for reconciliating those values, with an unpredictable cost increase. On the supplier side, such extra-effort takes the form of a reduction in efficiency and effectiveness before on the technical viewpoint and consequently from the economic viewpoint. A possible solution may be to include in the project plan few other measures expressing the non-functional side of the project (e.g. defectability, complexity, usability, etc..., largely cast from the list of characteristics of quality models as ISO 9126 [ISO01]) or applying measures expressing the size of the whole project from the project management viewpoint (e.g. PSU [BUGL07a]).

After this example referred to product measures used for project estimation, let's talk about MM. MM born within the TQM world in 1979 with the Crosby's '*Quality Maturity Organizational Grid*' [CROS79]. In the mid 80's, IBM began to bring the idea to software development, but always as a way for improving internal processes [RADI85]. In fact, the strategic element was the design in advance of the grid, depicting the speed of travel among maturity levels, proportional to the *engine* and the *fuel* available, neither too loose nor too challenging. And those grids proposed yet at that time what we call today the *continuous* representation.

The first 'external', contractual usage of MM was the one proposed in 1987 by SEI with the forefather of SA-CMM (Software Acquisition Capability Maturity Model), with the aim to evaluate the maturity of DoD suppliers [HUMP87]. And that was the moment in time from which organizations started to use the Maturity Level (ML) as the solely result coming out from such models, evolving during the years in the Sw-CMM [PAUL93] before till the current CMMI constellation, from the development one (CMMI-DEV) [SEI06] till the last one on IT Service Management (CMMI-SVC) [SEI09].

[6] E.g. in Italy this 2005 contract notice by Regione Sardinia: www.sardegnaterritorio.it/documenti/6_83_20060131131112.pdf (p.28).

4 Questions & Answers (Q&A)

Some questions to ask ourselves today, having awareness and not necessarily a deep knowledge of MM, are:

- **Q1**: Why use MM in a contract? What advantages?
- **Q2**: Which MM to choose and according to what criteria?
- **Q3**: What form of representation (*staged / continuous*) is suggested to apply?
- **Q4**: Is the use of the chosen MM a standard in the target community of users?

4.1 Why use MM in a contract? What advantages?

Moving from the SEI experience, having an 'algorithm' that returns a unique value of organizational maturity (thus following the *staged* representation) on an ordinal scale and therefore allowing to rank is particularly comfortable and easy for users. But from the measurement viewpoint, the criterion that should be used to validate such result is that it should return a faithful 'picture' as much as possible of the phenomenon being measured. The answer - which is anticipated to be negative - can be giving anyway only addressing the following questions.

4.2 Which MM to choose and according to what criteria?

The selection of processes to be included in a MM and their distribution by ML is obviously determined by the model's author, whatever he/she is. It is therefore useful to know who the author and the stakeholders are because this may be a primary element of interest when choosing a MM. For instance, CMMI has been developed by SEI (Software Engineering Institute[7]) and has as a primary shareholder the US DoD (Department of Defense[8]). Therefore the content of the model in terms of processes is driven by the needs and vision of a U.S. reality-military government. In the case of ISO standard (12207, 15504, etc..), the author is the International Organization for Standardization, through a series of working groups with people from industry, academia and research institutes around the world . Although CMMI and ISO 12207 are two *horizontal* MM for the Software Engineering domain somewhat similar, there are clearly visible differences in their approach right from the writing process and related groups: for instance, reuse is present in only one practice in CMMI Technical Solution process (TS, SP2 .4), while SPICE proposes a whole dedicated group with three processes (REU.x). Conversely, CMMI pays more attention to the architectural issue than ISO models, as verified also by the considerable list of publications on the subject produced over the years by SEI people[9]. And so on, it is sufficient to read the mapping between the two process models [ROUT01] for understanding the differences and complementarities which characterize them. Again, the criteria can vary widely depending on the goal: in the case of process improvement, the choice should rest with the model with the smallest difference against the organization's process model. In the case of an external use of MM, undoubtedly the dissemination and recognition in the market of a MM may be a sufficient reason for the

