GSPA: A GENERIC SOFTWARE PROCESS ASSESSMENT TOOL

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ABSTRACT

GSPA: A GENERIC SOFTWARE PROCESS ASSESSMENT TOOL

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Performing process improvement to deliver the qualified products with expected cost on time has been a requirement for organization targeting to be successful in software market. Software organizations usually perform process improvement based on well-known process assessment frameworks such as CMMI and ISO 15504. As improvement needs diverge, a number of process assessment models such as Automotive SPICE, Enterprise SPICE, Brazilian Software Improvement, and Agile Maturity Model are derived. In addition, self-assessment carries vital importance as more SME's initiate process improvement projects. Process assessment requires judgment and there is an unavoidable manual work. However there are also opportunities for automation. Performing process assessment manually leads to loss of time because of its complicated nature. Therefore, there is a need for a generic software process assessment tool to define process assessment models, facilitate assessment, and give simple and reasonable results. The existing tools do not meet the expected features completely, as they were generally developed for single process assessment model. For this reason, a generic software process assessment tool has been developed to support all structured process assessment models. A multiple case study is conducted to measure the sufficiency and the contributions of the tool.

Keywords: Process Assessment, Process Improvement, Software Process Assessment Tool, CMMI, ISO 15504

ÖZ

GSPA: GENEL BİR YAZILIM SÜREÇ DEĞERLENDİRME ARACI

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Yüksek Lisans, Bilişim Sistemleri

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Kaliteli ürünleri zamanında ve beklenen maliyetle teslim etmeyi amaçlayan yazılım süreç iyileştirme yöntemlerini uygulamak yazılım dünyasında başarılı olabilmeyi hedefleyen organizasyonlar için bir gereksinim olmuştur. Yazılım organizasyonları süreç iyileştirme çalışmalarını genellikle CMMI ve ISO 15504 gibi herkesçe bilinen süreç değerlendirme çerçevelerini esas olarak yapmaktadır. İyileştirme ihtiyaçları farklılaştığı için, Automotive SPICE, Enterprise SPICE, Brazilian Software Improvement ve Agile Maturity Model gibi bir dizi süreç değerlendirme modelleri türetilmiştir. Bununla birlikte, daha fazla KOBİ süreç iyileştirme projelerini başlattığı için öz değerlendirme hayati önem taşımaktadır. Süreç değerlendirme muhakeme gerektirmektedir ve kaçınılmaz bir el işi vardır. Ancak, aynı zamanda otomasyon için de fırsatlar vardır. Karmaşık doğasından dolayı, süreç değerlendirmeyi el ile gerçekleştirmek zaman kaybına yol açmaktadır. Bu nedenlerden ötürü, geliştirilen modelleri tanımlayacak, değerlendirmeyi kolaylaştıracak, basit ve anlamlı sonuçlar verecek bir araç isteği açığa çıkmıştır. Hali hazırda var olan araçlar genellikle tek bir süreç değerlendirme modeli için geliştirilmiş olmalarının yanı sıra kendilerinden beklenen özellikleri tam olarak karşılayamamaktadırlar. Bu amaçla, birçok yapılandırılmış süreç değerlendirme modelini destekleyecek genel bir yazılım süreç değerlendirme aracı geliştirilmiştir. Geliştirilen bu aracın yeterliliğini ve katkılarını ölçmek amacıyla çoklu durum çalışması uygulanmıştır.

Anahtar Kelimeler: Süreç Değerlendirme, Süreç İyileştirme, Yazılım Süreç Değerlendirme Aracı, CMMI, ISO 15504

To my family

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LIST OF ABBREVIATIONS

CMM	: Capability Maturity Model
CMMI	: Capability Maturity Model Integrated
IBM	: International Business Machines
IEC	: International Electrotechnical Commission
ISO	: International Organization for Standardization
IT	: Information Technology
ITIL	: Information Technology Infrastructure Library
SEI	: Software Engineering Institute
SPICE	: Software Process Improvement and Capability Determination

CHAPTER 1

INTRODUCTION

This chapter includes the introductory information about this study and it begins with the background of the problem which is described in detail. After that, the purpose of this study is expressed. Then, significance of the study is clarified. The research questions investigated for this study are defined in this chapter. Finally, this chapter ends with the description of the organization of the thesis.

1.1. Background of the Problem

Delivering qualified products on time with expected cost has become the common purpose of each company which aims to make profit in the globalized world. On this account, the companies focus on process improvement studies which reveal the current situation of processes and the necessary steps to be taken in order to improve processes. Process assessment is based on process assessment models to identify process improvement opportunities. CMMI [1] and ISO 15504 [2] are the most popular process assessment models used in software process assessment studies by software organizations [3]. In addition to these models, process assessment models which have been customized for various industries such as Auto SPICE [4], Medi SPICE [5], Enterprise SPICE [6] and Brazilian Software Improvement [7] are used for software process improvement. When the studies conducted between 1990 and 2009 were examined, it was noticed that 52 process assessment models, most of which were based on CMMI [1] and ISO 15504 [2], were developed [8]. Furthermore, the historical developments of process assessment models demonstrate that even the designers of the most widely-accepted models such as SEI and ISO/IEC create new versions of existing standards in order to adapt to the rapidly changing sector of software (ISO/IEC 12207 [9], ISO/IEC 15504 [2], CMMI v1.02 [10], CMMI v1.1 [11], CMMI v1.2 [12], CMMI v1.3 [1]). When new version of a model emerges, this new version has to be adapted by companies and a new assessment has to be performed based on it. These models are so popular that even researchers putting an emphasis to quality management in education have developed their own model called as Edu SPICE [6].

The costs of CMMI [1] and ISO 15504 [2] based on process assessments, as well as needs for adapting new software life cycle models caused a number of researchers to develop different models [13].

The diversity of process assessment models demonstrates the popularity of process improvement studies. However, it is not easy to perform process assessment manually. Therefore, it has been given importance to automation which will be helpful for decreasing the necessary task and gaining time [14]. For that purpose, a number of software process assessment tools are developed to increase the efficiency of process assessment since tool support has an important place in terms of cost and time in software process assessment studies [15].

1.2. Statement of the Problem

Self-assessment is of vital importance due to the fact that more and more SME's focusing on costs involve in process improvement. However, performing self-assessment takes too much time because of the fact that findings and evidences might be countless and complicated. In addition, it is not easy to comprehend and analyze the outputs emerging from the assessment while performing paper based assessment [16].

The existing tools have been developed mainly for either CMMI or ISO 15504, but not for the process assessment models created separately or with the customization of CMMI or ISO 15504 [16][17][18][19][21][22][23]. In addition, a comparison study about existing tools point out that there is no tool which meets expected features such as defining model, performing process assessment and parallel assessment to support process assessment teams[24]. Consequently, there is a need to develop an automated generic software process assessment tool which has all necessary features in order to support software process assessment based on various process assessment models.

1.3. Purpose of the Study

Software quality draws the attention of an organization since the common aim is to produce qualified products with expected cost on expected time. Since carrying out paper based process assessment takes too much time because of huge number of findings and complex structure of process assessment models, automated tools supporting process assessment have been valued more.

The purpose of this study is to design generic process assessment tool to prevent assessors and researchers from spending their time on development of new tool based on a new process assessment model and to investigate the effect of an automated process assessment tool on process assessment and improvement. Accordingly, this study will explore characteristics of a process assessment tool to support assessors for performing process improvement activities and the advantages of an automated software process assessment will be investigated compared to paper-based assessment. This study will also examine the weaknesses of the proposed tool so that future studies based on weaknesses can be conducted to increase the efficiency of the tool as a further research.

1.4. Significance of the Study

Process assessment is the essence of software organizations for those which aim to be successful in competitive software world. Although, performing process assessment is not a very time and money-saving way. A number of process assessment tools have been developed to support process assessment. Unfortunately, there is no current process assessment tool having "defining model", "evaluating different projects", "performing process assessment" and "parallel assessment" features altogether to perform process assessment. Hence, GSPA, generic software process assessment tool has been proposed in order to perform the most essential activities without losing time. Additionally, the benefits of using a process assessment tool are explored. The study will also provide information for assessors about the current process assessment tools because the tools are compared based on the determined criteria. That is, this study will yield the weaknesses and strengths so that assessors can choose the suitable tool even if the existing tools are not fully qualified.

This study will also guide the organizations which are planning to design their own process assessment model in accordance with their business needs. Moreover, there are some proposed process assessment models which are not validated practically and for this reason, this study will be beneficial for researchers who propose a process assessment model in order to implement the model with the help of this tool.

This study will also provide an effective and user-friendly automated generic process assessment tool for assessors to support process assessment and improvement.

1.5. Research Questions

Research Question 1: To what extent is the tool sufficient in meeting expected features?

Research Question 2: What are the advantages of an automated generic software process assessment tool?

Research Question 3: What are the weaknesses of the proposed tool?

1.6. Organization of the Thesis

Chapter two includes the literature review about software process assessment models and software process assessment tools. In that part, the most common software process assessment models are explained. Then, the comparison of software process assessment tools with determined criteria is investigated.

Chapter three explains GSPA. Firstly, a meta-model which has been developed for designing available process assessment models is defined together with the concepts in meta-model. After constructing the meta-model, the use case diagram is provided so that the functionality of SPA has can be easily understood at a glance.

Chapter four explains the application of GSPA and gives information about design and conduction of case studies. In this part, each selected case is described and data collection and analysis procedure are presented.

Chapter five yields findings obtained during case studies in detailed way for each case.

Chapter six concludes the overall findings and suggests future work which is planned after this study.

CHAPTER 2

LITERATURE REVIEW

This chapter presents the literature review about software process assessment models and software process assessment tools developed for academic or commercial purposes. In the software process assessment models section, the models which have been founded during literature review are presented with their description and the most common models are introduced in detail. In software process assessment tool section, the founded software process assessment tools are listed. Then, the comparison of current software process assessment tools is shown out.

2.1. Software Process Assessment Models

Process Assessment Model serves as a basis for conducting process assessment and emerging process improvement opportunities according to a certain standard which has been created to ensure that same procedure is followed for each process assessment [25]. That is, it aims to guide for process assessment about what should be done in a process and what is required for a process by providing certain elements and indicators [26]. A lot of process assessment models have been developed to help software process assessment and software process improvement. These models have been developed in order to facilitate in different domains such as Automotive Systems, Knowledge Management and IT Security [27].

In the literature review, we used worldwide accepted scientific databases such as IEEE Explorer, Web of Science, SpringerLink and ScienceDirect to find the existing process assessment models by searching the key words related with process assessment model. The following table shows the attained process assessment model with their descriptions at the end of literature review.

Table 1 List of Process Assessment Models with Description

Model Name	Description
Agility Assessment Model [28]	This model is developed in order to measure the agility of an organization with the support of TÜBİTAK by Informatics Institute. The model uses the same structure with ISO 15504 which has two dimensions. In Agility Assessment Model, the dimensions are called aspect dimension and agility

	dimension instead of process dimension and capability dimension.
Agile Maturity Model [29]	It has been developed based on CMMI for software organizations in order to adapt agile principles and practices.
Automotive SPICE [4]	This model which has been developed based on ISO 15504 is used for automotive industry.
Brazilian Software Improvement [7]	It has been developed based on both CMMI and ISO 15504 to support small and medium enterprises in their process in Brazil.
Edu SPICE [6]	By considering ISO 15504, it has been designed by the researchers who care about the quality in education.
Enterprise SPICE [30]	As its name points out, it has been developed based on ISO 15504 by combining important processes with the examination of different models and standards for those which aim process assessment and improvement in enterprises.
Extreme Programming Maturity Model(XPMM) [31]	By taking into consideration the structure of CMMI substantially, it was proposed to measure how extreme programming practices are implemented by organizations in 2001.
Medi SPICE [5]	This model which has been developed for health industry is based on ISO 15504.
Scrum Maturity Model [32]	It has been developed with the motivation of decreasing project failures resulted from poor communication between teams and clients by focusing on agile practices and principles. It has been created by considering CMMI.
Team SPICE[33]	Inspired by the structure of ISO 15504, Team SPICE has been developed to be guidance for effective teamwork during software projects.
Test Maturity Model [34]	In 1996, it was developed to facilitate software test procedure based on CMM.

Wangenheim examined 52 process assessment models which were proposed between 1990 and 2009 and found that 50 of them are based on CMMI and/or ISO 15504[8]. Therefore, it is necessary to examine these two process assessment models in detailed way.

2.1.1. CMMI

CMMI was developed with the aim of increase in the feasibility and efficiency of software process models by combining many different process assessment models into single framework by Software Engineering Institute (SEI) at Carnegie Mellon University. Crosby's maturity grid and IBM maturity grid were used as an inspiration to create precessors of CMMI [35]. CMM is the ancestor of CMMI and it was started to develop in 1986. In 1987, a preliminary maturity questionnaire about CMM was released. SEI created Capability Maturity Model for Software (Software CMM) by benefiting from the preliminary maturity questionnaire published as SW-CMM v1.0 in

1991. In 1993, SW-CMM v1.1 was released and the first book was published about Capability Maturity Model for Software in 1995. The following figure taken from last version of CMMI shows the historical development of CMMI between 1993 and 2010 [1].

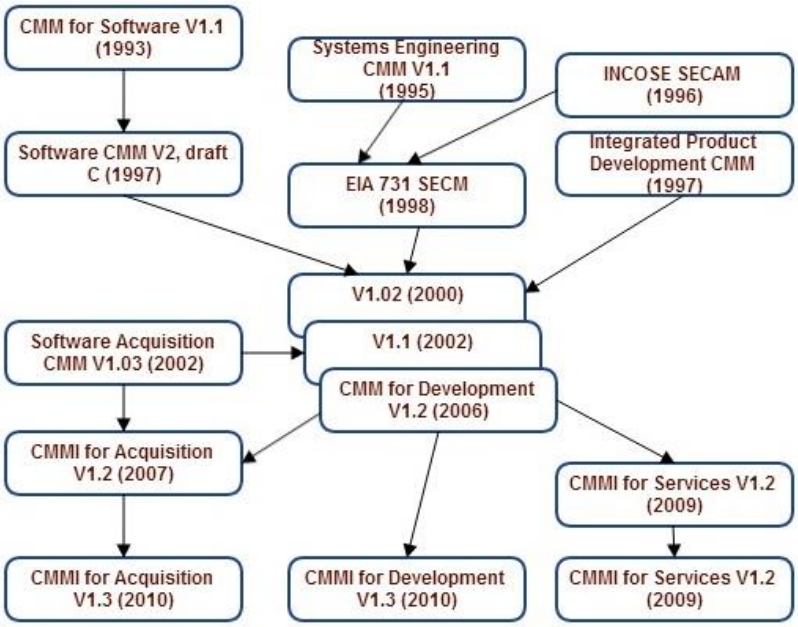

Figure 1 History of CMMs

CMMI is the integrated process assessment model of three maturity models which are the Capability Maturity Model for Software (SW-CMM) v2.0 draft C, the Systems Engineering Capability Model (SECM) and the Integrated Product Development Capability Maturity Model (IPD-CMM). In 2000, the first version of CMMI which is CMMI v1.02 had been released. The version 1.1 was published two years later. In 2006, version 1.2 was developed and its name changed as CMMI for Development v1.2. In next three years, two other CMMI constellations were released with the name of CMMI for Acquisition v1.2 and CMMI for Services v1.2 by taking into consideration CMMI for Development v1.2. In 2010, versions 1.3 of these three CMMI constellations were released and today they are used for process assessment and getting certificates about it by the organizations since these are last versions of CMMI. They are called as CMMI for Acquisition V1.3, CMMI for Development V1.3, and CMMI for Services V1.3.

