A Process Asset Library to Support Software Process Improvement in Small Settings

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Abstract. A main factor to the success of any organization process improvement effort is the Process Asset Library implementation that provides a central database accessible by anyone at the organization. This repository includes any process support materials to help process deployment. Those materials are composed of organization's standard software process, software process related documentation, descriptions of the software life cycles, guidelines, examples, templates, and any artefacts that the organization considers useful to help the process improvement. This paper describes the structure and contents of the Web-based Process Asset Library for Small businesses and small groups within large organizations. This library is structured using CMMI as reference model in order to implement those Process Areas described by this model.

1 Introduction

The Process Asset term was introduced for the first time by the Software Capability Maturity Model, (SW-CMM v1.1.) [1]. The key process area *Organization Process Definition (OPD)* describes the process asset concept. Its main objective is to develop and maintain a set of process assets that improve process performance across the organization projects and provide a basis for cumulative knowledge database process.

The SW-CMM defines process assets as a collection of entities for use by projects in developing, tailoring, maintaining, and implementing their software processes [1]. Also a process asset could be any entity that the organization considers useful in performing the activities of process definition and maintenance. These process assets provide the foundation to institutionalise the processes in any organization [1]. Although, SW-CMM introduces for the first time the process asset concept, it does not refer to the term *Process Asset Library*.

In the SW-CMM, the PAL concept was loosely translated into the "library of process-related documentation". As software process improvement became more common, the term *Process Asset Library* started to be used more frequently than the term used by SW-CMM [2].

The successor of the SW-CMM the *Capability Maturity Model Integration better known with the acronym* CMMI [3, 4] takes all the concepts from its predecessor and develop the term *Process Asset Library (PAL)*, giving the importance that it have and dedicating a specific practice to create and maintain a PAL.

The Process Asset Library (PAL) is a repository of information used to keep and make available all process assets that are useful to those who are defining, implementing, and managing processes in the organization [3, 4]. These process assets typically include:

- organization's standard defined software process,
- software process-related documentation,
- descriptions of the software life cycles,
- guidelines for tailoring the organization's standard software process,
- process implementation aids,
- checklists and templates,
- lessons-learned documents,
- standards, procedures, plans,
- training materials, and other artefacts that can be used by a project.

Apart from these, any entity that the organization considers useful in performing the activities of process definition and maintenance could be included as a process asset.

Other definition describe the PAL as an organized, well-indexed, searchable repository of process assets that is easily accessible by anyone who needs process guidance information, examples, data, templates or other process support materials [2]. PAL development is very important for an organization, because it keeps in the same repository all artefacts that could be used by process. The PAL is more than a single repository of things, it is the live component of the organization and is itself the database that contains all organizational process patrimony [2].

A Process Asset Library is a very important source of guidance to an organization. A well designed PAL facilitates standardization and process improvement in organizations, and is the key to achieve higher capability maturity levels. A poorly designed PAL degenerates into an attic of process that discourages and frustrates process users [5].

The first step in a process improvement effort for an organization is to have well documented policies, process definitions, procedures, project plans, quality plans, process guides, and lessons learned. The second one is to have an electronic repository to keep all this information and maintain available for all process users. A well designed and implemented PAL reduces planning, implementation and training costs throughout whole organization, especially in those processes that only are partially executed [6].

In every organization, a PAL provides the key infrastructure element that is required to support the process improvement effort. The PAL allows all the process information that it is needed when a new project commence to be public for all organization, [6].

2   Process Asset Library Goals and Implementation Benefits

This section explains goals and benefits that could be obtained with the implementation of a Process Asset Library.