[7] http://www.sei.cmu.edu.
[8] http://www.defenselink.mil.
[9] http://www.sei.cmu.edu/library/

choice, though it would not represent a 'technical must', and would be often requested by North American counterparts. In our humble opinion the 'technical must' – but it is a vision shared also by the CMMI Framework [SEI07] – cannot be solved simply in the choice of a single model; it is preferable to choose a main MM and on such process architecture take from other MM those contents with a better fit with your own interest and goals. Coming back to the previous example, If an organization were to use CMMI, but was interested in importing one or more processes related to reuse practices, it may consider that portion of the ISO models PRM (Process Reference Model) and propose them in a CMMI-like format. As well as the vice versa. The reference point must be and remain the target BPM and not the chosen MM. In many cases this is one of the main reasons of failure in process improvement initiatives: there is no 'import' of good practices from selected MM for inserting them into your existing organizational context, but there is a forced, *tout-court* closeness of your business model to what proposed by a MM for a mere compliance with such models, dictated by a contract (and not technical) priority, but with non-trivial impacts on implementation. In any case, a further selection criterion is surely provided by the vision, development and support plans announced for the mid-long term for a certain model. Not having enough confidence about a support – also in terms of interpretations - by the model's authors and/or a community of key users with whom exchange experiences over time may be sufficient to exclude it from the list of eligible models.

4.3 What form of representation (*staged / continuous*) is suggested to apply?

The processes of an MM can then be represented in different ways. The *staged* representation is the vision of a process model with a standard distribution of processes along maturity levels following an order of presumed increasing maturity needed for their establishment and successful implementation in an organization. For instance, the use of historical data in a quantitative way should be done after the implementation of the measurement and analysis process. Using the CMMI language, QPM (Quantitative Project Management) is a level 4 (ML4) process while MA (Measurement & Analysis) is a level 2 (ML2) process. The *continuous* representation instead expresses a 'free', unrestricted vision, in which the organization selects from a process model what it considers of its interest, drawing its own evolutionary path, with the appropriate stages of approach to excellence. From a measurement viewpoint, the *staged* representation measures the organizational unit (in the wider case coinciding with the entire organization) through a single ML, while with the *continuous* representation each process is evaluated in terms of capability level (CL) and an aggregation is possible - with the mechanism called *equivalent staging* – in order to determine the corresponding ML. As explained in CMMI-DEV v1.2[10], the *staged* representation can be useful for external benchmarks, while the *continuous* one is most recommended for improvement actions on internal processes. It should not leave impressed the winning of contracts to offshoring companies with high CMMI ratings, often at ML5. In fact, a *staged* vision most rewards those organizations with repeatable and standardized lines of projects more than to those

[10] See [SEI06], Part 1, Section "*Choosing a representation*".

ones strongly innovating and producing new ideas, at least simply because for the amount of objective evidences to produce in the appraisal. Instead, decomposing the organization in a series of processes according to the *continuous* representation allows to observe the organization through a picture more and more detailed and adhering to reality, both aiming at process improvement and external evaluation. Again, looking at most recent SEI data, more than 80% of appraised organizations have been evaluated at ML2 and ML3. Using the *staged* representation some processes such as CAR (Causal Analysis & Resolution) – positioned at ML5 – wouldn't be never appraised even if there a recognized equivalence for an ISO 9001 certified company with a ML in the middle between Level 2 and 3 [BUGL06]. And the new version 1.3 seems to include this request of change, moving CAR to ML3 [KONR09].

4.4 Is the use of the chosen MM a standard in the target community of users?

The premise for this discussion is that in general it is useful to adopt a *de facto* standard, where being a standard necessarily refer to be applied by a reference community where it is possible to verify its frequency of application with a statistical significance. Conversely, a mechanism is imposed to the market, that's a possible practice, but that can create on one hand resistance to the introduction and use of MM in their context and on the other one, barriers to entry in that market. Nowadays, the *horizontal* model currently most discussed, known, and with higher awareness is probably CMMI more than other MM, also for its free availability on the web of all relevant documents for its implementation, unlike ISO counterparts standards that request a fee, as other MM available only to small community of users. Looking at official half-year SEI statistics[11] listing the number of organizational units (OU) that have passed SCAMPI Class A appraisals (see Table 1 for complete data), as of September 2009, on a grand total of 4726 appraisals from 67 countries, Asia is the continent with most appraisals (46.9%, having China, India, Japan and Korea as the top4 Asian countries), covering all ML, followed by North America with 32.3%, while European countries summed only 13.3%.