2.1.1.1. Model Structure and CMMI Representations

There are two types of CMMI representations: Continuous and Staged Representations. They have almost the same contents but are organized in a different way.

Continuous Representation has been developed with the aim of measuring the capability level of specific process so that organizations can determine the order of processes in accordance with their needs [36]. It has been affected by ISO 15504 process assessment

model which has two dimensions. The following figure demonstrates the structure of continuous representation.

Figure 2 CMMI Continuous Representation

In continuous representation, each process is rated by their capability levels. Firstly, each process is measured according to their specific goals including specific practices in order to achieve first capability level. Then, other capability levels including generic goals are measured by taking into consideration generic practices.

There are four capability levels between 0 and 3 continuous representations. The following table represents the capability levels with their name in continuous representations.

Table 2 CMMI Capability Levels

Level	**Name**
0	Incomplete
1	Performed
2	Managed
3	Defined

Capability Level 0 – Incomplete: If the process is not performed, it is called incomplete. In other words, there are unsatisfied specific goals of process.

Capability Level 1 – Performed: This level focuses on specific goals for a process. In order for a process to be performed, the specific goals must be implemented. In this level, processes are not generally conducted on expected time and cost.

Capability Level 2 – Managed: the processes in this level are planned, monitored and controlled and performed.

Capability Level 3 – Defined: The processes in this level have the properties of capability level 1 and level 2 which are performed and managed. In addition, this level concentrates on generic goals and practices in capability level 3 which are related with definition and standardization of processes.

Staged representation is facilitated to measure the maturity of organization by giving a single rating to an organization at the end of assessment. Therefore, it enables to compare and contrast the organizations by considering the rating of organizations [37]. In this representation, each maturity level has different process areas. Namely, by choosing the target maturity level, organizations automatically determine on which processes they must focus [38]. The following figure demonstrates the structure of staged representation.

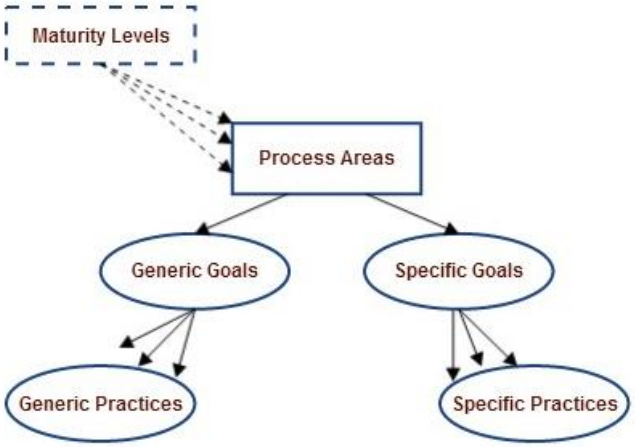

Figure 3 CMMI Staged Representation

In staged representation, maturity levels include process areas in which there are specific and generic goals that have to be achieved by organizations. To achieve these goals, generic or specific practices are implemented by organizations.

There are five maturity levels in staged representations. The following table shows the maturity levels with their name in staged representations.

Table 3 CMMI Maturity Levels

Level	**Name**
1	Initial
2	Managed
3	Defined
4	Quantitatively Managed
5	Optimized

Maturity Level 1 – Initial: This is the beginning level for organizations so that all of them are rated as at least level 1. Software development is not planned and there is a chaotic situation. The success of organization depends on individual skills. Generally, the project is not finished on planned budget and time. There is no good control mechanism in this level. Additionally, the solutions for problems are not permanent.

Maturity Level 2 – Managed: Projects are conducted and managed according to project plans which are prepared and documented before starting the projects. The projects

are planned, monitored and controlled in this level. Also, the software requirements are managed and certain measurements are made to plan the projects.

Maturity Level 3 – Defined: In this level, processes are defined in detail so that they can be easily understood and performed. Moreover, they are described in organizational base not in project base.

Maturity Level 4 – Quantitatively Managed: The performance of processes are managed and controlled with the quantitative data such as statistical analysis. As a result of this, the efficiency of processes can be easily estimated.

Maturity Level 5 – Optimized: Main focus of this level is on quantitative continuous improvement. Therefore, the causes behind the change in processes are investigated and solutions are produced to increase the efficiency of processes.

Table 4 Process Areas in CMMI

Level	**Focus**	**Process Areas**
Optimizing	Continuous Process Improvement	Organizational Innovation and Deployment Causal Analysis and Resolution
Quantitatively Managed	Quantitative Management	Organizational Process Performance Quantitative Project Management
Defined	Process Standardization	Requirements Development Technical Resolution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition Organizational Training Integrated Project Management Risk Management Decision Analysis and Resolution
Managed	Basic Project Management	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
Initial		

There are 22 process areas in CMMI Dev V1.3. In order to have a CMMI Maturity level, all practices and goals of related process areas in target maturity level should be implemented by organizations.

2.1.2. ISO/IEC 15504

ISO 15504, which is also called SPICE standing for Software Process Improvement and Determination was set out to develop as SPICE project by ISO (International Organization for Standardization) and the IEC (International Electrotechnical Commission) in 1993 [39]. In 1998, ISO/IEC released the first version of ISO 15504 as a technical report [40]. ISO 15504 became an international standard having three main purposes which are process improvement, capability determination and self-assessment [41]. It was developed with the aim of supporting the other models such as ISO/IEC 12207, ISO/IEC 15288 and ISO 9000 [42]. Furthermore, it was emerged as a solution to problems faced with process assessment models such as SW-CMM, Trillium and Bootstrap.

2.1.2.1. Model Structure

There are two dimensions called Process Dimension and Capability Dimension in ISO 15504 process assessment model. The following figure shows the relation between two dimensions.

Figure 4 Relationship between Process Dimension and Capability Dimension

The process dimension includes processes in process reference model. The process reference model is based on ISO/IEC 12207. In process dimension, there are processes including their purpose and outcomes. Processes are grouped according to their domains and categorized in accordance with the life cycle. There are 3 categories and 9 groups as figure 5 demonstrates.

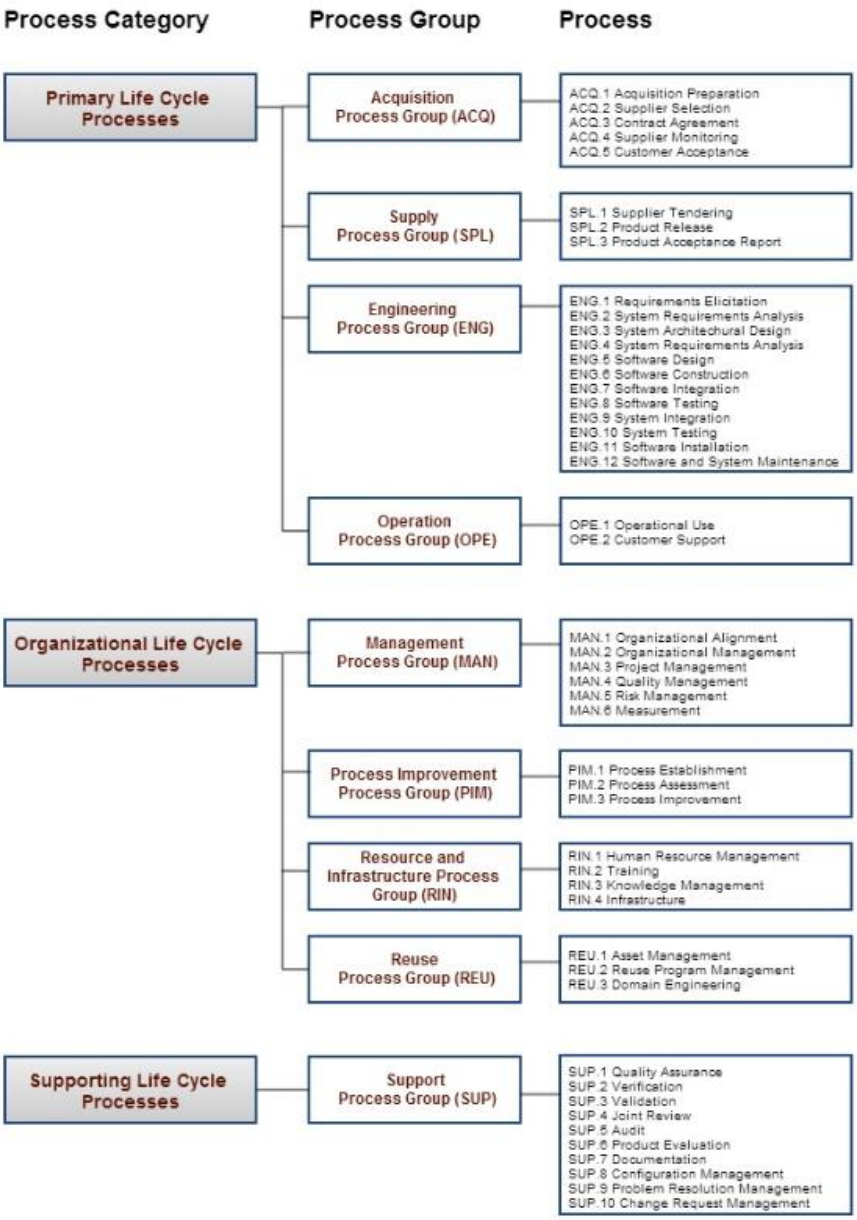

Figure 5 List of Processes with Categories and Groups

The capability dimension is related with the rating the processes fitting with their capabilities defined in the model. Capability dimension consists of capability levels with process attributes. The achievement of process attributes is the main concern of capability dimension in order for a process to have a capability level. There are six capability levels between 0 and 5. The following table shows the capability level with their names.

Table 5 ISO/IEC 15504 Capability Levels

Level	Name
0	Incomplete
1	Performed
2	Managed
3	Established
4	Predictable
5	Optimizing

Capability Level 0 – Incomplete: Process purposes and outcomes are not met at this level. In addition, enough evidence is not presented about the purposes of process. Therefore, there is no process attribute at this level.

Capability Level 1 – Performed: At this level, the main focus is achievement of process purposes and outcomes.

Capability Level 2 – Managed: The management of work products and performance are provided at this level. The processes are planned, monitored and controlled.

Capability Level 3 – Established: Processes are defined according to certain procedure and they are implemented based on this definition.

Capability Level 4 – Predictable: This level yields that performance of processes is predictable since it concentrates on quantitative data about process.

Capability Level 5 – Optimizing: The continuous improvement of process is targeted at this level. In other words, process is optimized to fulfill the business needs.

There are 9 process attributes to measure capability level of a certain process.

Table 6 ISO/IEC 15504 Process Attributes

Capability Level	Process Attribute
Level 1	1.1 Process Performance
Level 2	2.1 Performance Management 2.2 Work Product Management
Level 3	3.1 Process Definition 3.2 Process Deployment
Level 4	4.1 Process Measurement 4.2 Process Control
Level 5	5.1 Process Innovation 5.2 Process Optimization

2.2. Software Process Assessment Tools

Process assessment tools help assessor determine the capability of process in order to overcome assessment data and record assessment results during assessment [16]. The main purpose of the tools is to support assessment so as to minimize the cost and maximize the reliability of assessment reports [14]. A lot of process assessment tools have been developed in an effort to support process assessment with the aim of decreasing time and cost for assessment. The process assessment tools demonstrated in Table 7 are founded at the end of literature review benefiting from certain key words in science related databases.

Table 7 List of Software Process Assessment Tools

Tool Owner	Tool Name
Software Quality Institute of Griffith University	Appraisal Assistant[43]
Integrated System Diagnostics Incorporated	Appraisal Wizard [44]
Wibas	CMMI Browser [45]
Marc De Smet	CMMI v1.1 Self-Assessment Tool [23]
Chemuturi Consultancy	CMMiPal v1.0 [22]
HM&S IT-Consulting	CMM-Quest v1.3 [21]
Integrated System Diagnostics Incorporated	Model Wizard [46]
SEAL	SEAL QQ[18]
HM&S IT-Consulting	SPICE 1-2-1 [20]
HM&S IT-Consulting	SPiCE-Lite Tool [19]
Marc De Smet	SW-CMM v1.1 Interim Maturity Toolkit [17]

All of these tools are developed to support process assessment based on either CMMI or ISO 15504.

2.3. Comparison of Software Process Assessment Tools

In order to compare the tools, all software process assessment tools are tested to download and run. Those which can be run and are downloadable are selected for comparison. After that, the criteria have been determined by taking opinions of experts about process assessment due to the fact that there is no enough study about comparison of software process assessment tools in the literature [24].These criteria are shaped based on the features that a software process assessment tool must have. The following table presents the criteria:

Table 8 List of Comparison Criteria

Criteria Name
Suitability for defining new model
Suitability for performing assessment
Reporting automatically
Guiding assessor
Evaluation of different projects
Suitability for parallel assessment

Suitability for discovery of tool features

The descriptions of each criterion are given as below:

Suitability for defining new model: In order for a software process assessment tool to be flexible, it requires to be used for any kind of process assessment model. This is possible when a tool enables to define new process assessment model and to perform process assessment based on new defined model. Allowing deleting, editing, adding elements of new process assessment model and sorting the elements in a certain order are expected from a software process assessment tool. Moreover, elements of model have to be edited according to ontology of desired process assessment model. For example, another name should be given instead of "practice" or "goal". As a result of this, it will be helpful for those who want to translate the model elements into their own language.

Whether a tool can convert the results of process assessments based on a model to the results of another model is evaluated with this criterion. Transformation of process assessment results into each other and the comparison of results of process assessment based on different process assessment model can be made with the help of a meta-model comprising of all process assessment models. Hence, a decent software process assessment tool has to allow to define new process assessment model with an integrated meta-model.

Suitability for performing assessment: The necessary elements of process assessment model require can be rated, findings can be entered and evidences can be stored in a certain order in a fully functional software process assessment tool.

Reporting automatically: A software process assessment tool has to meet the minimum requirements (assessment date, assessment input, evidences, assessment findings, assessment result profile for each process) for reporting and supporting it with visual items.

