A Modeling View of Process Improvement

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Abstract. As a consequence of Software Process Improvement success there are forces that urge for further evolution. One force is the need for eliciting and refining underlying SPI principles. This article introduces a modeling view of process and process improvement with three types of process models (Process Capability Profile, Process Enactment Description and Process Performance Indicator) and an example on a process improvement cycle. This modeling view improves the integrated understanding of what we want, what is the current status, what we can do and what we are doing for improvement during a cycle. This modeling view is then used as a basis for introducing Modeling driven (Knowledge Working) Process Improvement as an evolution of current Model-based (Software, Systems and Services) Process Improvement.

Keywords: SPI, Process Modeling, PRO2PI Methodology, SPICE, CMMI.

1 Introduction

Software Process Improvement (SPI) has been a successful methodology for the necessary improvement of software development. SPI started about twenty five years ago with the development and usage of SW-CMM (Capability Maturity Model for Software) [1] and SPICE (Software Process Assessment and Capability dEtermination) [2] models. There have been evolutions on SPI, including its generalization from software to software, system and services, and the movement from models to framework of models. Now a days, CMMI (Capability Maturity Model Integration) [3] and ISO/IEC 15504 (SPICE) [4] (and its ongoing revision towards ISO/IEC 33000 Series [5]) are the most dominants frameworks for models and SPI. SPI methodology has been based in pre-defined models of best practices. Hence, it can be identified as "Model-based process improvement".

As a consequence of SPI success, there are forces that urge for further SPI evolution. A previous article identified seven groups of these forces [6]. One of these forces is the need for eliciting and refining underlying principles of SPI. Card states that "different approaches [for current SPI] are considered competitors, even though they are all based on very similar concepts and techniques. The current packaging obscures the underlying principles" [16]. ISO/IEC 15504 (SPICE) and the recent SPI Manifesto [7] advanced these underlying principles. SPICE provides requirements for process assessments models and documented process assessments processes. The SPI Manifest elicits the true values and principles of SPI, showing the need to emphasize improvements over conformance to pre-defined models.

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A challenge is how to evolve SPI in order to balance these forces. This article proposes modeling as the main reference to conduct this evolution. It proposes "Modeling driven Process Improvement" as an evolution of "Model-based Process Improvement". This article is organized as follows. This first section provides an introduction to the article. The second section provides an overview of model, metamodel, modeling and chain of models concepts. The third and fourth sections introduce a modeling view of process and process improvement with three types of process models and an example on theirs usage in a process improvement cycle. The fifth section analyses how two well established SPI frameworks (CMMI and ISO/IEC 15504) cover these three types of process models. The sixth section uses this modeling view as a basis for introducing Modeling driven (Knowledge Working) Process Improvement as an evolution of current Model-based (Software, Systems and Services) Process Improvement. Finally, the seventh section concludes the article.

The content of this article is part of an ongoing Research, Development and Innovation (R&D&I) effort on process improvement by *CTI Renato Archer* and its partners since 1999. CTI is a Brazilian Information Technology R&D&I Center (www.cti.gov.br). This R&D&I effort has been conducted with many cycles of industry demand, exploration, application and consolidation following the industry-as-laboratory research approach proposed by Potts [8] as the R&D&I methodology.

2 Model, Metamodel, Modeling and Chain of Models

This section presents basic concepts related with model, modeling and chain of models as references for the next sections. Bézivin, Favre and other authors [9] [10] [11] define model as "a simplification of a system built with an intended goal in mind" and complete this definition with "a model represents certain specific aspects of a system and only these aspects". Therefore there are three elements in a model: the system, the intended goal and the aspects. An intended goal of a model is to be able to answer questions in place of the actual system [9]. In a more precise statement a model follows the Limited Substitutability Principle: "The purpose of a model is always to be able to answer some specific sets of questions in place of the system, exactly in the same way the system itself would have answered similar questions" [9].

The correspondence between a system and a model is precisely defined by a metamodel. Each metamodel is used to specify which particular "aspect" of a system should be considered to constitute the model. A metamodel defines a consensual agreement on how elements of a system should be selected to produce a given model [9]. A metamodel is not a model of a model. Rather, a metamodel is a model of a language of models [10].