[11] http://www.sei.cmu.edu/cmmi/casestudies/profiles/

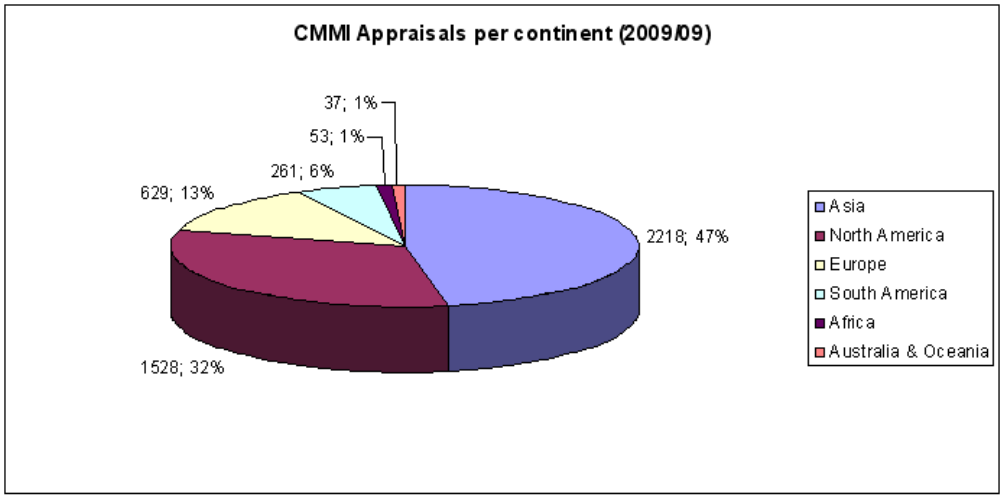

Fig. 1 – *Number of CMMI appraisals Class A (2009/09) per continent*

Breaking up data, Figure 2 shows the Top20: USA is the first country, followed by China, India and Japan. To be noted that 72.9% of those appraisals have been done outside United States. About organizational size, and 56% of appraisals refers to OU with no more than 100 people and 74.9% of OU with no more than 200 people[12].

About the representation type chosen, most of them apply for the staged one[13].

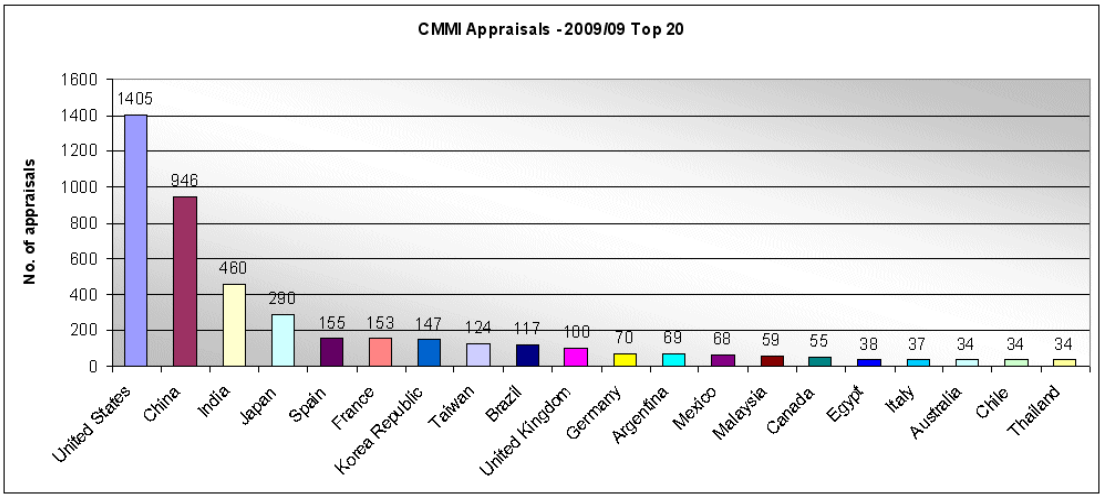

Fig. 2 – *Number of CMMI appraisals Class A (2009/09): Top20*

Looking at a different groupings, G8 countries[14] summed up 44.9% of appraisals, but excluding USA (having itself 1405 appraisals (29.7%), the remaining seven countries sum up only the 15.1% Looking at Figure 3 about G8 countries less USA, it is possible to look at the trends in running Class A appraisals and Japan is the country with the highest growing rate in achieving CMMI Appraisals, followed by France and UK. Again, all G8