Guiding assessor: Self-assessment can be performed by people who are not experts. Namely, the guidance of software process assessment according to process assessment model for assessors will facilitate the feasibility of the tool.

Evaluation of different projects: Process assessment in organizations is performed over multiple projects which are selected via certain sample methods in order to represent the whole organization. Inasmuch as, a software process assessment tool has to allow to evaluate multiple projects in parallel order or in sequence and to amalgamate the results of different project assessments reasonably.

Suitability for parallel assessment: Process assessment in organizations can be performed by multiple teams, as well as it can be performed by a single team. Thus, a software process assessment tool has to enable multiple teams to evaluate multiple projects simultaneously.

Suitability for discovery of tool features: In terms of ease of use, tool features such as starting process assessment, starting process assessment, process assessment, reporting, saving, editing settings of tool has to be found and understood easily by

users. In short, all features that a tool claims to provide with have to be presented clearly to the users. Furthermore, a tool has to provide help to facilitate the discovery of tool features and the visual design has to be user-friendly.

2.3.1. Appraisal Assistant

Appraisal Assistant, developed by Software Quality Institute of Griffith aims to support process assessment based on CMMI and ISO 15504.

Suitability for defining new model: The tool allows defining CMMI or ISO 15504 based process assessment model. The content of elements in a process assessment model is easily added, deleted and edited. However, name of concepts in model can be changed. While defining CMMI based process assessment model, generic goals cannot be associated with capability dimension. Any element of the model is always added as the last element. Therefore, it does not allow new elements among other elements. The tool does not enable the user to determine the number of levels of capability and maturity while defining new process assessment model. In addition, there is no an integrated meta-model in the tool.

Suitability for performing assessment: The tool is designated to perform CMMI and ISO 15504 based process assessment. Practices and goal of processes are rated and strengths and weaknesses can be entered. Practices to be viewed during assessment are not available in part related with process. Thus, there is no space for writing the findings related with practices.

Reporting automatically: Result profile of goals and practices, strong and weak aspects of the assessment, assessment findings, evidences, and assessment inputs can be reported separately.

Guiding assessor: The steps to be followed by assessor such as inserting evidence, entering findings, rating practices, rating goals, rating process area are not presented in correct order to the user. The ways to be followed and process indicator to be monitored are not understood clearly to enter evidence. In addition, it enables to get significant result according to assessment of projects, as well as it allows evaluating each practice for different projects.

Evaluation of different projects: The tool allows the definition of different project teams for an assessment. However, people who are not member of team can continue assessment. This problem may create potential security vulnerability. Moreover, it does not allow team members to perform an assessment simultaneously.

Suitability for parallel assessment: The tool enables defining different teams for a software process assessment. However, it allows people who are not team members to assess processes. This problem can create security gap. In addition, it does not enable team members to assess processes simultaneously.

Suitability for discovery of tool features: The tool does not allow discovering the features about reporting. Furthermore, it enables adjusting easily settings of the tool. However, it requires creating an organization to start an assessment and difficulties were encountered in the discovery of this feature. At the same time, complex structure

of the tools prevents the discovery of the features such as inserting evidence and creating assessment team.

2.3.2. Appraisal Wizard & Model Wizard

Appraisal Wizard and Model Wizard are evaluated in the same title since they are developed to support each other with same infrastructure by same organization. Both tools are developed by Integrated System Diagnostics Incorporated. While Appraisal Wizard developed for process assessment based on CMMI, Model Wizard is developed to create process assessment model based on CMMI.

Suitability for defining new model: A process assessment model which is defined in Model Wizard can be transferred to Appraisal Assistant. It facilitates the creation of a new model with the ability to copy existing models without damaging the existing models. Model Wizard allows adding, editing, deleting the elements of process assessment model. However, all elements in capability dimension have to be entered one by one since the model is not separated as capability and process dimension. This results in serious loss of time. There is no a meta-model in the tool. Although it enables establishing relationship between elements of model, the concepts of model are not seen correctly. For example, defined maturity level seems to be process area.

Suitability for performing assessment: The practices and goals belonging to relevant model are evaluated. Evidences can be entered by looking process indicator.

Reporting automatically: There is no graphic in reports although it has reporting feature in a detailed and summarized way. In addition, there are a lot of unnecessary writings. Moreover, an analysis of assessment is not made according to rating given during assessment.

Guiding assessor: There is nothing about guidance of assessment. Assessors are faced to use about what steps to follow.

Evaluation of different projects: It does not allow assessment of different projects.

Suitability for parallel assessment: Only team members can be determined in the tool.

Suitability for discovery of tool features: The design of tool is not suitable for discovering features of tool.

2.3.3. CMMiPal v1.0

CMMiPal v1.0, developed by Chemuturi Consultancy is used to perform process assessment by matching organization processes to CMMI elements.

Suitability for defining new model: Although it allows adding new elements and editing existing elements of process assessment model, it does not enable these elements to be in certain order. In addition, it is not possible to control operations about adding elements. There is no meta-model in this tool. The name of concepts in process assessment model cannot be changed.

Suitability for performing assessment: It is possible to rate goals and practices during assessment. It allows writing comments, strengths, and weaknesses. However, the processes to be assessed cannot be chosen specifically according to needs of organization. The rating scale is not suitable with CMMI. For instance, there is no equivalent of "Largely Achieved."

Reporting automatically: Even though it enables reporting of processes, goals, practices, and work products, there are only writings in reports and no assessment summary. There is no available assessment input in the tool. Moreover, it does not allow analysis according to ratings. That is, what is written or rated is shown without analysis as it is.

Guiding assessor: Although it warns about choosing an organization in order to start assessment, it does not include any clue about which of the elements such as goals, and practices to start the assessment and how to perform an assessment.

Evaluation of different projects: The tool does not permit defining and choosing the projects involved in assessment.

Suitability for parallel assessment: There is no feature about creating assessment team.

Suitability for discovery of tool features: The tool allows the discovery of features related with making gap analysis and adjusting settings of the tool. There are difficulties about the discovery of other features since the design of the tool is not attractive. It takes a lot of time to discover reporting and process assessment features. When a lot of operation windows are open, it is not easy to find open windows.

2.3.4. CMMI-Quest v1.3 & SPICE 1-2-1

CMMI-Quest v1.3 and SPICE 1-2-1 are examined in the same title because of the fact that they are developed with the usage of same structure by same organization. While, SPICE 1-2-1 is developed to support process assessment based on ISO 15504, CMMI-Quest is developed for CMMI based process assessment. In addition, both tools are developed by HM&S IT-Consulting.

Suitability for defining new model: It does not allow defining new process assessment model. Therefore, it is not possible to perform assessment based on different version of models.

Suitability for performing assessment: It does not allow entering assessment evidences. Apart from this, goals and practices can be rated. Process inputs and outputs can be rated. It is likely to choose processes to be assessed.

Reporting automatically: The results can be seen with graphics in detailed and summarized way, as well as it enables reporting. It allows reporting of findings, comments, process information, result information of process and goals. In addition, the element to be shown in report can be seen.

Guiding assessor: The tool guides assessor about which steps to follow. The steps to be performed are shown with numbers in order to indicate the order of steps. The transition between process areas is easy.

Evaluation of different projects: It allows the assessment of all processes on the base of organization. Furthermore, it does not enable assessment of different projects since it is not possible to add, delete or choose a new project.

Suitability for parallel assessment: There is no feature related with parallel assessment.

Suitability for discovery of tool features: The tool is designated to address the assessor. Settings of tool and assessment can be adjusted clearly by user. The parts to be written are explicit. Saving assessment and getting help are easy since they are shown with clear icons. In help part, there are screen shots supported with descriptions.

This comparison study has been conducted to get an idea about the features of current software process assessment tools. As a result of this comparison, all of the tools have deficiencies at a certain level. 4 level-scales were used in order to evaluate and compare the tools. : "Not Achieved (N)", "Partially Achieved (P)","Largely Achieved (L)", and "Fully Achieved (F)".

Table 9 Comparison Results

Criteria / Tool	**Suitability for new defining model**	**Suitability for performing assessment**	**Reporting Automatically**	**Guiding Assessor**	**Evaluation of different projects**	**Suitability for parallel assessment**	**Suitability for discovery of tool features**
Appraisal Assistant [14]	L	L	**F**	P	**F**	P	P
Appraisal Wizard[15] & Model Wizard[20]	L	**F**	P	N	N	N	N
CMMiPal v1.0[18]	P	L	P	P	N	N	P

CMM-Quest v1.3[19] **&** **SPICE 1-2-1[21]**	N	L	**F**	**F**	N	N	**F**

When all software process assessment tools are compared, Appraisal Assistant which has the most features from those got the best result. Although Appraisal Assistant got the highest score in terms of suitability for defining new model and suitability for performing assessment, there are some problems in defining process assessment model. On the other hand, it comes forward because of reporting feature and supporting different projects. However, it does not meet expectations in terms of parallel assessment and discovery of tool features. Among other software process assessment tools, while CMM-Quest v1.3 and SPICE 1-2-1 are good at guiding assessor, reporting automatically, discovering tool features, Appraisal Wizard and Model Wizard are only suitable for performing assessment. When these software process assessment tools are examined as a whole, no tool has the expected features completely.

CHAPTER 3

THE TOOL: GSPA

This chapter presents the constructed meta-model for creating process assessment model and uses case diagram that displays the functions of the tool. After that, the use cases are explained in detail with use case scenarios.

3.1. Meta-Model

Meta-model consists of classes representing concepts and their relationships to show the connection between classes[47]. There should be a single meta-model which can be created with combination of multiple models in the process assessment tool [48]. By combining the structure of the most common models, it can be benefited from multiple process assessment models. That is, the inadequate parts of a process assessment model can be compensated with the powerful side of other models. This will also help organizations improve their processes more accurately than competitors in market [49]. Therefore, we focused on establishing a meta-model by integrating two most known process assessment models which are CMMI and ISO 15504. In order to create a meta-model from CMMI and ISO 15504, we drew class diagrams of these two models, and then integrated them into one model.

Firstly, we drew class diagram of CMMI in order to understand the relationship between concepts in CMMI. The following figure points out the class diagram of CMMI:

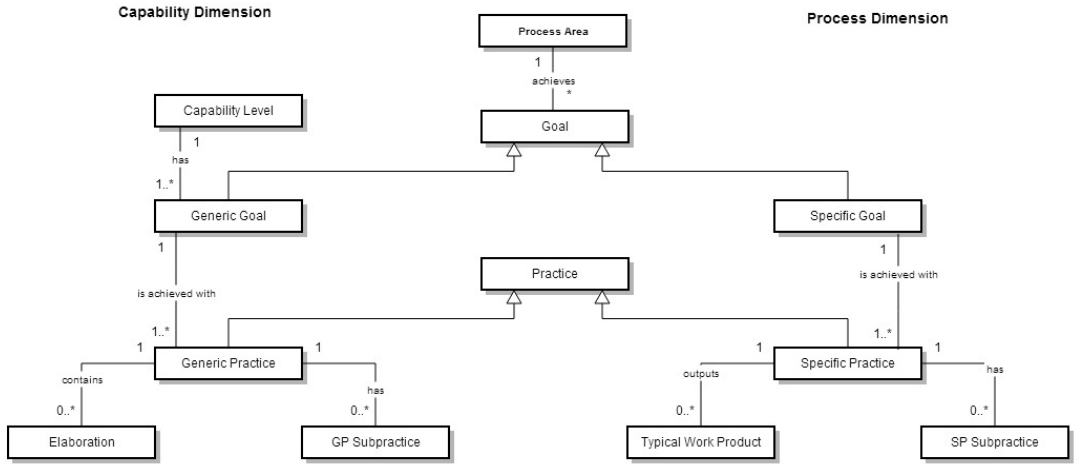

Figure 6 CMMI Class Diagram

Secondly, we drew the class diagram of ISO 15504 so as to grasp the relationships between concepts in ISO 15504. The following figure shows the class diagram of ISO 15504:

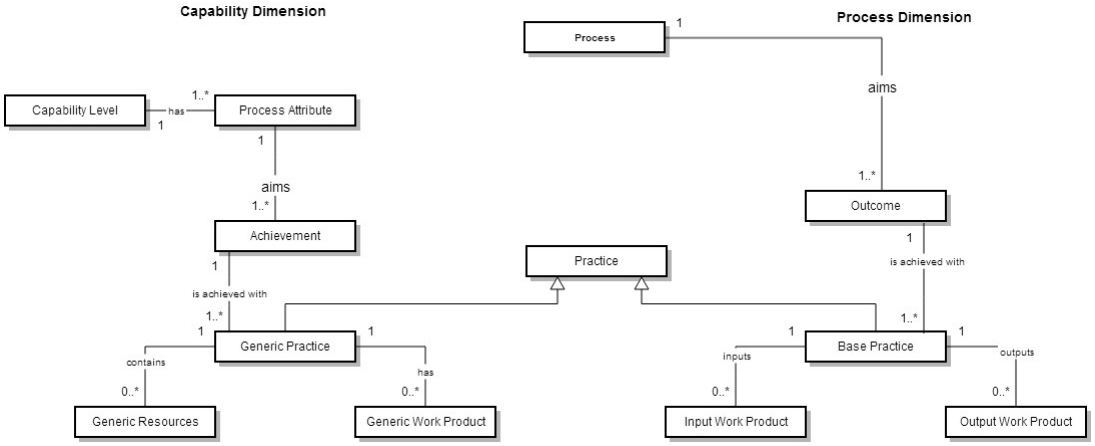

Figure 7 ISO 15504 Class Diagram

Then, we integrated CMMI and ISO 15504 concepts in order to create CMMI based or ISO 15504 based process assessment model. To integrate, we benefited from the study of Bella *et al.* to match up with between CMMI concepts and ISO 15504 concepts [50]. Then, we renamed the common concepts for our meta-model.

Based on the study of Bella *et al.*, we used following table for mapping [50].

Table 10 Mappings of CMMI, ISO 15504 and Meta-Model

CMMI	**ISO 15504**	**Meta-Model**
Process Area	Process	Process
Specific Goal	Process Outcome	Specific Outcome
Specific Practice	Base Practice	Specific Practice

Subpractice	-	Subpractice
Typical Work Product	Output Work Product	Output Work Product
Generic Goal	Process Attribute	Generic Attribute
Generic Practice	Generic Practice	Generic Practice
Generic Practice Elaboration	-	Generic Practice Elaboration
-	Generic Resource	Generic Resource
Capability Level	Capability Level	Capability Level
-	Generic Work Product	Generic Work Product
-	Input Work Product	Input Work Product

After mapping the process assessment models, we integrated process assessment models and created following meta-model.