A model can be used as a specification model, that represents a system to be built, or as a descriptive model that describes an existing system. New systems are produced from specification models. Descriptive models are produced from existing systems [10]. There is also the notion of co-evolution of model and system [10], where both model and system are in constant evolution and each version of the model is either a specification or a descriptive model.

Rothenberg indicates the meaning of modeling in the broadest sense as “the cost-effective [development and] use of something [, a model,] in place of something else for some cognitive purpose” [11]. Bézivin complements this definition stating that “modeling is essential to human activity because every action is preceded by the construct (implicit or explicit) of a model [or a set of models]” [9].

Be a model is not an intrinsic characteristic of an artifact. Rather it is a relationship between two artifacts. The same artifact can be a model of a system in one relationship and a system being modeled in another. Actually there is a chain of models, where a model in one relationship became a system in another, and so on. Peirce explored this concept of chain of models in his semiotics. Peirce´s semiotics provides a scientific basis for modeling [12]. So, Bézivin´s statement can be rephrased as “modeling is essential to knowledge working process improvement, because every human action is preceded by the construct (implicit or explicit) of chains of specification and descriptive models”.

3 Process as a Model and Types of Process Models

In SPI there are two popular definitions of (software) process. One is “process is what people do” [1] and the other is “a set of interrelated (or interacting) activities, which transform inputs into outputs, to achieve a given purpose” [3] [4]. From a modeling perspective, they complement each other. The first one defines process by the modeled system and the second one defines process by a model of that system. A proposed definition is process is a model of what people as a set of interrelated or interacting activities which transform inputs into outputs, to achieve a given purpose.

There is a trend to generalize SPI from software process to software, systems, services and other domains processes. A proposal is to use knowledge worker for this generalization. Knowledge worker is used in the sense defined first by Drucker [13] as “anyone who works for a living at the tasks of developing or using knowledge. Knowledge working is the activity of the knowledge worker. Knowledge workers have high degrees of expertise, education, or experience, and the primary purpose of their jobs involves the creation, distribution, or application of knowledge” [13].

Process however stills not enough. So, process became a system and modeling is used again to produce process models. From our experience, three types of process models are more important for SPI. Each one represents a process under a different perspective. Each one, based on that perspective, uses a set of elements and allows answers for some specific set of questions in a close and useful enough “way the system [in this case, the process] itself would have answered similar questions”. Figure 1 illustrates process as a model and types of process models.

The twelve people icons in the bottom part of Figure 1 illustrate knowledge workers working. (Knowledge working) Process is a model of “what knowledge workers do and think” “for an objective, transforming inputs into outputs” built with an intention to “improve” the work. The work is the system in the model-system relationship. The cloud with selected and organized view of people icons, including input and outputs, illustrate process as a model.

The three pairs of graphic icons in the upper part of Figure 1 illustrate three types of process models that are more important during a process improvement cycle. Each

one represents a process under a different perspective (or dimension). Each one, based on that perspective, uses a set of elements. Process is a model in the model/system relationship in the bottom part of Figure 1 and the same process is a system in each one of the three model-system relationship in the upper part.

The three icons in the very upper part of Figure 1 illustrate three more models in these chains of model-system relationship. Each icon is a model of a type of process model. Therefore there are seven models in Figure 1. All of them are models of what knowledge workers do and think for a living.