[12] Note that an organization can include 1+ OU. Therefore a 50-people OU can be also part of a large organization, sharing the same processes and organizational rules and management complexity.
[13] The latest SEI report with the explicit information about the representation type chosen was the 2004 Mid-Year one, dated August 2004.
[14] USA, Japan, France, Germany, United Kingdom, Canada, Italy and Russia.

countries covered all ML less Italy, that has only 37 OU appearing to get certified at ML2 and ML3, all appraised according to the staged representation[15]. And the number, going back to previous reports is almost stable.

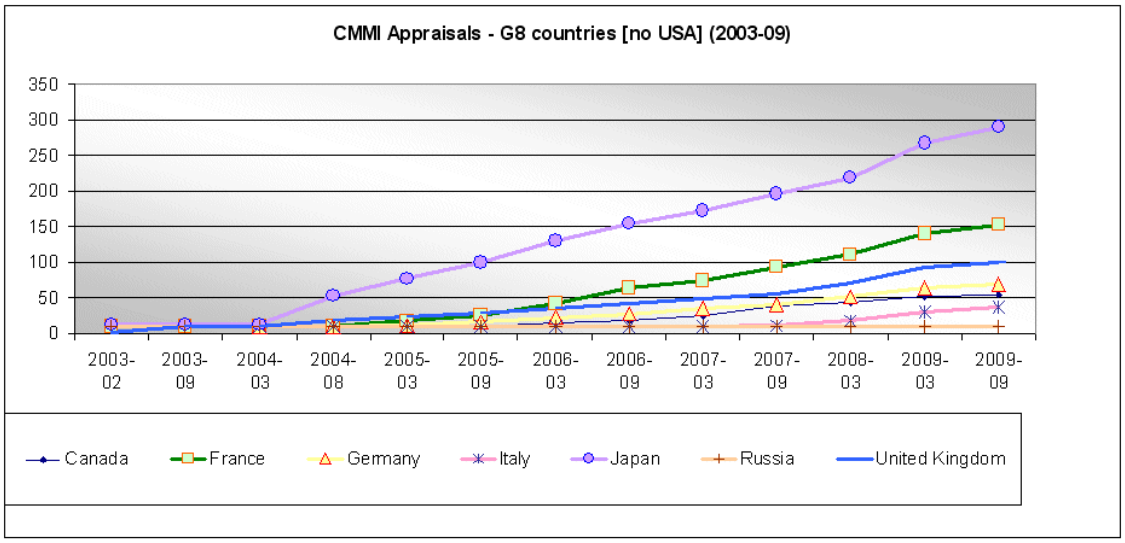

Fig. 3 – *Number of CMMI appraisals Class A (2009/09): G8 countries (USA excluded)*

But in order to answer to the initial question Q4, a comparison with other standards already adopted in ICT contractual practices such as ISO 9001:2000 (and now against the new 2008 version) is needed. At the end of 2008, the organizations certified ISO 9001 for all sectors were close to 1 million (982,832 certificates)[16] from 176 countries. Referring to a single country, for instance Italy (the second top country for ISO 9001 achieved after China) in the same period the number of certifications achieved were 118,309 (12% of the world total), 2839 (2.4%) of which in the EA33 Sector (*Information Technology*) and c.a. 12403 (10.48%) in the EA35 Sector (*Professional Services*)[17]. Supposing also a similar distribution at the worldwide level, the ISO 9001 certificates for the EA33 sector would be more than 23000, while the SEI data about Class A appraisals at the end of 2009 is less than 5000, with a ratio of c.a. 4.5:1.

[15] http://sas.sei.cmu.edu/pars/pars.aspx

[16] ISO data from the latest available survey, gathered at the end of 2008 [NIEL08].

[17] SINCERT data (Dec 2008), see www.sincert.it/documentisincert.asp?id=148&root=elenchi). Note that at the end of 2009, Sincert and Sinal joined into a unique new institution, called ACCREDIA (www.accredia.it).