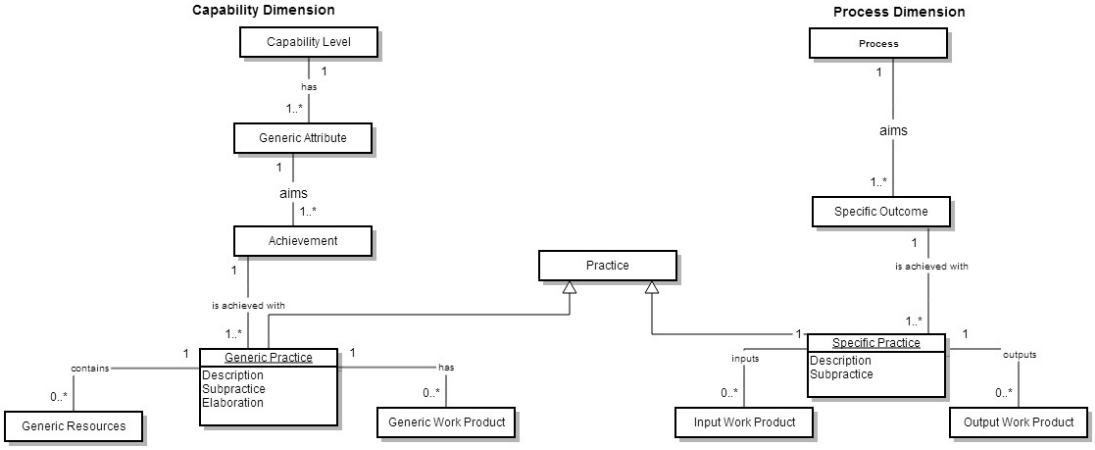

Figure 8 Integration of CMMI and ISO 15504

Finally, we added rating framework and categorization concepts to the meta-model because we aimed to perform assessment based on new created process assessment model from the meta-model.

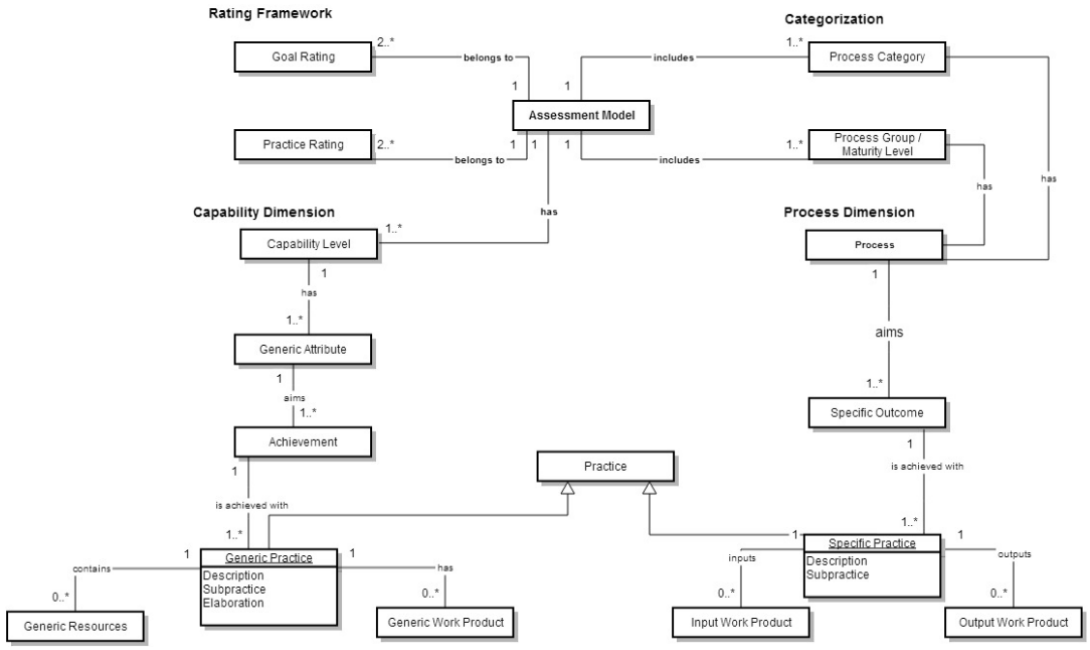

Figure 9 Meta-Model

3.1.1. Meta-Model Components

The meta-model created with the integration of CMMI and ISO 15504 have important concepts. While most of them are mandatory, some of them are not compulsory in creating new process assessment model. In this meta-model, we extended the meta-model by adding Rating Framework and Categorization to Capability Dimension and Process Dimension. This section explains the components of meta-model.

3.1.1.1. Process Dimension

In the process dimension, processes and the components belongs to processes are determined to achieve the specific outcomes of process.

Process: It is a collection of relevant and interacting activities. It is the most important part of process assessment since they are evaluated and aimed to have the highest capability during process assessment.

Specific Outcome: The processes particularly aim to achieve specific outcomes. That is, at the end of the activities related to process, the specific outcomes are supposed to obtain so that the purposes of process can be reached. Therefore, the specific outcome is an observable consequence of the process.

Specific Practice: In order to reach the specific outcomes, specific practices are performed. In other words, a specific practice is an activity to obtain specific outcome(s).

Input Work Product: It is an input resource used for reaching specific outcome when performing process activities.

Output Work Product: It is an indicator that is obtained after achieving specific outcome.

3.1.1.2. Capability Dimension

Capability Dimension has generic components to measure the capability of processes in terms of determined process attributes or goals.

Capability Level: At the end of process assessment, the capabilities of process are measured and labeled with a capability level which is a point having certain range.

Generic Attribute: It is the generic property for each process in order to measure the capability of process.

Achievement: In order to reach the purposes of generic attribute, achievement must be obtained at the end of performing each process. Inasmuch as, it is an observable result of process attribute.

Generic Practice: In order to reach the achievements of generic attribute, generic practices are performed. Namely, a generic practice is an activity to obtain achievement(s).

Generic Resource: It is an input resource used for reaching achievement of generic attribute while performing process activities.

Generic Work Product: It is an indicator that is obtained after achieving achievement.

3.1.1.3. Rating Framework

Rating framework is necessary in order to measure capability of processes during process assessment.

Goal Rating: Generic Attributes are rated in accordance with whether a process has a related attribute completely or not. Based on ratings about goals, the capability of process is measured.

Practice Rating: Practices are rated in order to evaluate them for reaching goals. Based on practice ratings, the goal rating is determined during the assessment.

3.1.1.4. Categorization

In CMMI and ISO 15504, processes are categorized to find more meaningful results. In the tool, this part is combined with process dimension since this part defines only the category or group of processes.

Process Category: It is used to categorize the processes. Process category indicates the same type of processes.

Process Group/Maturity Level: It is used to group processes or indicate the maturity level to which a process belongs.

3.2. Use Case Diagram

After creating meta-model, we drew use case diagram to develop a generic software process assessment tool for supporting various type of process assessment model. Use case diagram is shaped according to these purposes since the main purpose of the tool is to create process assessment model and perform process assessment based on the created process assessment model. Then, use case scenario is explained for each use case.

Figure 10 Use Case Diagram

3.2.1. Manage Record

As it is seen from figure 10, all elements of model are manageable. Namely, all elements can be added, edited, or deleted since all management use cases include “Add”, “Edit”, “Delete”. Because the use cases related with management use same interface and algorithm, all management uses cases are explained in three use case scenario in order to prevent the duplication of the same sentences. The elements are explained as “Record” in three use case scenario “Add Record”, “Edit Record”, “Delete Record”. The

only difference between the records is the information which will be entered or displayed.

3.2.1.1. Add Record

Table 11 Add Record Scenario

Use Case:	1
Priority	Essential
Description	This feature will allow the assessor to add related record.
Actor(s)	Assessor
Precondition(s)	Actor should start the creation of process assessment model.
Basic Path	1. Actor clicks the "Next" button during the creation of process assessment model. 2. System displays the related management page. 3. Actor clicks “Add” button. 4. System activates related page to add. 5. Actor enters necessary information and clicks “Save” button. 6. System asks the actor “Do you want to save this record”. 7. Actor selects “Yes”. 8. System adds the saved record to list and shows the related list.
Alternate Path	7.a. If Actor clicks “No” Button, Basic Path continues with step 2.
Post condition(s)	Actor added a record.
Exception Path	5.a. If there is already added record with the entered information, system gives an error message ”The record has been already added” and Basic Path continues with step 3. 5.b. If actor enters invalid character, system gives an error message “You entered invalid character.” and Basic Path continues with step 3. 5.c. If administrator does not enter the information indicated with “*”, system gives an error message “You should fill the information indicated with “*” and Basic Path continues with step 3.

Reference	Figure 13 Process Category Figure 14 Process Group Figure 15 Process Figure 16 Outcome Figure 17 Base Practice Figure 18 Input Work Product Figure 19 Output Work Product Figure 21 Capability Level 2 Figure 22 Process Attribute Figure 23 Achievement Figure 24 Generic Practice Figure 25 Generic Practice Elaboration Figure 26 Generic Resource Figure 27 Generic Work Product Figure 28 Practice Rating Scale Figure 29 Goal Rating Scale

3.2.1.2. Edit Record

Table 12 Edit Record Scenario

Use Case:	2
Priority	Essential
Description	This feature will allow the assessor to edit a record.
Actor(s)	Assessor
Precondition(s)	Actor should start the creation of process assessment model.
Basic Path	1. Actor selects a record 2. System shows selected record information 3. Actor clicks “Edit” button.

	4. System activates information entry. 5. Actor enters necessary information and clicks “Save” button. 6. System asks “Do you want to save this record”. 7. Actor clicks “Yes” button. 8. System updates information and displays the list.
Alternate Path	N/A
Post condition(s)	Actor edited the record.
Exception Path	1.a. If actor does not select a record to update and click “Edit” button, system gives an error message “Select a record” and Basic Path continues with step 1. 5.a. If administrator enters invalid character, system gives an error message “You entered invalid character.” and Basic Path continues with step 5. 5.b. If administrator does not enter related information, system gives an error message “You should enter related information” and Basic Path continues with step 5. 5.c. If there is already added another user with the new entered record, system gives an error message ”The record has been already added” and Basic Path continues with step 4.
Reference	Figure 13 Process Category Figure 14 Process Group Figure 15 Process Figure 16 Outcome Figure 17 Base Practice Figure 18 Input Work Product Figure 19 Output Work Product Figure 21 Capability Level 2 Figure 22 Process Attribute

	Figure 23 Achievement Figure 24 Generic Practice Figure 25 Generic Practice Elaboration Figure 26 Generic Resource Figure 27 Generic Work Product Figure 28 Practice Rating Scale Figure 29 Goal Rating Scale

3.2.1.3. Delete Record

Table 13 Delete Record Scenario

Use Case:	3
Priority	Essential
Description	This feature will allow the assessor to delete related element.
Actor(s)	Assessor
Precondition(s)	Actor should start the creation of process assessment model.
Basic Path	1. System displays element list. 2. Actor selects the element to be deleted. 3. System displays element information. 4. Actor clicks “Delete” button. 5. System asks “Do you want to delete this record”. 6. Actor clicks “Yes” button. 7. The system removes the element and updates the list.
Alternate Path	5.a. If Actor clicks “No” Button, Basic Path continues with step 2.
Post condition(s)	Actor deleted record.
Exception Path	3.a. If actor does not select a record to delete and click “Delete” button, system gives an error message “Select a record” and Basic Path continues with step 2.
Reference	Figure 13 Process Category Figure 14 Process Group

	Figure 15 Process Figure 16 Outcome Figure 17 Base Practice Figure 18 Input Work Product Figure 19 Output Work Product Figure 21 Capability Level 2 Figure 22 Process Attribute Figure 23 Achievement Figure 24 Generic Practice Figure 25 Generic Practice Elaboration Figure 26 Generic Resource Figure 27 Generic Work Product Figure 28 Practice Rating Scale Figure 29 Goal Rating Scale

3.2.2. Create Process Assessment Model

Table 14 Create Process Assessment Model Scenario

Use Case:	4
Priority	Essential
Description	This feature will allow Assessor to create Process Assessment Model.
Actor(s)	Assessor
Precondition(s)	Actor(s) should run the system.
Basic Path	1. Actor adds related element for process assessment model. 2. System displays added elements in the list. 3. Actor clicks “Next” Actor repeats steps 1-3 until indicates “Finish” 4. System saves created process assessment model to database.

Alternate Path	N/A
Post condition(s)	The assessor created process assessment model.
Exception Path	*. If Actors enter invalid character for any elements of process assessment model, system gives an error message "You entered invalid character." and Basic Path continues with step 1 by showing related labels with "*". 5.b. If Actors do not enter necessary Information, system gives an error message "You should enter the information" and Basic Path continues with step 1 by showing related element labels with "*".
Reference	Figure 12 Create Process Assessment Model

3.2.3. Prepare for Assessment

Table 15 Prepare for Assessment Scenario

Use Case:	5
Priority	Essential
Description	This feature will allow Assessor to prepare for assessment.
Actor(s)	Assessor
Precondition(s)	Actor(s) should run the system.
Basic Path	1. Actor selects "Process Assessment Model" from list of process models. 2. System displays "Processes" belonging to selected process assessment model inside the "Prepare" tab. 3. Actor selects "Processes" to be assessed. Then, actors go to "Project" tab. 4. System displays project management part. 5. Actor enters Project Information ("Name", "Project Manager", "Start Date", "End Date", "Type of Project", "Technologies used", "Customer", "Number of Employee", "Cost", Description) and clicks "Add" button. 6. System adds the project to project list and shows the project list.
Alternate Path	N/A
Post condition(s)	The assessor prepared the assessment.
Exception Path	5.a. If Actors enter invalid character for project information, system gives an error message "You entered invalid character." and Basic Path continues

	with step 4 by showing “Name” labels with “*”. 5.b. If Actors do not enter Name, system gives an error message “You should enter “Name” and Basic Path continues with step 4 by showing “Name” labels with “*”.
Reference	Figure 31 Prepare Processes Figure 32 Prepare Projects

3.2.4. Fill during Assessment

Table 16 Fill during Assessment Scenario

Use Case:	6
Priority	Essential
Description	This feature will allow Assessor to fill findings and rate necessary elements during assessment.
Actor(s)	Assessor
Precondition(s)	Actor(s) should prepare the assessment.
Basic Path	1. Actor clicks “Fill in” tab. 2. System displays “Processes” and “Projects” selected for process assessment, process assessment model contents. 3. Actor selects “Project” to be assessed. 4. System updates the screen according to project information. 5. Actor selects “Process” to be assessed 6. System displays information about selected process for selected project. 7. Actor selects “Generic Attribute”. 8. System shows the process attribute elements which are “Notes”, “Strengths”, “Improvements”, ”Weaknesses”, Base or Generic Practices Ratings and Findings, “Work Products” and “Evidences”. 9. Actor enters findings and rates practices and generic attribute. Actor repeats steps 7-9 for each Generic Attribute. Then goes to step 5 and repeats steps 5-9 for each process. Then goes to step 3 and repeats step 3-9 for

	each project. 10. Actor selects “All” for merging project evaluations. 11. System displays merged assessment findings and ratings. 12. Actor rates each practice and generic attribute.
Alternate Path	N/A
Post condition(s)	The assessor filled assessment findings and rated practices and generic attributes.
Exception Path	N/A
Reference	Figure 33 Fill In 1 Figure 34 Fill In 2