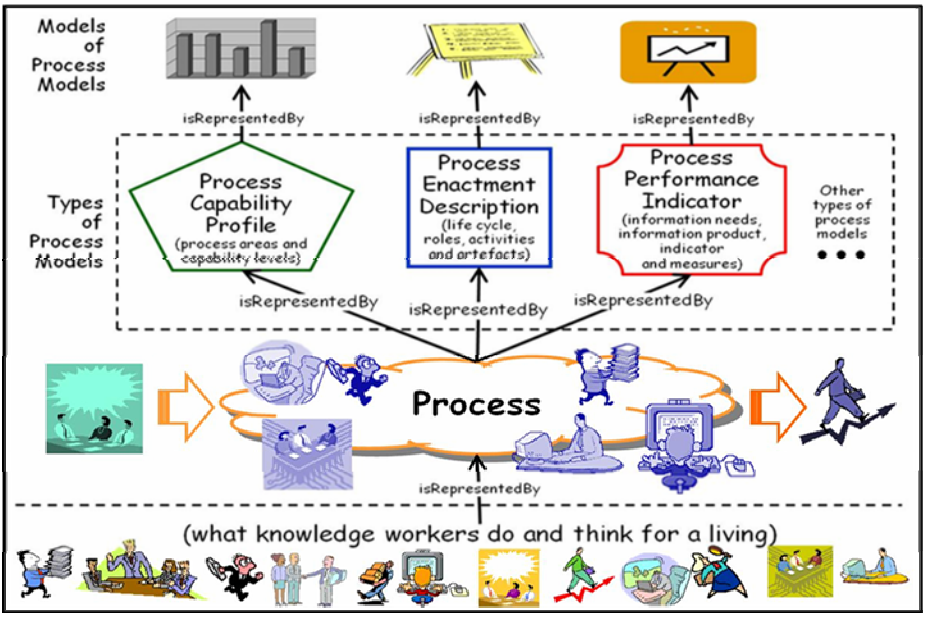

Fig. 1. Process as a model and types of process models for SPI

The three icons in the very upper part of Figure 1 illustrate three more models in these chains of model-system relationship. Each icon is a model of a type of process model. Therefore there are seven models in Figure 1. All of them are models of what knowledge workers do and think for a living.

A Process Capability Profile model is structured with process (or process areas) and capability levels, as defined, for example, by ISO/IEC 15504-5 Process Assessment Model [4]. A Process Enactment Description model is structured with life cycle, roles, activities and artifacts, as defined, for example, by Software Process Engineering Metamodel (SPEM). A Process Performance Indicator model is structured with information needs, information product, indicator and measures, as defined, for example, by Practical Software and System Measurement (PSM) and ISO/IEC 15939 Software Measurement Process.

Suppose we don´t know the process of a given organization. We know, however, that Maturity Level 3 of the Exemplar Organizational Maturity Model defined in ISO/IEC 15504-7 (15504-ML3) (or Maturity Level 3 of CMMI-DEV model – CMMI-ML3) is a

Process Capability Profile model of this process. What questions can we answer for this process? For example, the question “Can we have a good confidence that this organization will deliver functional software, on time?” can be answered with “Yes” because 15504-ML3 (or CMMI-ML3) allows this answer. What questions we cannot answer for this process? For example, the question “Will this organization deliver incremental versions during the development or everything at the end?” cannot be answered because 15504-ML3 does not allow answer for this question. The answer depends on the life cycle model.

Suppose we also know, however, a Process Enactment Description model of this process and it says that the process uses an incremental life cycle. We then can answer “Incremental versions” for this question. What questions we still cannot answer for this process? For example, a question about which level of quality (in terms of percentage of serious faults) should we expect for each delivery, cannot be answered because neither one of the two previous models allow an answer for this question. Suppose we also know, however, a Process Performance Indicator model of this process and it says that “98% of all delivery software systems have less than 2 shipped defects per thousand of source lines of code”. Then we can answer this question because this model allows this answer.

4 A Process Modeling View of Process Improvement

This section presents examples of a process modeling view of a process improvement cycle. Figure 2 provides a simplified and high density illustration with process modeling view´s snapshots of a SPI cycle with the three types of process models.

In Figure 2 the bigger gray arrow shows the flow of a SPI cycle. The smaller gray arrows show sub cycles of the implementation phase of the SPI cycle. The three small icons and the four clouds in the middle represent versions of the current or future process. Each question and its correspondent geometric form represent either a descriptive model (*D Model*) of the current process or a specification model (*S Model*) of a future process. The position of each model and the index of the modeled process indicate roughly where the correspondent modeling is performed in the SPI cycle.