5 Some thoughts on appraised data for improvement

Observing this 'photograph' at the end of 2009, the ensuing debate is that few organizations already certified and assuming that other ones will be already moving towards such goal, they will need a certain time before being included in that list. Therefore the inclusion of a CMMI staged certification today in a RFP/RFQ/tender (typically at ML2/ML3) as pre-requisite for participation corresponds in filtering the number of eligible participants and potential winners[18]. And in those countries with a low number of eligible organizations, it risks to predefine the short list of competitors from the beginning, since it's not possible for another company to participate at least to that RFP, due to the '*time to move up*'[19]. And in such case, that MM can be interpreted by anyone who is not certified with a certain direct or indirect resistance in the near future, seen as another 'blue sticker' to achieve in addition to ISO 9001, but not to really 'live' within their own organization. In fact, the cost for a project for implementing CMMI practices according to the *staged* representation, even if only for ML2 processes (although variable depending on the amount gaps detected from the preliminary gap analysis to bridge during the implementation project) and the cost of the final appraisal (usually between 15 and 25 calendar/days, with expenses in charge of the appraised organization), hardly falls under 80K€.

According to the new rules (v1.2)[20], the certificate has a three-year validity, similar to ISO certifications, while up to v1.1 was *una tantum*.

But the phenomenon should be examined looking at its whole scope in order to understand its extent and rate of growth, having the aim to confirm or modify the way MM are used within ICT contracts. Always looking the last SEI report (September 2009), the top5 countries in terms of growth rate in the last 5 years have been China (+2682%, from 34 till 946 appraisals), Spain (1622%, from 9 up to 155 appraisals), Brazil (+1070%, from 10 up to 117 appraisals), Taiwan (+854%, from 13 up to 124 certified organizations) and France (+750%, from 18 up to 153 appraisals). Looking at the G8 group, the higher growth rates are in France (+750%), followed by Germany (+483%), Canada (+450%) and USA (+402%), while Italy – even if progressed in percentage terms (+270%) – in absolute terms in the 7th one just before Russia (only 37 appraisals).

Observing more in details those appraisal data, in the PARS webpage (http://sas.sei.cmu.edu/pars/pars.aspx) several filters can be applied but not about the representation type: you need to browse the list looking at the last column 'Maturity Level (*clickable*) – Representation (*not clickable*)'. At the date of writing (January 2010), only 286 out of 2927 appraisals (9.8%) reported there[21] were against the *continuous representation*.

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[18] Some recent examples taken from the web just to name a few: National Archives And Records Administration Request For Proposal (Rfp No. NAMA-03-R-0018 - www.archives.gov/era/pdf/rfp.pdf); EDMC Schools in New Delhi (www.ndmc.gov.in/Departments/IT/eoi_ndmc_schools.pdf); Telecom Fiji (www.tfl.com.fj/_resources/tfl/.../Fiji%20CDMA%202000%20%20RFP.pdf).

[19] In these periodical reports very useful information (always present in the old Sw-CMM statistics, not yet stable in the new CMMI reports) is provided by the average/median time for moving from one to another ML (the so-called '*Time to move up*' figure), therefore typically referring to the staged representation. For instance, in order to arrive at ML3, an OU usually needs between c.a. 13 and 24 calendar months (depending on the starting level, ML2 or ML1) from the beginning of the project for implementing CMMI requirements into the target BPM, while for moving from ML3 to ML4 the time requested is between 12 and 28 calendar months.

[20] http://www.sei.cmu.edu/newsitems/sunset.cfm

Hence the need to understand the reasons for such a slow and sluggish *corporate*-wide adoption of CMMI *staged* (but the same considerations apply to any other MM), in order to assess the impact of its possible and successful adoption in contractual practices. The following figure shows a first-level root-cause analysis (RCA) using the Ishikawa (or Fishbone) diagram.