2.1   The Process Asset Library Goals

The main Process Asset Library (PAL) goal is to provide an organized, indexed, searchable repository of process assets and make it easily accessible to anyone who needs process guidance information. The PAL provides to the organization a central database for acquiring, defining, and disseminating the knowledge about processes related to the software development and maintenance [2]. Other PAL goals include but are not limited to the following:

- Reduce unnecessary duplication of process assets.
- Provide mechanisms for sharing knowledge about the process assets and how they will be used by the process owners and users.
- Support an effective learning environment to train new employees related have to use the organization's processes.
- Provide a basis for making decisions about developing and tailoring all organization's processes.
- Improve the consistency of content related to process assets.

   In addition a PAL should be containing the lessons learned of those organization's projects that have been successful, in order to increase the knowledge database with each project's best practices.

2.2   Process Asset Library Implementation Benefits

For small settings, a PAL is a key infrastructure element that reduces training time, and helps to guide a process focused culture within the organization [2]. Also, a PAL is a key element to support the reduction in time needed for planning new projects. Other benefits could include:

- Increasing the participation of the people involved to the process in making suggestions for changes to process assets.
- Reducing the cost of project start-up, both from the point of view of less training time needed to prepare people in the way of the processes to be used, and from the point of view of reusing the existing assets.
- Making easy process standardization because the organization's projects use the same type of assets and facilitating the adaptation of those assets that are not compliant with some kind of projects.
- Providing information related to projects that are useful to develop an Integral Balanced Scorecard (BSC). The balanced scorecard is a strategic planning and management system to align business activities to the vision and strategy of the organization, improve internal and external communications, and monitor organization performance against strategic goals.
- Facilitating the implementation of new processes and allows that entire organization takes advantage of process assets stored in the PAL.

Note that the value of the process assets depends on its availability and accessibility, and with the PAL implementation is easier to gain this value. "The ability to rapidly deploy and use processes to serve the needs of their marketplace is a critical attribute of an organization experiencing hypergrowth" [7].

3 Web-Based Process Assets Library Application Structure

Considering the benefits that a PAL implementation brings to the success of a process improvement effort, this research work focuses on the development of a Web-based Process Assets Library easily accessible by the process users. This Web-based PAL has been building in the Polytechnic University of Madrid by the Research Group of Software Process Improvement for Spain and Latin American Region. The name of this research project is PAL-SS (*Process Asset Library for Small Settings*).

The International Process Research Consortium (IPRC) uses the term Small Settings to define organizations that are small and medium size enterprises, small groups within large companies, or small projects. The Software Engineering Institute (SEI) is the sponsor and organizer of the IPRC [8].

Small Settings are special challenges of process improvement. In the United States, small businesses account for 99 percent of all employer firms, employ 50 percent of all private sector employees, and hold 41 percent of all high technology jobs. Small businesses are recognized as a critical component of the USA economy. In other countries, small business is the economy [8].

The PAL-SS was developed initially as a prototype an currently is accessible by the Word Wide Web. Its main objective is to maintain available the knowledge of the process assets that has been developed by this research group for Small Settings organizations.

This paper describes the main structure of the PAL-SS that is based on the CMMI model components (Figure 1). The PAL-SS is designed using a Web-based platform, which in turn, allows the users to exploit it without any complex installation. Additionally PAL-SS could be used from any software and hardware platform. It can be accessed using any type of web browser (e.g Mozilla Firefox, Microsoft Internet Explorer, Netscape, or Opera).

The design of a PAL-SS include in their structure the three critical dimensions that organizations typically focus on to improve its process: "People", "Procedures and Methods", and "Tools and Equipment"[9].

The PAL-SS is structuring in intuitive way and its architecture allows adding process assets following the CMMI process model. In order to maintain the CMMI structure, each asset links with their respective subpractice, and each subpractice belongs to a generic or specific practice. The implementation of these practices will allow the goals achievement of a process area (Fig. 1).

The structure of the PAL-SS is based on standard process components, these components are classified by process areas, practices, subpractices, and products. Components are called standard because they will be used by different projects. Those standard components are grouped into patterns. A pattern keeps a cluster of standard components that are going to be used by a unique type of project but this pattern could be used by another equivalent project.