In the beginning of what is going to be a SPI cycle, a manager wants to know what is going on in a software development department. As answer, she got the impression that “most projects seem to be very late” and concludes that this is not good for business. From process modeling point of view, she got “most projects seem to be very late” as a vague Process Performance Indicator descriptive model of the current process. As a second step, she wants to know what performance indication could be feasible and good for them. After some inquiries, she concludes that “90% of projects, +/- 10% on time” (at least 90% of all relevant software development projects on time with an accepted interval up to 10% delay or anticipating) is a satisfying and feasible indicator. If, in the future, an improved process results in that indicator, the business will be better. From process modeling point of view, this indicator is a (more precise) Process Performance Indicator specification model for a future process.

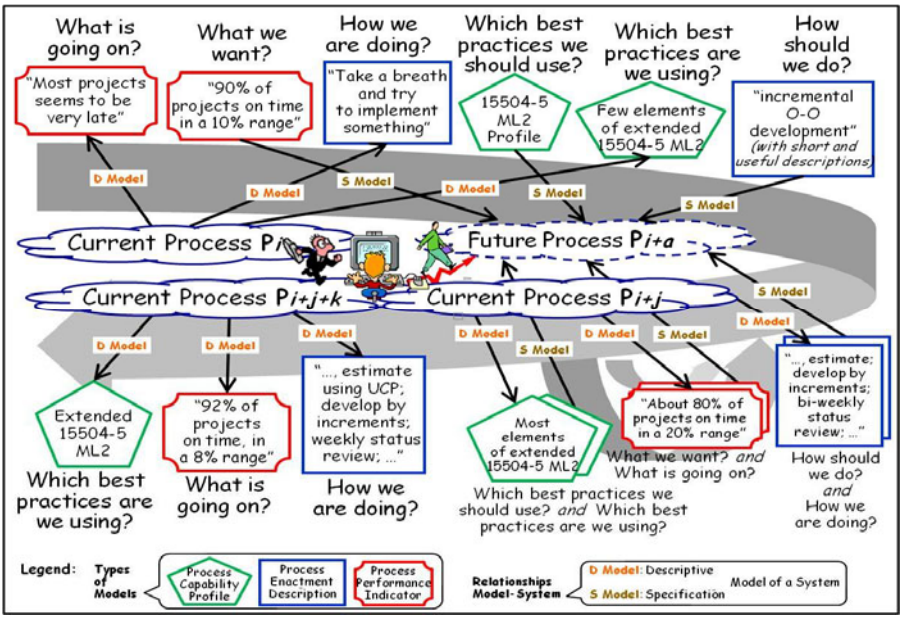

Fig. 2. Snapshots of process modeling view of a SPI cycle

As a third step, she wants to know how they are developing software projects. She got the impression that there is no standard process to develop software projects. The process is improvised for each project and there is no planning for it. She concludes that the current process is something as "take a breath and try to implement something". From process modeling point of view, she got a Process Enacting Description descriptive model of the current process.

As a fourth step, she wants to know which best practices can help. After some inquiries, she concludes that ISO/IEC 15504-5 or CMMI-DEV model of best practices could help. More precisely, the Maturity Level 2 of the Exemplar Organizational Maturity Model in ISO/IEC 15504-7 (15504 ML2) (or Maturity Level 2 of CMMI-DEV model) could be used as reference for feasible and useful best practices. If, in the future, an improved process implements the set of best practices of 15504 ML2, the business will be better. From process modeling point of view, the 15504 ML2 is a Process Capability Profile specification model for a future process.

As a fifth step, she wants to know how they are using the best practices from 15504 ML2. To answer that question, she contracts a process assessment. This process assessment results that they implement just few of these 15504 ML2 best practices. The process assessment also identifies some other few best practices that have been performed without be part of the 15504 ML2. The profile composed of few elements of 15504 ML2 and the other few best practices is, from process modeling point of view, a Process Capability Profile descriptive model of the current process.

As a sixth step, she wants to know requirements for process enactment descriptions. She concludes that these descriptions should be “short and useful” and its first version is “incremental O-O development”. From process modeling point of view, the “short and useful” are requirements for and “incremental O-O development” is a Process Enactment Description specification model for a future process.

At that point, from process modeling point of view, the organization has three descriptive models of its current process and three specification models for a future process. These models are established to provide a basis for improving the process.