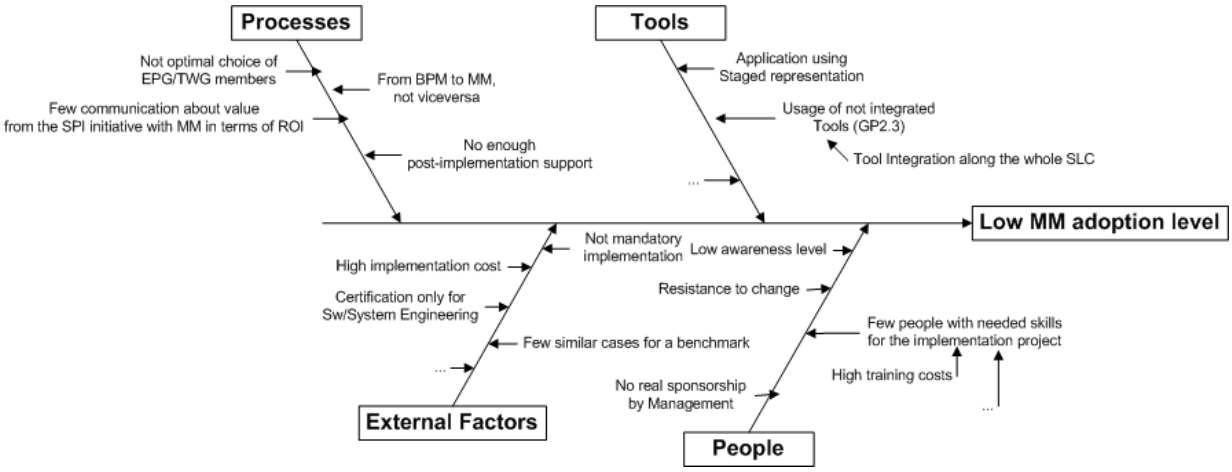

Fig. 4 – *Low adoption of Maturity Models: analysis of possible root causes*

Thus, being the use of MM in several countries in an embryonic stage, we believe some actions preparatory for their wider adoption could be:

- Disseminate and broaden the technical knowledge of these models from the base of potential users, moving from universities and ICT technical associations (e.g. IEEE, ACM, PMI, etc.) to stimulate their use, highlighting the potential advantages by their adoption. Once people understand the functioning of the architecture of a generic MM and how to use it, the cognitive effort to use another MM is related to the understanding of the new process model.
- Do not consider the *staged* representation, suggesting only the *continuous* one, as did for example in ISO 15504 (aka SPICE) since 1995. The '*divide-et-impera*' principle suggests, due to the high cost for implementing *tout-court* a model (even if up to ML3, in any case are no less than 18 processes to consider over the 22 ones in CMMI-DEV v1.2, the 82% of total), starting with the processes that with higher priority but from the viewpoint and perception of organizations. Thus, initially working hard on a few processes, but instilling a new working practice in the organization's staff, the cost related to the implementation of any further process group will be correspondingly lower, with an increased staff knowledge and skills.
- To *scout* possible MM from which to take the cue for improvement. This applies both to client and supplier organizations. As mentioned, there are both horizontal and vertical models related to different application domains, as well as models specially tailored for SMEs, especially in the experience of Central-South America. It should be mentioned - both derived from ISO standards - for example **MARES** (the model recommended for Brazilian companies up to 50 employees,

[21] To be noted that PARS reports data only from those organizations willing to appear on such list, that's the reason for a lower number than the grand total reported in the latest SEI Process Maturity periodical report.

with CL from 0 to 3, excluding levels 4-5) [GRES04] and **MoProSoft** (the Mexican model for VSE with only 6 processes, forming the basis for a new ISO standard by JTC1/SC7/WG24) [MEXI06]. Only after having expanded the *real* customer base of MM users, concretely applied and 'suffered' in the everyday work by ICT organizations[22], their application and use in contracts could be allow to give a shot from the 'grow' phase to 'maturity'.

In any case, the suggestion still remain to require the compliance to single processes (for instance, the **RAPID** approach [ROUT00] is based on only 8 processes to evaluate, symptomatic of a general trend of the organizational maturity but not monitoring the entire process model) to a given capability level (CL) by performing Class B/C appraisals in pre-defined, specific moments during the project lifetime and not on the whole set of processes by maturity level (ML) as *a priori* element of pre-qualification[23].

What is important to pursue is an always growing but gradual spread of the culture in evaluating processes [MAST07], both in Customer and Provider organizations, giving more and more MM a technical reason to be used in Contract Management, by the value they bring into technical management.

[22] Partly verifiable with the same reports from the managers of the certification/qualification schema for a certain MM (e.g.: SEI for CMMI, INT-ACS for ISO/IEC 15504).
[23] An experience from a DoD contractor is proposed in [ADAM07].