3.2.5. Analyze

Table 17 Analyze Scenario

Use Case:	7
Priority	Essential
Description	This feature will allow Assessor to see assessment results with graphics.
Actor(s)	Assessor
Precondition(s)	Actor(s) should fill findings and rate practices and goals during assessment.
Basic Path	1. Actor selects “Analyze” tab. 2. System demonstrates graph list. 3. Actor selects the type of graph. 4. System displays the selected graph.
Alternate Path	N/A
Post condition(s)	The assessor analyzed the assessment results.
Exception Path	N/A
Reference	Figure 35 Analyze Process Attribute Graph Figure 36 Practice Graph Figure 37 Capability Level Graph

3.2.6. Report

Table 18 Report Scenario

Use Case:	8
Priority	Essential

Description	This feature will allow Assessor to report the assessment results.
Actor(s)	Assessor
Precondition(s)	Actor(s) should fill findings and rate practices and goals during assessment.
Basic Path	1. Actor selects “Report” tab. 2. System displays “Assessment Information” and “Organization Information” in the “Report” tab. 3. Actor enters Assessment Information(“Assessment Sponsor”, “Assessment Purpose”, “Assessment Team”, “Assessment Weaknesses/Strengths”) and Organization Information (“Name”, “Department”, “Contact Person”, “Phone”, “Address”, “Context”). Then, actor clicks “Generate” button. 4. System displays “Report” in “.rtf “extension.
Alternate Path	N/A
Post condition(s)	The assessor reported the assessment results.
Exception Path	5.a. If Actors enter invalid character for assessment information or organization information, system gives an error message “You entered invalid character.” and Basic Path continues with step 2 by showing related labels with “*”. 5.b. If Actors do not enter necessary information, system gives an error message “You should enter the necessary information” and Basic Path continues with step 4 by showing related labels with “*”.
Reference	Figure 38 Report

CHAPTER 4

APPLICATION OF GSPA

This chapter presents the application of GSPA in a multiple case study setting. Section 4.1 explains multiple case study in detail. Firstly, the research questions raised for this study are indicated. Then, the case study design is explained in detailed way. After that, how case studies are conducted for this study is clarified. Then, data collection procedure is elucidated with instruments used for collecting data. Finally, the analysis is explained in this section.

4.1. Multiple Case Study

We have conducted multiple case study in order to measure the efficiency of the tool on supporting various process assessment models such as CMMI, ISO 15504, and Agility Assessment model. Multiple case study is suitable for this study since we need to examine more than one phenomena. With multiple case studies, our aim is to carry out certain number of assessment based on certain number of process assessment model in order to generalize our results about whether the tool supports different kinds of process assessment models or not.

4.1.1. Research Questions

In order to determine the research questions, we carried out extensive literature review and interviews with experts. Firstly, we investigated the necessary features that a software process assessment tool must have to perform process assessment and published a paper explaining necessary features in detailed way [24]. These features are obtained by making interview with experts. As a result of this research, we aimed to develop a tool having this features. Hence, the following research question is firstly investigated in this study.

RQ1: To what extent is the tool sufficient in meeting expected features?

Then, in order to find the impact of the tool in process assessment, the following research question is raised.

RQ2: What are the advantages of an automated generic software process assessment tool?

After that, the following research question is examined to find the weakness of the tool that will play an importance role to improve the tool.

RQ3: What are the weaknesses of the proposed tool?

4.1.2. Case Study Design

The literature review has been conducted in order to determine the existing process assessment models at the beginning of this study. This step is very important to measure how the tool supports different process assessment models. The world-wide databases have been scanned to find the existing process assessment models. The most common two process assessment models and one new created model based on at least one of these common models are selected in order to evaluate the supporting level of the tool on different kinds of process assessment model. While choosing the most common process assessment models, we considered the number of process assessment models derived from them. We chose the models whose structures are used mostly by process assessment models. In addition to these two common models, we chose a model using same structure with these models, but having different concepts. The reason of choosing a process assessment model having same structure and different concepts is to show how flexible the tool in supporting process assessment models.

After that, the available assessors who are experts about related process assessment model are determined. These assessors should have either at least one year experience about process assessment or complete Software Quality Management Course, one of the course of Informatics Institute program with grade AA(90/100).

In order to answer the research questions, assessment examples related to determined process assessment models are chosen by assessor. In order to measure the suitability for performing assessment, the assessment example has to include evidences, ratings and comments or notes about assessment. Furthermore, assessment example has to include a detailed report to contrast the assessment results and measure the automatic reporting level of the tool. Also, at least two different projects have to be examined to create assessment example so that the feature about evaluation of different projects can be measured. Purposiveness and availability of the assessment examples from those which meets the conditions are also regarded in selecting assessment examples because of security issues.

In order to find the advantages of a generic software process assessment tool when compared to traditional assessment, discover weaknesses of the proposed tool that can be guidance for improvement studies in the future and to measure the sufficiency of the tool in meeting expected features, the tool is used for creating a process assessment model and performing assessment based on the created model. Firstly, the process assessment model that assessment example is based on are created with the tool. Then, the assessment is repeated by assessor who is expert on related process assessment model and took an active role during assessment which constitutes the assessment example.

This case study design is used for each case since it is suitable for conducting the case study for each case.

4.1.3. Case Study Conduct

Process assessment models listed in Table 19 are found at the end of literature review. Agile Maturity Model, Scrum Maturity Model, Brazilian Software Improvement uses the structure of CMMI. Therefore, CMMI is the first selected process assessment model for our study. ISO 15504 is the second selected process assessment model since Automotive SPICE, Edu SPICE, Enterprise SPICE, and Medi SPICE are created based on ISO 15504. That is, since CMMI and ISO 15504 are the most wide-spread process assessment models and many process assessment models are based on them, CMMI and ISO 15504 are chosen. If CMMI and ISO 15504 are defined and assessments based on them are performed in the tool, its derivatives such as Auto SPICE, Medi SPICE, Enterprise SPICE, Scrum Maturity Model and Extreme Programming Maturity Model can also be defined and supported with the tool. In addition to this, Agility Assessment Model, created for measuring the agility of organizations was determined since it uses same structure with ISO 15504 and different concepts.

Table 19 List of Process Assessment Models

Model Name
Agility Assessment Model[28]
Agile Maturity Model [29]
Automotive SPICE [4]
Brazilian Software Improvement [7]
CMMI [1]
Edu SPICE [6]
Enterprise SPICE [30]
Extreme Programming Maturity Model [31]
ISO 15504[2]
Medi SPICE [5]
Scrum Maturity Model [32]
Team SPICE [33]
Test Maturity Model [34]

After choosing process assessment models, three assessors are specified. Two of the assessors have at least three years working experience in process assessment and one of them is a graduate student who took Software Quality Management Course and got AA from the course.

Then, one assessment example is found for each process assessment model. These examples are determined according to conditions that are explained in case study design. As a result of this, the assessors chose an available process assessment example meeting necessary conditions. The assessment example based on CMMI consists of two process areas which are “Project Planning” and “Organizational Training” and three projects were examined to perform this assessment. The other assessment example is related with ISO 15504 which includes one process named as Quality Assurance and two projects. The last determined assessment example is based on Agility Assessment

Model and two aspects which are “Exploration” and “Transition” are assessed and two projects are examined for this process assessment.

Then, assessors who are experts on related process assessment model performed the assessment with the tool to find answer our research questions. The necessary steps are not told to the assessors. They are only told to create a process assessment model and perform process assessment based on it. They completed the assessment by applying the following steps:

1- Create process assessment model
2- Choose created process assessment model
3- Select Processes to be assessed
4- Define Projects
5- Start assessment to assess processes
6- Assess process one by one for each project
    a. Enter findings and evidences
    b. Rate practices and goals
7- Choose all to merge projects
8- Rate practices and goals
9- Go to “Analyze” step to see all graphics.
10- Report the assessment
    a. Enter Assessment Information
    b. Organization Information

4.1.4. Case Description

Each case product is selected and assessed in accordance with multiple case study design. This section explains the detailed characteristic of each case.

4.1.4.1. Case 1

Assessment example about ISO 15504 is an assessment performed for Software Quality Management course, one of the courses of Informatics Institute program. In the course, each group is supposed to choose a process and assess the capability of the chosen process. Therefore, the case consists of ISO 15504 based assessment including one process. In this case, the chosen process by the assessor is “Quality Assurance”. Therefore, “Quality Assurance” process is defined in the tool. Then, the results in assessment example are entered to the tool. The assessment example was obtained by assessing an organization having CMMI Level 3 certificate. In the organization, there are 100 employees. The example includes findings about all practices and evidences and the ratings of process attributes. The assessment result of quality assurance process shows that its capability level is third capability level. That is, the process is established. While all process attributes until third capability level are rated as “Fully Achieved”, two process attributes which are process measurement attribute and process control attribute are partially achieved for quality assurance process. In assessing processes, two projects are used.

4.1.4.2. Case 2

The second assessment example chosen by assessor who has been working intensively about process assessment related with CMMI and ISO 15504 for six years is based on

CMMI. The assessor chose this assessment example since it is the last formal CMMI assessment that assessor performed. In CMMI, while some processes are assessed according to organizational findings, projects are examined to measure the capability of some processes. Therefore, two processes are chosen. While one of them is organization based, the other one is project based. The chosen process assessment example was obtained at the end of assessing processes of an organization. The organization in which assessment is performed is working on defense industry and the total number of employee is 55. Three projects were assessed in order to measure the capabilities of processes. The numbers of employee in projects are 16, 7, and 10 respectively.

The chosen processes from assessment example are Project Planning and Organizational Training. Whereas project planning belongs to project management category, organizational training belongs to process management category. The example contains evidences, observation notes, findings, ratings of practices and goals. The assessment results yields out that all practices of both processes are rated as fully implemented for three levels. Therefore, the goals with which practices are associated are rated as satisfied. As a result of this assessment, the organization received certificate of CMMI level 3.

4.1.4.3. Case 3

The third assessment example is Agility Assessment Model, a new created model by using same structure with ISO 15504 and different concepts with it. This was chosen from an assessor having three year-experience on CMMI assessment and being one of the creators of Agility Assessment Model.

There are two dimensions which are the aspect dimension and agility dimension in Agility Assessment Model. While the aspect dimension includes five aspects which are Exploration, Construction, Transition, Management and Culture, there are four agility levels from 0 to 3 in agility dimension.

The assessment example is obtained by assessing a government organization developing web based applications and having 60 employees. Since the organization aims to get CMMI certification, CMMI project is conducted in the organization. Furthermore, the organization has ITIL (Information Technology Infrastructure Library) certification. Agility of five aspects is measured in the organization. These measurement shows that two aspects which are Exploration and Transition have adhoc level, other aspects have not implemented level in terms of agility. From these aspects, we selected exploration and transition aspects since they have more meaningful and suitable findings and results. In addition, two projects are used for this process assessment.

4.1.5. Data Collection

Data for each case study is obtained by making interview with each assessor about the tool. The data is based on the ideas of the assessor about the tool. In addition, during assessment, observations and think aloud process are implemented so that the results can be more accurate.

4.1.5.1. Interview

Interview was conducted with assessors in order to find the sufficiency of the tool in meeting expected feature, find the contribution of the tool to process assessment and discover weaknesses of the proposed tool that can be guidance for improvement studies in the future.

In order to find how sufficient the tool is, 4 rating scale questions (Not Achieved, Partially Achieved, Largely Achieved, and Fully Achieved) were asked for each feature and then related "why" question was asked to assessor to learn the reasons of answer and validate the answer to rating scale question. After finishing the questions about features, the question prepared for finding the difference between automated based and paper-based assessment was asked. Then, the question related to effort was asked. These two questions are very important to find the contribution of the tool to process assessment. Afterwards, a general question is asked to learn the strong and weak sides of the tool in detailed way. The interview questions are structured since it is easy to code them and generate theme. During interviews, the researcher was careful not to ask lead-in questions in order to provide interview to be valid. One question at a time was asked to the interviewee. In order to provide the reliability, the questions were asked in another way according to flow of interview.

4.1.5.2. Observation and Think Aloud

In order to get more accurate results, it is important to observe the case when it occurs. Therefore, we observed the assessor while they are using the tool for especially measuring the capability of the tool. By doing so, we could record everything about the usage of the tool. In addition, assessor thinks aloud in order to understand the feelings and thoughts of assessor. With the help of think aloud process and observation, the validation of answers to interview was be provided. During observation and think aloud processes, notes are taken in order to find answer especially for first research question which investigates how sufficient the tool is in meeting determined features.

4.1.6. Data Analysis

The qualitative data analysis was conducted for this study. It was based on content analysis which facilitates the analysis of interview answers and observation notes. The content analysis is used to see the integrated and summarized way of the content of text or speech by transforming raw data into meaningful categories or themes to answer research questions[51]. In this phase, the data was coded in order to find answer the research questions. Then, themes based on research questions were generated. Subsequently, codes were organized according to themes. The following figure shows the data analysis procedure in detail.

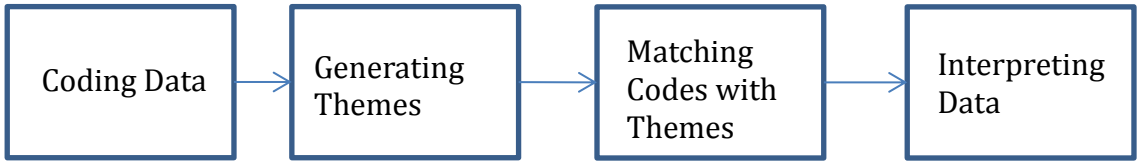

Figure 11 Data Analysis Procedure

Coding Data: This is the initial part to analyze the data and it is necessary to get more meaningful results. The important things are expressed with meaningful concepts. These codes are determined from interview and observation in the way that answers research questions.

Generating Themes: It is important to find the similar properties of each code so that they can be easily understood. That is, the codes are grouped in same themes. Therefore, the themes are generated according to research questions. Nine themes were determined for this study: (1) suitability for defining new model, (2) suitability for performing assessment, (3) reporting automatically, (4) guiding assessor, (5) evaluation of different projects, (6) suitability for parallel assessment, (7) suitability for discovery of tool features, (8) advantages of the tool, (9) weaknesses of the tool.

Matching Codes with Themes: This is very important step to establish meaningful relationship between themes and codes. Codes should be matched with themes in order to find related answer for specific research question.

Interpreting Data: The relationship of the codes and themes with research questions is expressed.