Then, sub-cycles of process analysis and process change proposal, analyses, implementation and revision are performed. At same point a Process Engineering Group analyzes the current process and together with a Process Steering group decide to improve the current process description to incorporate an orientation to perform bi-weekly status review of the software development project. An action group then produces new process description with elements that can be synthesized as “estimate; develop with increments; bi-weekly status review;”. From process modeling point of view, this is a Process Enactment Description specification model.

After the implementation of this improved process in some pilot projects, three process descriptive modeling are performed. Each one produces a descriptive model of the new current process: (a) a Process Enacting Description model represented as “…, estimate; develop with increments; bi-weekly status review; …”, that answer the question “How we are doing”; (b) a Process Performance Indicator model represented as “About 80% projects are on time in a 20% range” that answer the question “What is going on”; and (c) a Process Capability Profile model represented as “most elements of extended 15504 ML2”, that answer the question “Which best practices we are using”. Then further sub-cycles are performed with more process modeling.

Finally, at the end of Institutionalize improvement phase another three process descriptive modeling are performed on the institutionalized improved process. Each one produces a descriptive model of this process: (a) a descriptive Process Enacting Description model represented as “…, estimate using Use Case Points; develop with increments; weekly status review; …”; (b) a descriptive Process Performance Indicator model represented as “92% projects are on time in a 8% range”; and (c) a Process Capability Profile model represented as “extended 15504 ML2”.

5 CMMI, SPICE and Modeling View of Process Improvement

ISO/IEC 15504 (SPICE) and CMMI are well established, relevant and representative of the current state of the art of SPI. From CMMI Framework, the SPI state of the art can be represented by IDEAL cycle for process improvement, SCAMPI method for process assessment [8] and CMMI-DEV model for development [3]. From ISO/IEC 15504 (SPICE) the SPI state of the art can be represented by the measurement framework for process capability, the measurement framework for organizational maturity, the requirements for performing an assessment (ISO/IEC 15504-2), the requirements for a Process Reference Model (PRM), the requirements for a Process Assessment Model (PAM), the steps of process improvement (ISO/IEC 15504-4), the exemplar PAM for software engineering (ISO/IEC 15504-5) and the exemplar organizational maturity model for software engineering (ISO/IEC 15504-7) [4].

As an evaluation of the claim that the modeling view of process and process improvement presented in the previous section, is an integrated view of current SPI, Table 1 and the next paragraphs provides an analyses on how CMMI and SPICE already cover these three types of process models and modeling. In Table 1, the column Elements indicates which CMMI and SPICE elements deals with each type of process model as specification and descriptive modeling. The column # indicates a degree of achievement of the full modeling with the set of elements. This degree is in the same four points scale defined by SPICE with similar meaning: N (Not achieved), P (Partially achieved), L (Largely achieved) and F (Fully achieved).

Table 1. Types of models/modeling and CMMI/SPICE models

Types of models and modeling		**CMMI-DEV, IDEAL and SCAMPI**		**ISO/IEC 15504 (SPICE)**	
Model	**Modeling**	**Elements**	**#**	**Elements**	**#**
Process Capability Profile model	**Specification modeling**	IDEAL cycle; CMMI-DEV model	L	15504-4 cycle; 15504-5;7 models	F
	Descriptive modeling	SCAMPI method; CMMI-DEV model	P	15504-2 reqs. asses.; 15504-5;7 models	L
Process Enactment Description model	**Specification modeling**	OPD SP 1-4; IPM SP 1.1	F	MAN.1.BP2; PIM.1.BP1,BP3	F
	Descriptive modeling	PPQA SG 1	L	SUP.1.BP3; SUP.5.BP3	L
Process Performance Indicator model	**Specification modeling**	MA SG1	F	MAN.6.BP3,BP4	F
	Descriptive modeling	MA SG2	L	MAN.6.BP5,BP6	L

Each CMMI-DEV profile, including maturity levels 2 to 5, is a Process Capability Profile type of model. During the first phases of a process improvement cycle, following, for example, the IDEAL model, a CMMI-DEV profile is used as a Process Capability Profile specification model for the future process. This profile however uses only a predefined set of the 22 process areas defined in CMMI-DEV. Only a process that is an implementation of these process areas can be specified. Any other relevant process cannot be specified. Therefore a CMMI-DEV profile cannot always be a model of the whole future process. So CMMI Largely (L) achieves Process Capability Profile specification modeling. An assessment using SCAMPI method uses a CMMI-DEV profile as reference. During the first phases of SCAMPI, a specific CMMI profile is defined. A SCAMPI assessment produces a Process Capability Profile descriptive model only for the process that implements that profile. Any relevant process that is not an implementation of that profile is not considered. So CMMI Partially (P) achieves Process Capability Profile descriptive modeling.