6 Conclusions & Prospects

The most natural thing in life is evolution. And MM moved from the initial Crosby's idea just thinking to a slight but constant evolution during time of the maturity of several drivers within the management of an organization.

So, as Brooks said many years ago, there are no '*silver bullets*'[24], neither when speaking about process management with maturity models. Thus, as in life, the most important thing is to use those models (that are representations of the reality of interest) and not be used by those models, whatever they are, forcing the way an organization works and typically run its processes. Observing the requirements that ICT contracts typically insert, MM can add value if properly used and applied.

Thus, first of all there is a need of more awareness about the value that a MM can bring to an organization. We have to study and understand which are the core elements among similar MM for choosing the one with a better fit for our purposes or a combination of them. Secondly, there is a need to consider the final goal, that should be an overall improvement from several viewpoints, in a *win-win* logic for the different stakeholders.

Few suggestions:

(i) more MM (and not necessarily just only one) could be considered at the same time;

(ii) there are several MM specific for SME and VSE, that could be the proper tool for that kind of organizational size without loosing improvement possibilities;

(iii) the *continuous* representation should be used instead of the more rigid *staged* one;

(iv) improvement plan should be designed taking care of the causal relationships among processes, that cross maturity levels (that's another reason for discarding the *staged* representation);

(v) adopting the continuous representation, single PA could be chosen as a monitoring tool during the whole contract lifecycle, more than asking to be yet certified at a certain ML as a prerequisite for participating to a bid/RFP, with no specific controls or quality gate during the contract lifetime based on such MM. On the other side, a possible risk can be to look for certification before and to improve after, driven by commercial goals[25].

Of course, this is our humble viewpoint, but looking at the data above presented, probably MM are not currently used exploiting their core value in business terms.

Our wish for the near future is that more and more organizations, no matter their size, will use more the MM idea than specific models, as proposed also from ISO 9004 [ISO09], but passing for few simple improvements moving from the contractual side, where simple doesn't mean trivial. A real improvement must be always driven first of

[24] "*There is no single development, in either technology or management technique, which by itself promises even one order of magnitude [tenfold] improvement within a decade in productivity, in reliability, in simplicity.*" [BROO75]

[25] See this research on the adoption of COBIT [NARD09] (p27) using the "*Forrester Waves*" [KOET08].

all by common sense. And common sense is driven and leveraged by education and experience, supported by data.

Education is the continuous reconstruction of experience, that's a continuous experience (John Dewey)

Experience is a hard teacher because she gives the test first, the lesson afterwards (Vernon Sanders Shaw)

Analyze facts and talk through data (Kaoru Ishikawa)

7 Annex A – SCAMPI Class A Appraisals (2003-09)

SCAMPI Class A Appraisals (2003-09) [*ordered by decrescent no. of appraisals and number of reportings*]

Source: SEI CMMI Class A Process Maturity Profiles (URL: http://www.sei.cmu.edu/cmmi/casestudies/profiles/)

Rank #	Country	# Reporting	Continent	G8	2003-02	2003-09	2004-03	2004-08	2005-03	2005-09	2006-03	2006-09	2007-03	2007-09	2008-03	2009-03	2009-09
1	United States	13	North America	Y	34	34	34	170	280	365	500	598	718	859	1034	1272	1405
2	China	12	Asia			10	10	16	34	62	117	158	240	321	465	745	946
3	India	13	Asia		10	10	10	44	70	104	140	177	204	256	323	409	460
4	Japan	13	Asia	Y	13	13	13	54	77	100	131	155	172	197	220	267	290
5	Spain	10	Europe					8	9	10	18	25	31	55	75	105	155
6	France	13	Europe	Y	10	10	10	10	18	26	42	65	75	94	112	141	153
7	Korea Republic	13	Asia		10	10	10	10	23	30	50	56	78	87	107	138	147
8	Taiwan	13	Asia		2	5	8	10	13	18	26	31	46	71	88	117	124
9	Brazil	9	South America						10	10	22	39	48	58	79	106	117
10	United Kingdom	13	Europe	Y	2	10	10	17	25	29	35	42	48	57	71	93	100
11	Germany	11	Europe	Y			10	10	12	16	22	28	35	41	51	64	70
12	Argentina	11	South America				10	10	10	10	12	15	19	26	47	64	69
13	Mexico	9	South America						10	10	10	10	15	29	39	57	68
14	Malaysia	11	Asia				10	10	10	10	10	15	19	29	42	56	59
15	Canada	12	North America	Y		10	10	10	10	10	15	18	26	38	43	51	55
16	Egypt	9	Africa						10	10	10	10	17	25	27	34	38
18	Australia	13	Australia & Oceania		10	10	10	10	12	14	21	23	23	26	29	32	34
17	Italy	11	Europe	Y			10	10	10	10	10	10	10	12	17	31	37
18	Chile	11	South America				10	10	10	10	10	10	15	17	20	30	34
18	Thailand	11	Asia				10	10	10	10	10	10	10	10	10	27	34
21	Pakistan	6	Asia									10	10	10	14	25	26
22	Colombia	11	South America				10	10	10	10	10	10	10	16	18	22	24
23	Philippines	10	Asia					10	10	10	10	14	16	17	20	21	22
24	Singapore	11	Asia				10	10	10	10	10	10	10	10	16	19	20