4.1.7. Validity Threads

There are some threads in terms of validity and reliability in this study. In order to deal with these threads which can be faced during or after conducting case studies, some precautions are taken before starting multiple case study.

In order to provide construct validity, the case study design and interview questions are reviewed by two experts. In addition, the construct validity is obtained by using multiple instruments including participant observations and interviews. We compare the findings in these instruments. This also increased the internal validity. Internal validity can be affected seriously by time. If case study takes too much time, the assessor cannot concentrate on the study and can give short answer to interview questions. These can make difficult to find the causes which can be an answer to research questions. Therefore, the interview questions are asked by changing the structure of questions again. This also prevented misunderstanding possibility of questions for assessors.

External validity is very important in order to generalize the results. Therefore, the sampling carries vital importance to represent the population. In this study, purposive sampling was used for determining assessor and assessment examples. That is, assessors and assessment examples are selected based on pre-defined criteria. In addition, the main purpose of carrying out multiple use case study is to generalize the results. Moreover, replication of same case study can be done since all cases are designed in the same way. During case study, to prevent external validity threads which can send away the assessor from main purpose of this study, the main steps are determined and indicated to assessor before using the tool. In addition, replication is

provided with the help of tool since it directs assessor in the way that is explained in case study conduct section.

In addition to these, the data analysis was performed by the person who designed and conducted this study. The results interpreted at the end of data analysis are reviewed by assessors who performed assessments in order to provide the reliability of data analysis.

CHAPTER 5

RESULTS

This chapter presents the findings and discusses the results for each case. The findings from interviews and observations are presented in this chapter.

5.1. Case 1

The tool is designed properly with the structure of ISO 15504. Hence, ISO 15504 process assessment model was easily defined in the tool. All elements belonging to ISO 15504 could be defined completely. The relationship with outcome and achievement were established for necessary elements such as base or generic practice. All elements in ISO 15504 were easily added, edited or deleted. Both capability dimension and process dimension were defined independently. In addition, the tool enabled to determine the number of capability level. Moreover, the model elements were not mixed with each other since there was high cohesion and low coupling between model elements.

All base practices and generic practices could be rated in ISO 15504. All findings and observation notes were entered for each practice to the tool. In addition, evidences were entered for each process attribute. Also, all process attributes were rated.

There were the detailed and summarized information about assessment in the report. Furthermore, the ratings of practices and process attributes, entered evidences, and findings for each project were seen in the report. However, there was only one reporting template in the tool.

The tool provides guidance to the assessor with buttons and texts. The assessor could perform ISO 15504 assessment by following necessary steps. In addition, the tool supports the evaluation of different projects. Also, the different projects could be merged and the reasonable result could be obtained by combining evaluation of different projects. However, there was no feature supporting parallel assessment in the tool.

It was easy to discover the feature of the tool while defining process assessment model and performing assessment. The buttons and descriptions helped the assessor use properties of the tool.

The assessor rated seven features as follows:

Table 20 ISO 15504 Rating Results

Feature	Rating
Suitability for defining new model	Fully Achieved
Suitability for performing assessment	Fully Achieved
Reporting Automatically	Largely Achieved
Guiding Assessor	Fully Achieved
Evaluation of different projects	Fully Achieved
Suitability for parallel assessment	Not Achieved
Suitability for discovery of tool features	Fully Achieved

The advantages of the tool to process assessment for ISO 15504 are listed below:

- The information about ISO 15504 was provided systematically so that there was not any time losing for searching the necessary elements.
- The effort was decreased with the tool because of its analysis and reporting feature.

The weaknesses of the tool are listed below:

- There was only one reporting template to obtain assessment results.
- The tool did not warn about the missing definitions.
- The user interface was not satisfactory enough.

5.2. Case 2

The bottom and top level of CMMI capability dimension were determined with the tool. In addition, Generic Goal, Generic Practice, Specific Practices were defined in the tool. However, the work products were associated with Generic Goals instead of Generic Practices. Furthermore, both capability dimension and process dimension were defined.

During assessment, it was not possible to enter evidences for each practice. Instead, the evidences were entered for only goals. Fortunately, each goal and practice was rated. The observation notes taken by assessor during assessment were entered for each practice to the tool. While generic goals were evaluated for each process area, it was not easy to evaluate generic goals as a whole.

CMMI evaluation results were seen as detailed and summarized in the report. Moreover, the ratings of generic practices and goals obtained from each project and findings and observation notes were seen regularly in the report. The report contains everything including assessment input and organization information. The reports were changed after generation since the type of the report was rich text file.

While defining CMMI, it was observed that there was no explanation about the maximum character for element abbreviation. Furthermore, there was no information about which elements are necessary for defining process assessment model. However, the assessor understood which steps to follow and perform assessment according to these steps.

In the tool, three different projects were defined for process assessment and the assessment was performed for each project. However, it was not possible to perform parallel assessment since there was no feature about it. In terms of discovery of tool features, the assessor did not face with any problem. All buttons and text areas were used when it was necessary.

The assessor rated seven features as follows:

Table 21 CMMI Rating Results

Feature	Rating
Suitability for defining new model	Fully Achieved
Suitability for performing assessment	Largely Achieved
Reporting Automatically	Fully Achieved
Guiding Assessor	Fully Achieved
Evaluation of different projects	Fully Achieved
Suitability for parallel assessment	Not Achieved
Suitability for discovery of tool features	Fully Achieved

The advantages of the tool to process assessment for CMMI are listed below:

- The data about CMMI process assessment model were hold systematically.
- Assessment results were saved relationally.
- The reporting feature helped assessor gain %20-%30 of her time.

The weaknesses of the tool are listed below:

- The user interface was not satisfactory enough.
- There was no evidence area for each practice and general area for assessing generic goal.

5.3. Case 3

All elements in Agility Assessment Model except for fallacy were defined by using the tool. Elements in the model could be added, edited and deleted easily. The names of concepts in the model could be changed. The elements in the model could be associated with each other. For example, generic practice was matched with related aspect attribute. In addition, the elements in the model could be matched with achievement or outcome. Capability levels were easily determined. Information about elements belonging to Agility Assessment Model could be entered in detailed way via the tool. The general model structure the tool supports was suitable for Agility Assessment Model. Furthermore, capability and agility dimension could be defined independently and compatibly with each other. However, it did not allow all elements in a process attribute in one step. Instead, all elements belonging to all aspect attributes should have been defined one by one. For example, all achievements in the model should have been defined and the next step should have been passed. Therefore, it took more time than expected.

All aspect attributes and practices could be rated with the help of the tool. Weaknesses and strengths could be entered for each aspect attributes. The evidences which were

found during assessment could be entered with type information to the tool easily. Notes and findings could be entered as text for each practice. However, there was no area to write everything during assessment. Instead, text areas for writing strengths or weaknesses were used for this purpose.

The results were demonstrated with graphics in detailed and summarized way. Moreover, assessment inputs and organization information were seen properly in the report. The report also included notes and ratings regularly for each practice and aspect attribute.

While the tool allowed the definition of elements in Agility Assessment Model in a certain order, there was no explanation whether it was necessary to define model element or not. In addition, the steps to be followed by assessor were enumerated. However, there was no guidance about if it was necessary to merge all projects after entering assessment findings for each project. The steps such as entering findings and evidences, entering and rating practices and aspect attributes were clearly understood and followed by assessor.

Two different projects defined in preparation step of assessment were assessed separately and brought together and then the practices and aspect attributes were rated based on evaluation of the two different projects. On the other hand, there was no feature to create assessment team and allow different teams to perform assessment.

The assessor faced some usability problems while using the tool. Definition of bottom and top level were not clear to determine capability level range. In the tool, it was asked to determine which aspect attribute represents process dimension and assessor was expected to select one aspect attribute. However, this property was not understood by the assessor. The elements in Agility Assessment Model were listed with their abbreviation but there was no explanation indicating that they were listed with their abbreviation. In addition, discovering model creation feature at the beginning was a little bit difficult for assessor since there was no tree view explaining model structure in detail.

The assessor rated seven features as follows:

Table 22 Agility Assessment Model Rating Results

Feature	**Rating**
Suitability for defining new model	Fully Achieved
Suitability for performing assessment	Fully Achieved
Reporting Automatically	Fully Achieved
Guiding Assessor	Largely Achieved
Evaluation of different projects	Fully Achieved
Suitability for parallel assessment	Not Achieved
Suitability for discovery of tool features	Partially Achieved

The advantages of the tool to process assessment for Agility Assessment Model are listed below:

- The assessment was performed easily because of guidance feature of the tool.

- The access and regulation of the evidences were easier with the tool.
- Everything was clear during assessment so that every step and entry could be made successfully.
- The reporting feature helped assessor to gain %20-%25 of her time.
- The internal consistency of Agility Assessment Model was measured with this tool.
- The compatibility with the structure of ISO 15504 was checked with the tool.

The weaknesses of the tool are listed below:

- Special model concepts such as fallacy could not be added.
- The explanations and descriptions were not satisfactory enough.
- There was no detailed tree view explaining the model structure.
- There was no visible free text area while performing assessment.

CHAPTER 6

DISCUSSION AND CONCLUSION

This chapter presents the discussion about results for each research question, the conclusion of the study and displays the future study plans.

6.1. Discussion

RQ1: To what extent is the tool sufficient in meeting expected features?

The following table obtained during interview explains the sufficiency level of the tool in meeting expected features.

Table 23 Feature Results

Feature/Process Assessment Model	**Agility Assessment Model**	**ISO 15504**	**CMMI**
Suitability for defining new model	**Fully Achieved**	**Fully Achieved**	**Fully Achieved**
Suitability for performing assessment	**Fully Achieved**	**Fully Achieved**	Largely Achieved
Reporting Automatically	**Fully Achieved**	Largely Achieved	**Fully Achieved**
Guiding Assessor	Largely Achieved	**Fully Achieved**	**Fully Achieved**
Evaluation of different projects	**Fully Achieved**	**Fully Achieved**	**Fully Achieved**
Suitability for parallel assessment	Not Achieved	Not Achieved	Not Achieved
Suitability for discovery of tool features	Largely Achieved	**Fully Achieved**	**Fully Achieved**

Suitability for defining new model: Although there are some concepts which are not defined as desired in the tool for both Agility Assessment and CMMI, all necessary concepts are defined for both model. While defining Agility Assessment Model, only

fallacy which does not affect the process assessment seriously could not be defined. In addition, example work products are defined but not matched with practices during the definition of CMMI. This can be solved by giving appropriate name such as "SP 1.1 Example Work Product 1" for example work product. In terms of definition of ISO 15504, the assessor does not face any problem by using the tool. Therefore, the suitability for defining new model is rated as "Fully Achieved".

Suitability for Process Assessment: During assessment, all necessary elements are rated and findings are entered for especially Agility Assessment Model and ISO 15504. Even if all evidences are entered during CMMI assessment, the evidences are not matched with practices. Therefore, maintaining assessment is sometimes hard for assessor.

Reporting Automatically: The tool enables to report automatically for each assessment. It includes all necessary information for the three models. However, there is no supplementary feature for determining what will be shown in reporting. Nevertheless, the content of report can be changed after the report is generated since its format is rich text file.

Guiding Assessor: The tool guides assessor during both creation of process assessment model and process assessment even if some steps such as merging projects are not understood easily.

Evaluation of Different Projects: In the tool, different projects are defined, assessed and merged to obtain meaningful result for each process assessment model.

Suitability for Parallel Assessment: Since the tool does not allow parallel assessment, the assessment is not performed parallelly by different teams for each process assessment model.

Suitability for discovery of tool features: Although discovering tool features are rated as "Fully Achieved" by CMMI assessor and ISO 15504assessor, Agility Assessment Model Assessor rated as "Largely Achieved" since she sometimes faces the problems such as understanding concepts and merging projects.

As it is seen from the table, all features except suitability for parallel assessment are rated as "Fully Achieved" by at least two assessors. Especially, the main purpose of this study which is to create different process assessment models is met with the property of suitability for defining new model. This shows that our meta-model works completely without any problem. In addition, the supporting level of the functionality of the tool is measured with the features which are suitability for performing assessment, reporting automatically, and evaluation of different projects. The results related with these features show that the tool supports all kind of process assessment models during assessment in terms of functionality. Furthermore, guiding assessor and suitability for discovery of tool features are very important in terms of especially usability. While there are little problems for process assessment models derived from ISO 15504 of CMMI, the tool is used easily for CMMI and ISO 15504. The results of this study show that the tool meets expected features almost completely for all features expect for parallel assessment.

RQ 2: What are the advantages of an automated generic process assessment tool?

The multiple case study results show that the tool has enormous advantages for process assessment. They are listed as:

- The internal consistency of newly created process assessment models can be validated with this tool by matching each indicator such as practice or work product with outcome or achievement.
- The compatibility of newly created process assessment model with ISO 15504 or CMMI can be measured by comparing model concepts with the meta-model created by integrating ISO 15504 and CMMI.
- Since the information about newly created process assessment model are shown systematically, the assessors gain significant time by not losing time within the pages of technical report defining process assessment model.
- The reporting feature helps assessor gain 20-25 percent of their time during process assessment.
- Performing assessment is easier with the help of guidance feature of the tool.

RQ 3: What are the weaknesses of the proposed tool?

The multiple case study demonstrates that the tool has some insufficient points but these points are not that important. In other words, the functionality of the tool is not deteriorated by these weaknesses. We summarize the weaknesses as below:

- There are some concepts such as fallacy that cannot be defined as desired with the tool.
- The user interfaces are not attractive enough.
- Explanations and descriptions about determining process dimension attribute and level satisfaction point, and merging projects are not satisfactory enough.
- There is no error control mechanism in the tool.
- It is not suitable for parallel assessment.

6.2. Conclusion

In this study, GSPA, generic software process assessment tool is proposed to support the process assessment based on various process assessment models and examined the sufficiency and contribution on process assessment with multiple case study. Firstly, the literature was scanned systematically to find the process assessment models and existing software process assessment tools. Then, the existing tools are examined in terms of sufficiency for supporting different process assessment models. In the light of previous studies about software process assessment tools, GSPA is determined to develop to find answer problems that organizations face for process assessment. In order to support different process assessment models, a meta-model for GSPA was constructed with the integration of the two most common process assessment models which are CMMI and ISO 15504. Then, the requirements for a software process assessment tool are explained with use case diagram and use case scenarios. After that, multiple case study is conducted to provide the validation of GSPA on supporting various process assessment models with determined criteria and find the contributions and weaknesses of the tool.

The study results show that the tool fulfills the requirements of 6 of 7 expected features satisfactorily. Therefore, the proposed generic process assessment tool is successful in

doing almost all properties. In addition, it has many advantages for process assessment in terms of gaining time, creating process assessment model, validating process assessment model, performing process assessment based on different process assessment models even if it has some weaknesses that do not affect the functionality of the tool.