Each 15504-5 profile, and each 15504-7 organizational maturity levels from 1 to 5, is a Process Capability Profile type of model. Similar with CMMI, with a difference: It is possible to define any new process for 15504-5 and included it in a 15504-7 organizational maturity model. Therefore SPICE Fully (F) achieves Process

Capability Profile specification modeling. For assessment, however, the profile must be specified during the first phases of an assessment. The descriptive model is constrained by this profile. Therefore SPICE Largely (L) achieves Process Capability Profile descriptive modeling.

CMMI-DEV´s Organizational Process Definition (OPD) and Process and Product Quality Assurance (PPQA) process areas include modeling with Process Enactment Description type of model. CMMI defines "process description" as "a documented expression of a set of activities performed to achieve a given purpose". The term "Process Enactment Description model" is used in this article to mean CMMI process description. The word "enactment" is necessary because all types of process models are process descriptions. This specific description is to guide the enactment of a process. CMMI defines "process definition" as "the act of defining and describing a process" and its result as "process description". The term "Process Enactment Description modeling" is used in this article to mean CMMI process definition.

The purpose of OPD is "to establish and maintain a usable set of organizational process assets, work environment standards, and rules and guidelines for teams". OPD SG (Specific Goal) 1 states "a set of organizational process assets is established and maintained". OPD SP (Specific Practice) 1.1 states "establish and maintain the organization's set of standard processes". OPD SP 1.2 states "establish and maintain descriptions of lifecycle models approved for use in the organization". OPD SP 1.3 states "establish and maintain tailoring criteria and guidelines for the organization's set of standard processes". The purpose of IPM is "to establish and manage the project and the involvement of relevant stakeholders according to an integrated and defined process that is tailored from the organization's set of standard processes". IPM SG1 states "the project is conducted using a defined process tailored from the organization's set of standard processes". IPM SP 1.1 states "establish and maintain the project's defined process from project startup through the life of the project". So CMMI Fully (F) achieves Process Enactment Description specification modeling

The purpose of PPQA is "to provide staff and management with objective insight into processes and associated work products". PPQA SG 1 states "Adherence of the performed process and associated work products to applicable process descriptions, standards, and procedures is objectively evaluated". This evaluation is constrained by to applicable process descriptions, standards, and procedures, so the result can be a descriptive partial model of the process. Therefore CMMI Largely (L) achieves Process Enactment Description descriptive modeling.

ISO/IEC 15504-5´s Organizational alignment process (MAN.1), Process establishment process (PIM.1), Quality assurance process (SUP.1) and Audit process (SUP.5) include modeling with Process Enactment Description type of model. The purpose of the Organizational alignment process (MAN.1) is to enable the software processes needed by the organization to provided software products and services, to be consistent with its business goals". MAN.1.BP2 states "Define the process framework - Identify the processes that need to be performed in order to achieve the business goals". The purpose of the Process establishment process (PIM.1) is to "establish a suite of organizational processes for all life cycle processes as they apply to its business activities". PIM.1.BP1 states "Define process architecture - Define a standard set of processes, purpose of each process and interactions between them" and PIM.1.BP3 states "Define standard processes - Define and maintain a description of

each standard process according to the needs to establish processes in the organization (NOTE: Effective, organization-wide establishment of standard processes may require that they are documented)". Therefore SPICE Fully (F) achieves Process Enactment Description specification modeling.