25	Hong Kong	11	Asia				10	10	10	10	10	10	10	10	14	18	18
25	Israel	10	Middle East					10	10	10	10	10	10	12	16	17	18
27	Turkey	8	Asia							10	10	10	10	10	10	14	15
28	Vietnam	8	Asia							10	10	10	10	10	10	12	14
29	Bulgaria	4	Europe											10	10	10	10
30	Denmark	13	Europe		10	10	10	10	10	10	10	10	10	10	10	10	10	10
30	Russia	13	Asia	Y	10	10	10	10	10	10	10	10	10	10	10	10	10	10
30	Switzerland	13	Europe		10	10	10	10	10	10	10	10	10	10	10	10	10	10
30	Belarus	11	Europe				10	10	10	10	10	10	10	10	10	10	10	10
30	Sweden	11	Europe				10	10	10	10	10	10	10	10	10	10	10	10
30	South Africa	10	Africa					10	10	10	10	10	10	10	10	10	10	10
30	Czeck Republic	9	Europe						10	10	10	10	10	10	10	10	10	10
30	Ireland	9	Europe						10	10	10	10	10	10	10	10	10	10
30	Netherlands	9	Europe						10	10	10	10	10	10	10	10	10	10
30	New Zealand	9	Australia & Oceania						10	10	10	10	10	10	10	10	10	10
30	Belgium	8	Europe							10	10	10	10	10	10	10	10	10
30	Finland	8	Europe							10	10	10	10	10	10	10	10	10
30	Portugal	8	Europe							10	10	10	10	10	10	10	10	10
30	Slovakia	8	Europe							10	10	10	10	10	10	10	10	10
30	Austria	7	Europe								10	10	10	10	10	10	10	10
30	Latvia	7	Europe								10	10	10	10	10	10	10	10
30	Mauritius	7	Africa								10	10	10	10	10	10	10	10
30	Ukraine	7	Europe								10	10	10	10	10	10	10	10
30	Bahrain	6	Asia									10	10	10	10	10	10	10
30	Dominican Republic	6	South America									10	10	10	10	10	10	10
30	Indonesia	6	Asia									10	10	10	10	10	10	10
30	Morocco	6	Africa									10	10	10	10	10	10	10
30	Peru	5	South America										10	10	10	10	10	10
30	Costa Rica	4	South America											10	10	10	10	10
30	Poland	4	Europe											10	10	10	10	10
30	Romania	4	Europe											10	10	10	10	10
30	United Arab Emirates	4	Asia											10	10	10	10	10
30	Uruguay	4	South America											10	10	10	10	10

30	Bangladesh	3	Asia	10	10	10
30	Hungary	3	Europe	10	10	10
30	Norway	3	Europe	10	10	10
30	Saudia Arabia	3	Asia	10	10	10
30	Greece	2	Europe		10	10
30	Lithuania	2	Europe		10	10
30	Luxembourg	2	Europe		10	10
30	Nepal	2	Asia		10	10
30	Panama	2	South America		10	10
30	Sri Lanka	2	Asia		10	10

- Note 1: in blue the years when a country had no appraisals
- Note 2: in yellow the years when a country had till 10 appraisals but SEI did not provide the exact figure
- Note 3: Elaboration from SEI Process Maturity Profiles reports (published @ http://www.sei.cmu.edu/cmmi/casestudies/profiles/)

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