For example, on the one hand, the pattern "A" contains a set of process components 1, 3 and 5, on the other hand, the pattern "B" contains a set process components
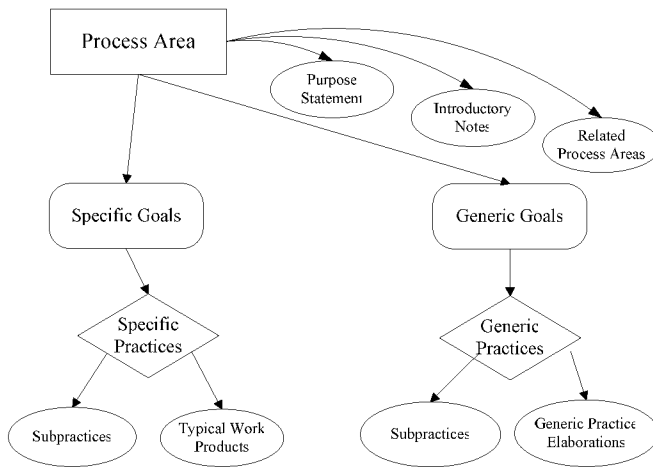
Fig. 1. CMMI model components

1, 4 and 8, in such a way all projects that need using process components 1, 3, 5 use Pattern "A" and all projects that need using process components 1, 4, 8 use Pattern "B". With the use of patterns it will be able to cluster standard process components in n different types of projects, so a pattern previously defined could be used by other projects of the same characteristics.

The use of patterns will allow having a knowledge database of those projects that are used with more frequency and in this way it will facilitate the use of defined assets into equal or similar projects (Fig. 2).

In order to facilitate the inclusion and the search of assets, the PAL-SS has been structured in two standard parts, on the one hand, "Organizational Standard Definitions" which maintain all the process components such as (process areas, goals, practices, subpractices and products) and, on the other hand, "Organizational Standard Metrics" which preserve all the metric that will be used to measure to each standard process component. Moreover those standard and metric are cluster into "Patter Statement Definitions" (Fig. 2).
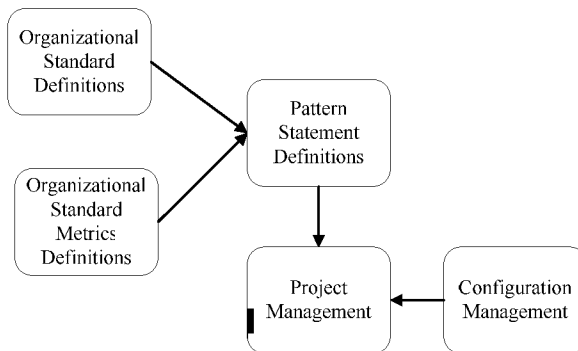

Fig. 2. Functional structure of PAL-SS

3.1 CMMI Model Components Descriptions

The PAL-SS is structured using the CMMI model components as reference, and the database design include each component.

The description of CMMI model components are the following [9]:

Process Areas. A process area is a cluster of related practices in an area that, when implemented collectively, satisfy a set of goals considered important for making improvement in that area. CMMI for Development v1.2 has divided into 22 Process Areas.

Specific Goals. A specific goal describes the unique characteristics that must be present to satisfy the process area. A specific goal is used in appraisals to help determine whether a process area is satisfied.

Generic Goals. A generic goal describes the characteristics that must be present to institutionalize the processes that implement a process area. Generic goals apply to multiple process areas.

Specific Practices. A specific practice is the description of an activity that is considered important in achieving the associated specific goal. The specific practices describe the activities that are expected to result in achievement of the specific goals of a process area.

Subpractices. A subpractice is a detailed description that provides guidance for interpreting and implementing a specific or generic practice.