The purpose of Quality assurance process (SUP.1) is to provide assurance that work products and processes comply with predefined provisions and plans. SUP.1.BP3 states "assure the quality of project process activities and project work products". The purpose of Audit process (SUP.5) is to independently determine compliance of selected products and processes with the requirements, plans and agreement, as appropriate. SUP.5.BP3 states "audit for conformance against the requirements. Selected work products, services or processes are audited to determine their conformance with their requirements and planned arrangements. Non-conformances are recorded". This assurance and this audit are constrained by predefined provisions and plans, so the result can be a descriptive partial model of the process. Therefore SPICE Largely (L) achieves Process Enactment Description descriptive modeling.

CMMI-DEV´s Measurement and Analysis (MA) process area and SPICE´s Measurement process (MAN.6) include modeling with Process Performance Indicator type of model. MA SG 1 states "Analysis Activities Measurement objectives and activities are [establish, maintain and] aligned with identified information needs and objectives". Therefore CMMI Fully (F) achieves Process Performance Indicator specification modeling. MAN.6.BP3 states "Identify measurement information needs - Identify the measurement information needs of organizational and management processes" and MAN.6.BP4 states "Specify measures - Identify and develop an appropriate set of measures based on measurement information needs". Therefore SPICE Fully (F) achieves Process Performance Indicator specification modeling.

MA SG 2 SG 2 states "Measurement results, which address identified information needs and objectives, are provided". These measurements results are constrained by predefined measures, so the result can be a descriptive partial model of the process. Therefore CMMI Largely (L) achieves Process Performance Indicator description modeling. MAN.6.BP5 states "Collect and store measurement data - Identify, collect and store measurement data, including context information necessary to verify, understand, or evaluate the data" and MAN.6.BP6 states "Analyze measurement data - Analyze and interpret measurement data, and develop information products". These measurements results are constrained by predefined measures, so the result can be a descriptive partial model of the process. Therefore SPICE Largely (L) achieves Process Performance Indicator description modeling.

6 Towards a Modeling Driven Process Improvement

The analyses described in the previous section indicates that CMMI and SPICE already cover these three types of process models and modeling, with three limitations: a) CMMI allows the usage of only a predefine set of process areas for Process Capability Profile models; b) CMMI and SPICE constrain descriptive modeling by previously specified specification models; and c) CMMI and SPICE did not fully explore the integration of all three types of process models.

Current SPI usually considers Process Capability Profile models as reference for process improvement, but neither Process Enactment Description models nor Process Performance Indicator models. Current SPI usually considers Process Enactment Description models as models of the processes, but neither Process Capability Profile models nor Process Performance Indicator models. Best practices models from CMMI and SPICE, as, for example, CMMI and ISO/IEC 15504-5, include a process area for Process Performance Indicator modeling (measurement process area), but neither for Process Capability Profile modeling nor Process Enactment Description modeling. All three types of models as references for process improvement and as process models could be considered to improve process improvement. Process areas for all three types of modeling could be considered as well.

The example in Section 4 indicates that using this modeling view during a process improvement cycle improves the integrated understanding of what we want (using specification modeling), what is the current status (using descriptive modeling), what we can do (using a balance between specification and descriptive models) and what we are doing (using specification and descriptive modeling) for improvement during a cycle. However, in order to use the whole potential of this modeling view, an improved worldview is proposed: Modeling driven Process Improvement. The term driven is used in the sense of Model Driven Engineering (MDE).

Modeling driven Process Improvement is the worldview of PRO2PI Methodology. PRO2PI Methodology has been evolved from **Pro**cess Capability **Pro**file ***to*** drive **P**rocess **I**mprovement [6] [14] towards **Pro**cess *Modeling* **Pro**file ***to*** drive **P**rocess **I**mprovement, in order to explore the whole potentiality of Modeling driven Process Improvement. This evolution emerged when a method for tridimensional process assessment using modeling theory was developed and used following Potts´s industry-as-laboratory approach [15]. Modeling driven Process Improvement is a worldview in which process improvement is driven by process modeling. There is a co-evolution of process models and process, where dynamic specification or descriptive process models (Process Capability Profile models, Process Enactment Description models and Process Performance Indicator models) represent a (specified) future process or the actual current process. In a previous article [6] the expression “model driven” was used. The expression “modeling driven” emphasizes the process of modeling instead of the model itself. The SPI Manifesto states three values and principles. The proposed Modeling driven Process Improvement is consistent with the SPI Manifesto´s values and principles, especially with the principle “Use dynamic and adaptable models as needed” using modeling as the underlying integration theory.

