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# **Dependency Analysis between CMMI Process Areas**

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#### **KEYWORDS**

Dependency Analysis, CMMI, Process Areas, Maturity Levels.

# ABSTRACT

SPI and in particular CMMI is being widely use by several organizations to improve their product quality. However, the SMEs are reluctant in adopting it and in particular maturity level 2 of CMMI, because they think that achieving this level is too expensive and do not see a clear benefit on it. Our solution to captivate the interest of SMEs in CMMI is the anticipation of some process areas of maturity level 3 considered as a benefit by the organization and implement those process areas at the same time of maturity level 2.

# INTRODUCTION

CMMI-DEV (Capability Maturity Model Integration for Development) (CMMI 2006; Chrissis et al. 2006) is a well-known Software Process Improvement (SPI) model developed by the Software Engineering Institute (SEI). It is concerned in helping organizations to improve their processes. This SPI model has been implemented by several organizations (Goldenson and Gibson 2003; Gibson et al. 2006) that report a great improvement in reducing costs, improving the productivity, and the performance. According to (Staples and Niazi 2008) the most frequent reasons given by organizations for adopting a CMM based SPI model, like CMMI, were the improvement of their software quality, development time, development costs and productivity. However, customer satisfaction and staff motivation were referred in some SMEs.

In what concerns why organizations do not adopt the maturity level 2 of CMMI, according to (Staples et al. 2007) the most frequent reasons given were: small organization, too costly, no time, using other SPI and no clear benefit in this CMMI level. Organizations do not consider the maturity level 2 a high value improvement since the process areas (PAs) of this maturity level are mainly concerned on the process quality and the organizations are concerned with the product quality. To make CMMI widely used in small organizations, Wilkie et al. 2005, suggest that CMMI should be recasted to cover the needs of this type of organizations. Our solution to make CMMI widely used in SMEs does not consist in recasting the CMMI, but to propose to the organizations the implementation of the PAs of the maturity level 2 and, at same time, to implement some

PAs of the maturity level 3. These PAs could be chosen by the organization according to their needs of improvement or chosen according the higher benefit to the organization. To analyze the impact of this approach, we decided to study the dependencies between the PAs, to better understand which other PAs than those chosen for implementation must be at least taken into account because of the dependencies between them.

#### **DISCOVERING THE PAS DEPENDENCIES**

By looking into the official CMMI documentation we cannot have a global view of the dependencies between the all the PAs. By reading the "related process areas" section of each process area, we can only understand what are the dependencies of each process area independently.

To obtain the complete list and a graph representation of all the dependencies between all the PAs we started to analyze the "related process areas" section for all the PAs. Then, we decided to create a matrix (that contains the information of all the dependencies) and a set of graphs (that graphically represents the information stored in the matrix). The matrix rows represent the source PAs and the columns represent the destination PAs, in the dependency analysis perspective.

#### **Elementary Dependency Analysis**

Our efforts to characterize the elementary dependency analysis (EDA) of a particular process area. PPQA process area is next illustrated as an example.

In the "related process areas" section of the PPQA, we can read "refer to the Project Planning process area for more information about identifying processes and associated work products that will be objectively evaluated" and "refer to the Verification process area for satisfying more information about specified requirements". This means that the PPQA is related to the PP and VER PAs. This information is represented in the matrix by marking with an X the cell that corresponds to the PPQA row and to the PP column and also the cell that corresponds to the PPQA row and to the VER column (see Table 1).

Table 1. PPQA matrix line

		ML 2							ML 3											ML4		ML 5	
	PA PA depends	{PA 1} Reqm	{PA 2} PIIC	{PA 3} pp	{PA 4} Sam	{PA 5} IIA	(PA 6) CII	(PA 7) PPQA	{PA 8} Pi	(PA 9) RD	{PA 10} TS	(PA 11) Val	(PA 12) Ver	{PA 13} OPD	{PA 14} Opf	(PA 15) Ot	{PA 16} IPM	(PA 17) RSKM	(PA 18) Dar	(PA 19) OPP	(PA 20) QPM	{PA 21} OID	(PA 22) Car
ML 2	(PA 7) PPQA			X									X										



The matrix is capable of representing the dependency information about all the PAs. We also represent this information in graphs, for better understanding. The graph for this EDA example is presented in figure. 1.



Figures 1: Elementary Dependency Analysis Graph

# **Dependencies of CMMI PAs**

Table 2. Dependencies between all the CMMI PAs





Figures 2: Global dependencies between CMMI PAs

To create the complete matrix and graphs of the CMMI PAs we executed the EDA for all the PAs. The resulting matrix is presented in Table 2. To easily understand the impact of the dependencies between all the PAs, we organized the matrix by maturity level.

It is also possible to obtain a graph representation of the global matrix of Table 2, which can be seen in figure 2.

# ML-2 DEPENDENCY ANALYSIS WITH EDA FOR VALIDATION AND VERIFICATION PAS

As a motivation to convince SMEs that CMMI maturity level 2 brings real benefits, we decided study what are the theoretical dependencies we should expect when performing the ML2 assessment and, at the same time, prepare for one CL3 assessment for some process areas, namely validation and verification (figure 3)



Figures 3: Dependencies between ML2 and V&V PAs

# CONCLUSIONS

CMMI official documentation does not explicitly describe the existing dependencies among the PAs. To find out the global theoretical dependencies, we need to complement the reading of the documentation with special care and analysis capabilities, but, even after that, it is hard to obtain the global view of the dependencies.

Our motivation to explicit the global dependencies between CMMI PAs arose when we tried to understand the impact of implementing the maturity level 2 simultaneously with some PAs from maturity level 3 as a way to make CMMI more widely used in Portuguese SMEs.

As future work, we will also complement our current dependency analysis study with other dependencies gathered from other sources of information.

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