Typical Work Products. The typical work products section lists sample output from a specific practice. These examples are called typical work products because there are often other work products that are also useful but are not listed.
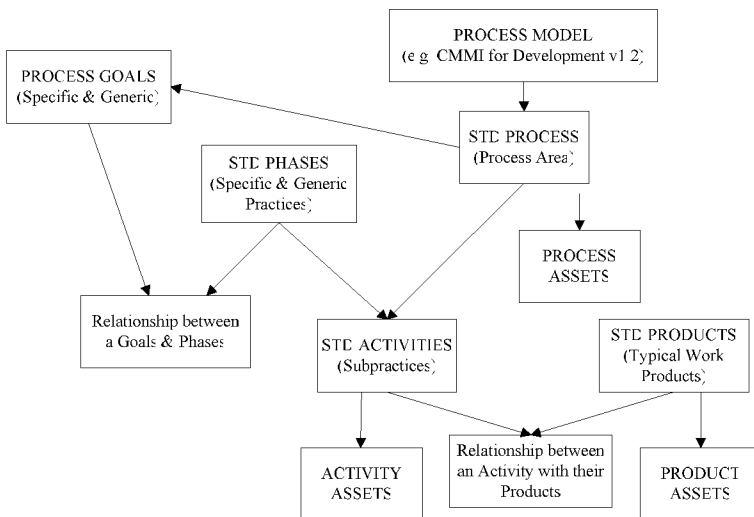

Fig. 3. Functional components in a PAL-SS relational database

Generic Practice Elaborations. A generic practice elaboration appears after a generic practice in a process area to provide guidance on how the generic practice should be applied uniquely to the process area.

3.2 Process Assets Library Structure Using CMMI Model Components as a Reference

Using the model components described at section 3.1 the PAL-SS has been structured taking these components as reference (Fig. 3).

The PAL-SS takes each CMMI Process Area and keeps up a correspondence with "Standard Process". The Specific and Generic Goals keeps up a correspondence with "Process Goals". And each Specific and Generic Practices keeps up correspondence with "Standard Phases" (Fig. 4).
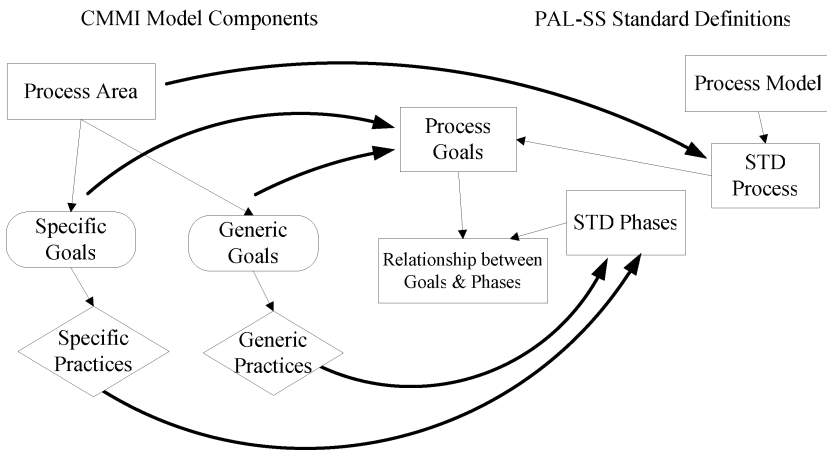

Fig. 4. CMMI model components match with PAL-SS

At the same time, and following the previous structure, the tasks needed to perform a process are represented at CMMI model components with the name of "*Subpractices*" and keep up a correspondence in the PAL-SS structure with "Standard Activities". When a task is performed the resulting products are named by CMMI as "*Typical Work Products*" and keep up a correspondence in the PAL-SS structure with "Standard Products" (Fig. 5).

Finally, the informative model components of CMMI, that is additional information that helps to understand a process area, are included at the PAL-SS as "Assets". These assets include a process area and they will be used for the implementation of the process. The PAL-SS structure classifies the assets into "Process Assets", "Activity Assets", and "Product Assets" (Fig. 6).