7 Conclusion

This article introduces a modeling view of process and process improvement with three types of process models (Process Capability Profile, Process Enactment Description and Process Performance Indicator) and (knowledge working) process as a model of what knowledge workers do and think for a living, where the model is a set of interrelated (or interacting) activities which transform inputs into outputs, to achieve a given purpose”. Drucker´s knowledge working process is proposed as a

generalization of software, systems, services and other domains processes. This modeling view is corroborated by an example of its usage in a process improvement cycle and by an analysis on how two representative SPI frameworks (CMMI and ISO/IEC 15504) partially support this view. Using this modeling view as a basis, Modeling driven Process Improvement is proposed as an evolution of current Model-based Process Improvement.

References

1. Humphrey, W.S.: Managing the Software Process. Addison-Wesley, Reading (1989)
2. Rout, T.P., El Emam, K., Fusani, M., Goldenson, D., Jung, H.-W.: SPICE in retrospect: Developing a standard for process assessment. J. Syst. Software (2007)
3. CMMI Product Team, CMMI® for Development, Version 1.3, Improving processes for developing better products and services. Technical Report, CMU/SEI-2010-TR-033, ESC-TR-2010-033, Software Engineering Process Management Program (November 2010)
4. The International Organization for Standardization and the International Electrotechnical Commission. ISO/IEC 15504, composed of seven parts (15504-1 to 15504-7) parts, under the general title Information technology — Process assessment (2004-2008)
5. Dorling, A.: Next Generation 15504 - the 33001 series of Standards – UPDATE, August 24 (2009), http://www.spiceusergroup.org
6. Salviano, C.F.: Model-Driven Process Capability Engineering for Knowledge Working Intensive Organization. In: Proc. of 8th Int. SPICE Conf., Nuremberg, Germany, pp. 1–9 (2008)
7. Pries-Heje, J., Johansen, J. (chief eds.): SPI Manifesto, eurospi. net, version A.1.2 (2010)
8. Potts, C.: Software-Engineering Research Revised. IEEE Sw. 10(5), 19–28 (1998)
9. Bézivin, J.: On The Unification Power of Models. In: Software and System Modeling (2005)
10. Favre, J.M.: Megamodeling and Etymology - A story of Words: from MED to MDE via MODEL in five millenniums, ADELE Team, LSR-IMAG, University of Grenoble, France (2004), http://www-adele.imag.fr/~jmfavre
11. Rothenberg, J.: AI, Simulation & Modeling. In: Widman, L.E., Loparo, K.A., Nielsen, N.R. (eds.) The nature of modeling, August 1989, pp. 75–92. John Wiley & Sons, Inc., Chichester (1989); (Reprinted as N–3027–DARPA, The RAND Corporation, November 1989)
12. Atkin, A.: Peirce's Theory of Signs. The Stanford Encyclopedia of Philosophy (Winter 2010), http://plato.stanford.edu/archives/win2010/entries/peirce-semiotics/
13. Drucker, P.: Landmarks of Tomorrow - A Report on the New 'Post-Modern' World. Harper & Row, New York (1959)
14. Salviano, C.F.: A Multi-Model Process Improvement Methodology Driven by Capability Profiles. In: Proc. of IEEE COMPSAC, Seattle, USA, pp. 636–637 (2009), doi:10.1109/COMPSAC.2009.94
15. Salviano, C.F., Martinez, M.R.M., Banhesse, E.L., Enelize, A., Zoucas, A., Thiry, M.: A Method for Tridimensional Process Assessment Using Modelling Theory. In: Proc. of IEEE Seventh QUATIC, Porto, Portugal, pp. 430–435 (2010), doi:10.1109/QUATIC.2010.95
16. Card, D.N.: Research Directions in Software Process Improvement. In: Proc. 28th IEEE Int. Comp. Sw. and App. Conf., Hong Kong, China, September 27-30, pp. 238–239 (2004)