Process assets are divided by Process Area. Each Process Area contains the organization's policy for it, a process definition, and other supporting information.
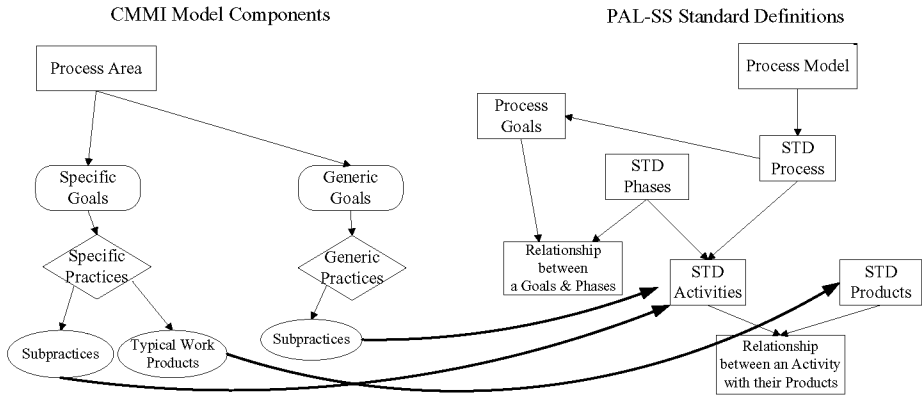
Fig. 5. Matching Subpractices, TWP with PAL-SS activities
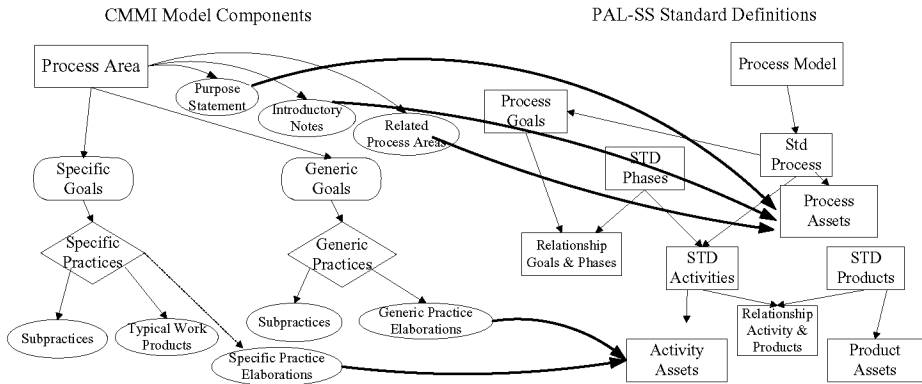

Fig. 6. CMMI informative model components are process assets in PAL-SS

Other information included as "Assets" are sample plans, templates, and other documents from our organization and others Small Settings. Internal processes used in the day-to-day process operations are also included.

This way the PAL-SS will allow making on a support tool for the process improvement implementation. It will let having an agile mechanism that contains all process components to be implemented.

The process area will include all the components and the assets that are required for the process implementation in a Small-Setting, such as process description, activities that are required to perform the process, tailoring guides and templates that will be due to use. Similarly, it will be due to include essential metrics that are required to measure the process and their products, which are necessary to be able to control the process.

3.3 Components of the Web-Based Process Assets Library for Small Settings

The PAL-SS web tool has been divided into five principal components (Fig. 7):
- Project management
- Organizational Standard Definitions
- Measurement Repository Definitions
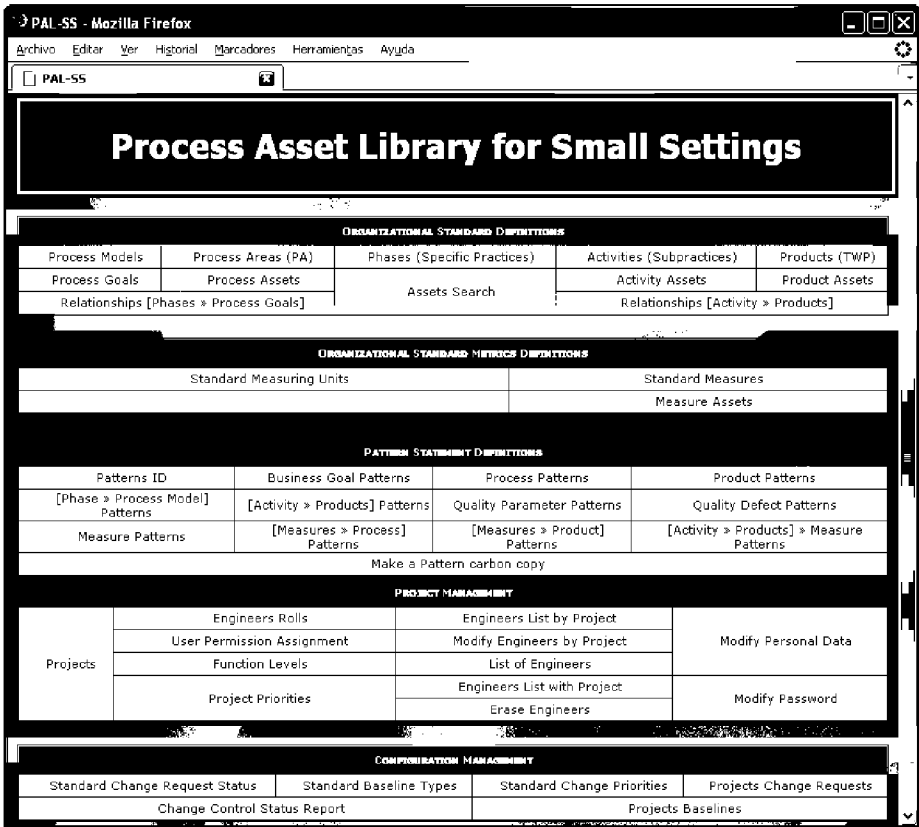- Configuration Management, and
- Pattern Statement Definitions

Fig. 7. Management Menu of web-based Process Asset Library for Small Setting

The functionality of each component is the following:

Organizational Standard Definitions. This component specifies all the relations that exist between a process their objectives, activities, tasks and products.

Measurement Repository Definitions. This component defines each metric and that it will be used to measure the process, tasks and products.

Pattern Statement Definitions. This component specifies a set of processes, phases, activities and products that were used by similar projects. Meaning that pattern for a project could only be used in projects of the same type, but it can be registered as many patterns as necessary.

Project Management. This component manages all projects and their data. It is important to say that each project must be match with a Pattern previously defined.

Configuration Management. This component manages the changes that have each project, such as requirement change, control baselines, project change management.

4 Conclusions

The PAL is a collection of assets, maintained by an organization, for use by projects in developing, tailoring, maintaining, and implementing their software processes an is important resource that can help reduce the effort in using processes [3, 4]. The CMMI establish that in order to advance at maturity level 3 a structured and well implemented Process Asset Library is required. Most of the organizations that are in advanced levels of maturity coincide on having a Process Asset Library and argue that is the key to have a culture focused to the maturity of the processes.[2]. A Process Asset has no value if it is not easily accessible by the users when they need it. Every matured organization has to implement a PAL but, it is generally one of the least concepts that an organization has considered for its implementation.

The Process Asset Library presented in this paper was developed by Research Group of Software Process Improvement for Spain and Latin American Region and it was structured to be used by Small Settings in a Web-based environment easy to use. Currently the PAL-SS has assets of Requirement Management (REQM), Project Planning (PP), and Project Monitoring and Control (PMC) process areas. Those assets will be used at the implementation those activities that are needed to perform the goals of a specific process area. The PAL-SS has been used by students software projects and is currently being validated it in a pilot project within a Small Setting. Future research includes developing assets from others CMMI process areas like as (PPQA) as well as the incorporation of other models like TCPi, CMMI-ACQ and ITIL.

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