6.3. Future Work

The result of this study reveals that there is still a need to develop generic process assessment tool for parallel assessment. Hence, the functionality of the tool will be extended by adding the feature for parallel assessment even if the tool meets other expected features. That is, different teams can perform process assessment at the same time.

The user interface of the tool will be improved so that it will be more user-friendly. Then, usability studies will be conducted to measure the usability of the tool in detailed way.

There are some weaknesses of the tool related with definition of some new concepts, understandability of explanations and descriptions, and user interfaces even though these weaknesses are not significant. As a further research, the weaknesses of the tool will be improved. For that purpose, creating process assessment model will be more flexible by allowing adding new concepts and establishing the relationship between concepts. For example, fallacy can be added for Agility Assessment Model. In addition, various reporting template will be added so that the tool can attract more users. Furthermore, the explanations and descriptions in the tool will be revised. Moreover, the tool will track the assessor and warn if s/he makes a mistake. Moreover, a video tutorial will be prepared to increase the usability of the tool.

Finally, the tool will be transferred to web and allow organizations to perform process assessment via the tool and data about the organizations will be collected for various process assessment models, especially for Agility Assessment Model. By doing so, the benchmarking of current software organizations can be done based on a specific process assessment model.

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APPENDICES

APPENDIX A: Screen Shots

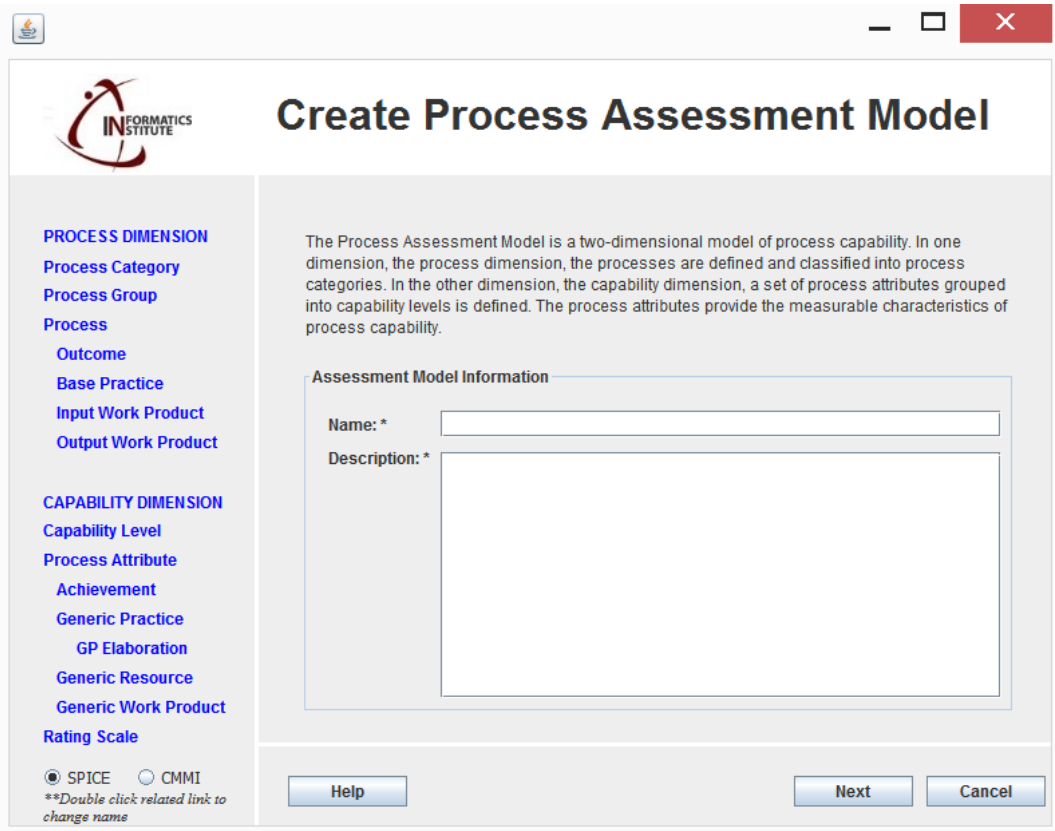


Figure 12 Create Process Assessment Model

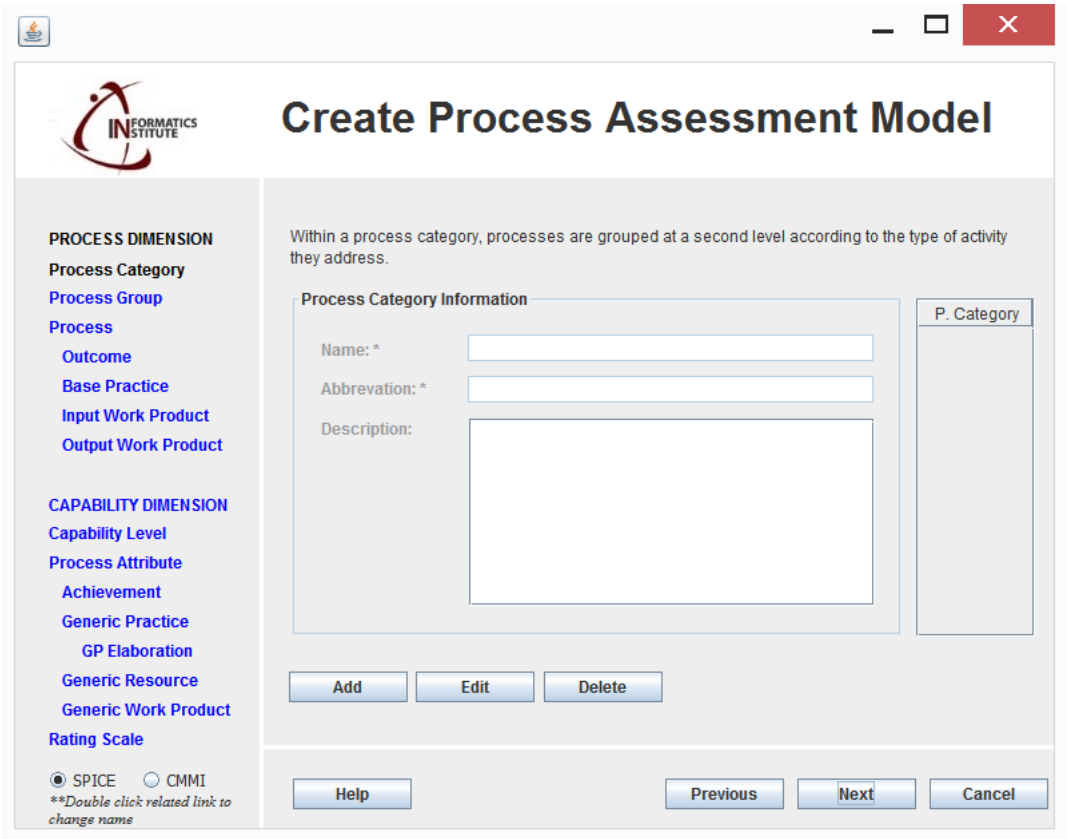


Figure 13 Process Category

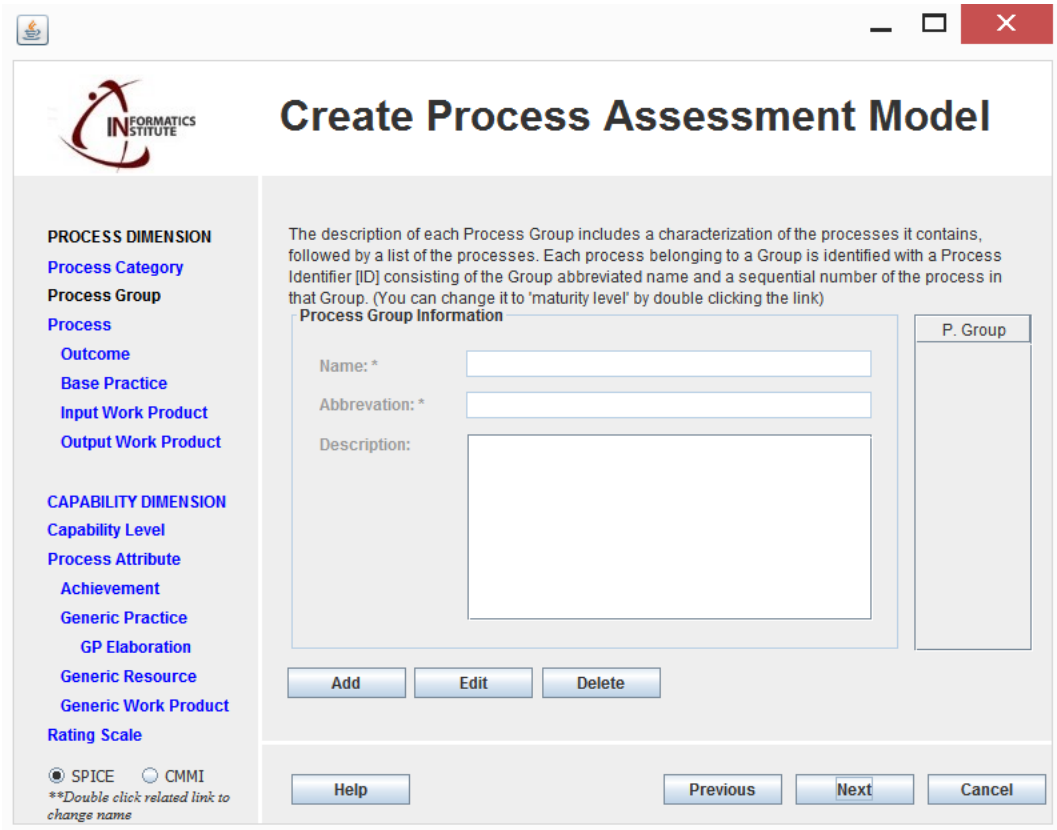


Figure 14 Process Group

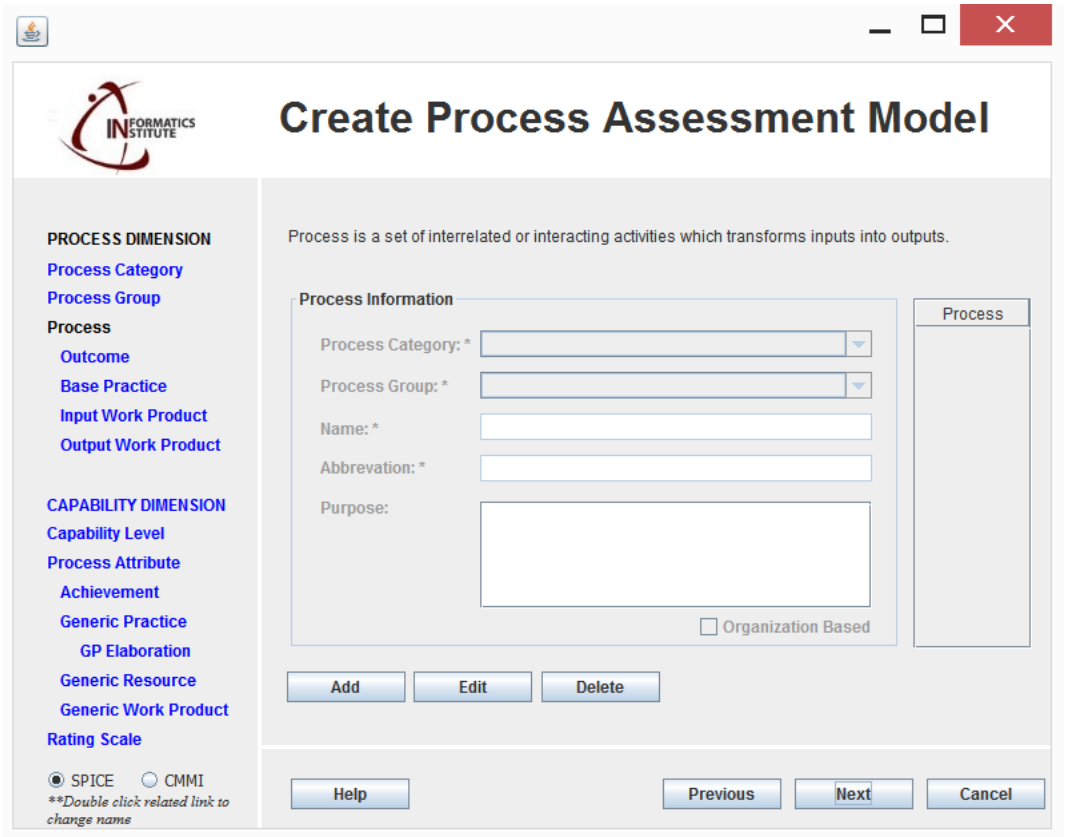


Figure 15 Process

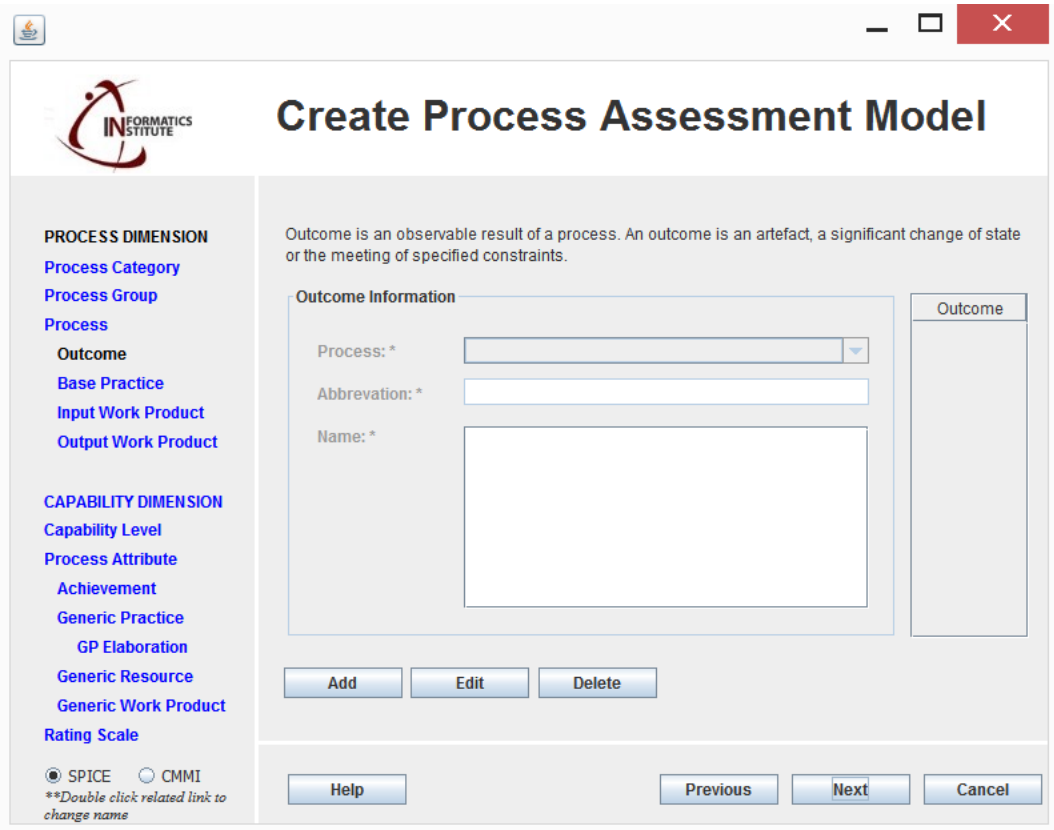


Figure 16 Outcome

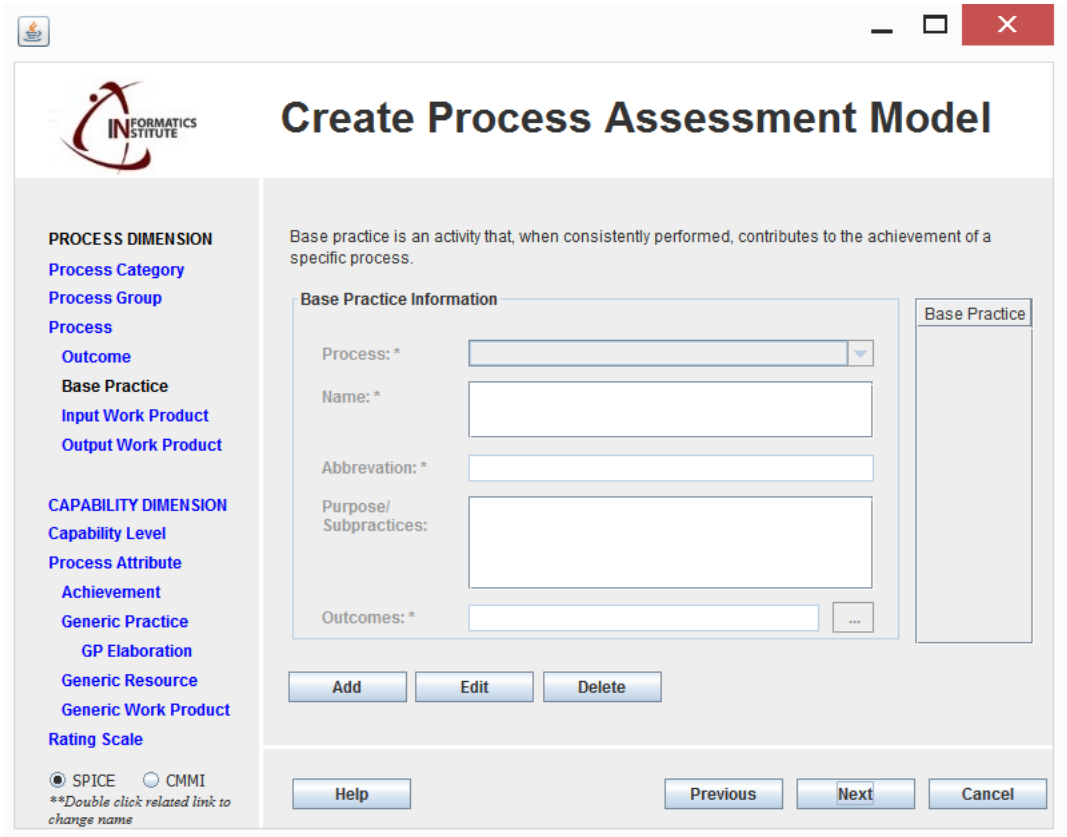


Figure 17 Base Practice

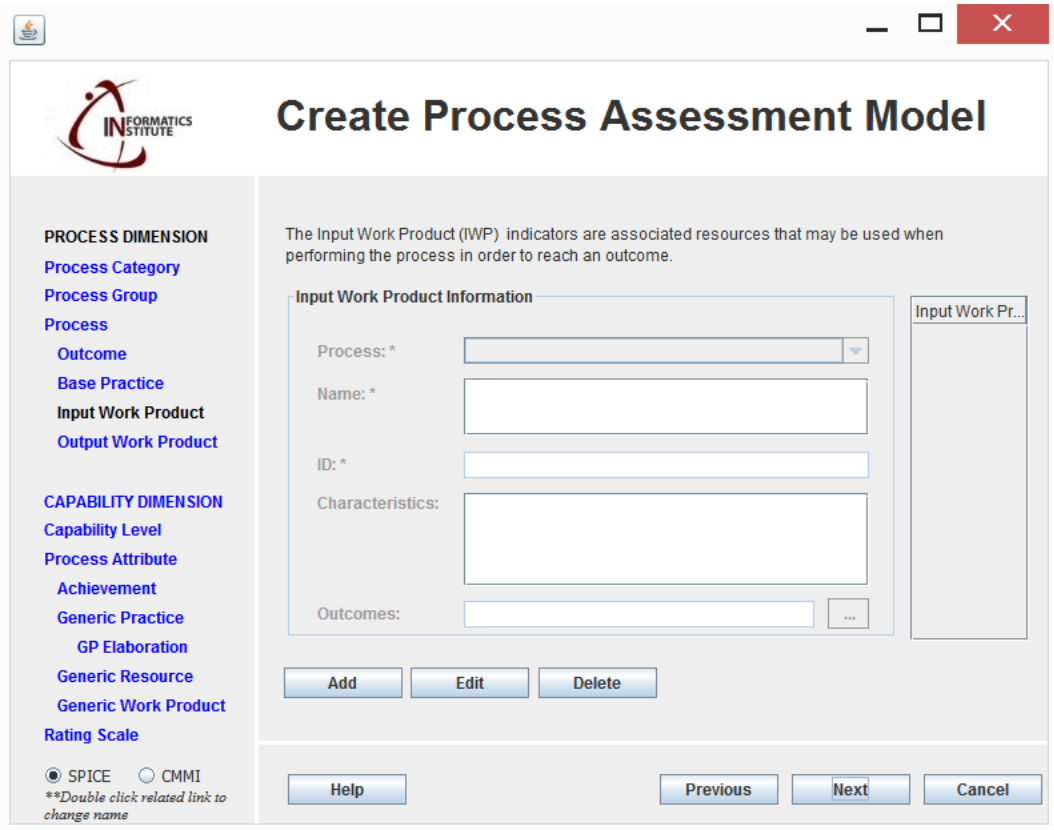


Figure 18 Input Work Product

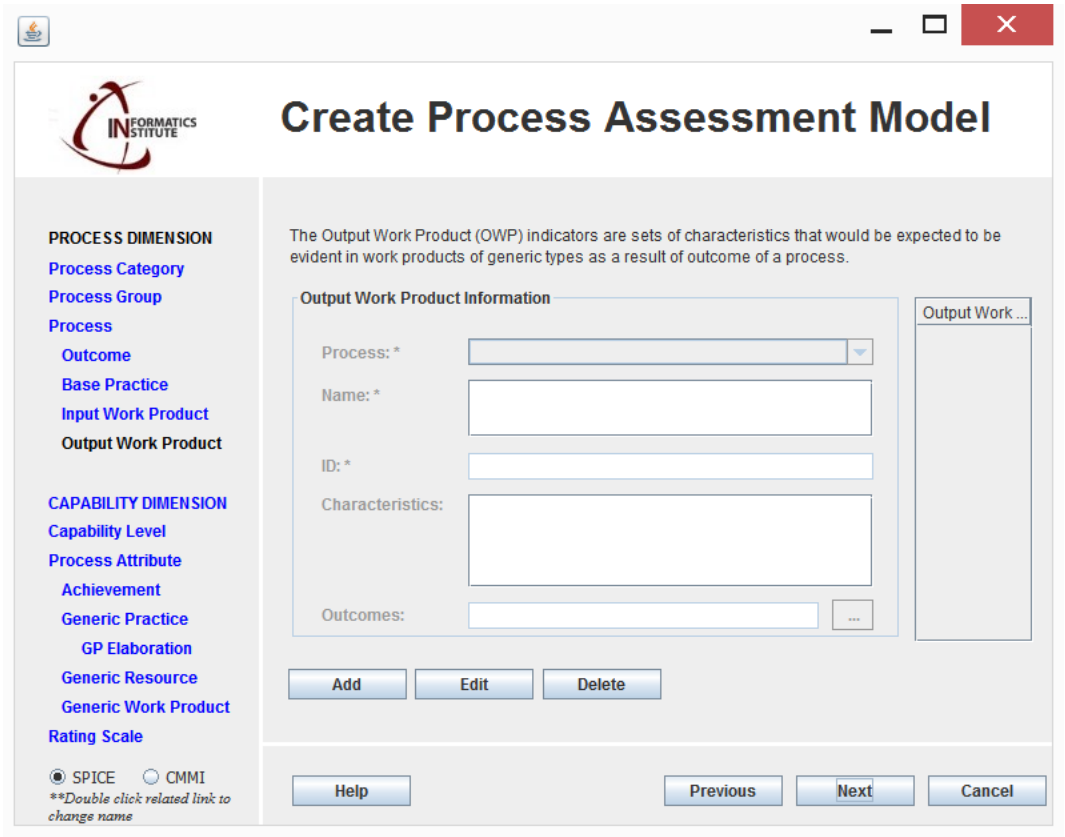


Figure 19 Output Work Product

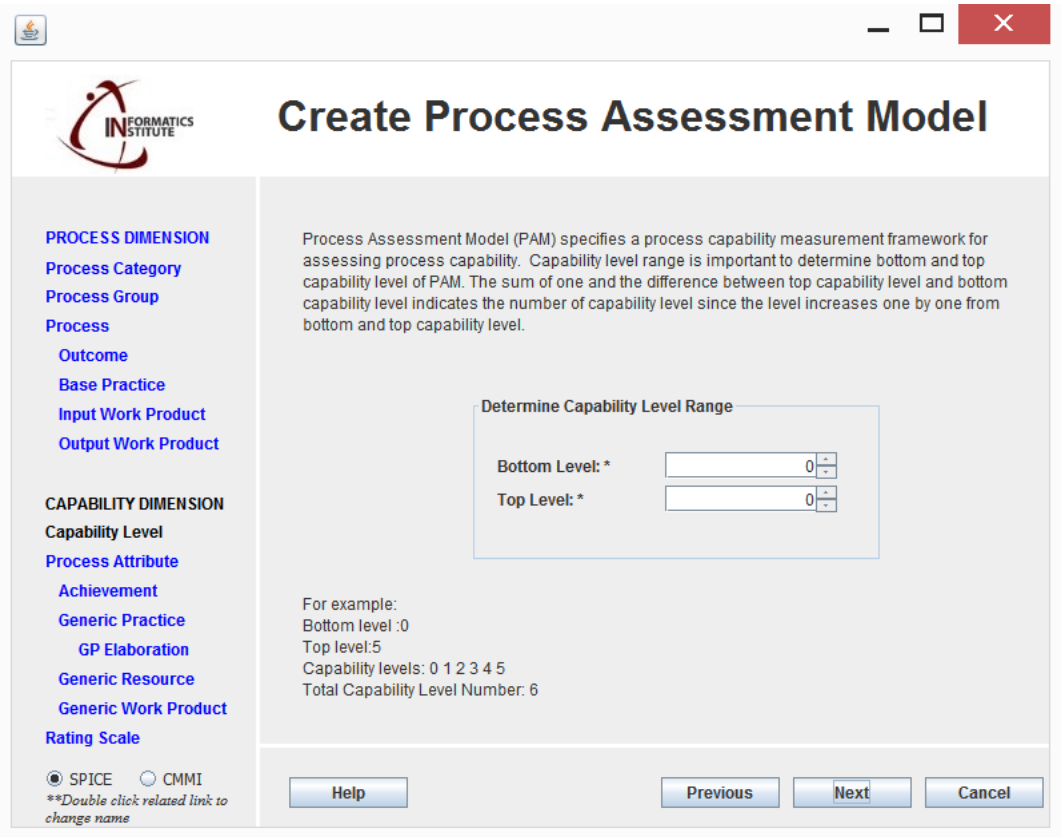


Figure 20 Capability Level 1

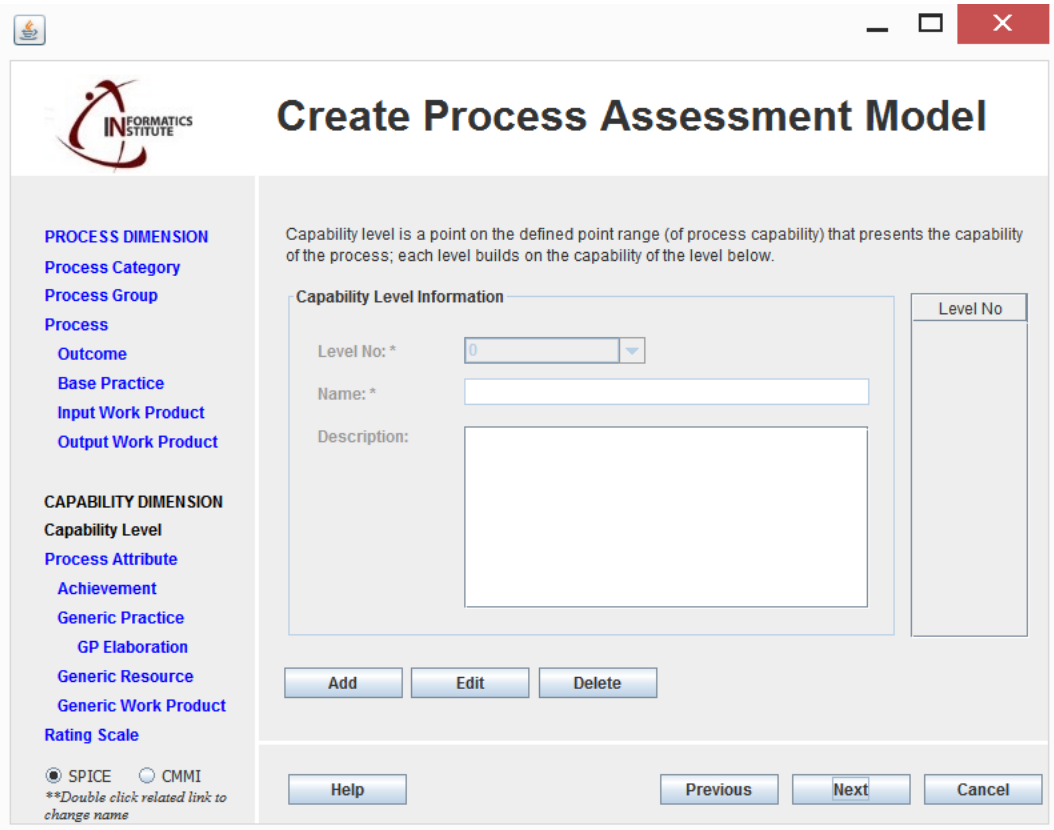


Figure 21 Capability Level 2

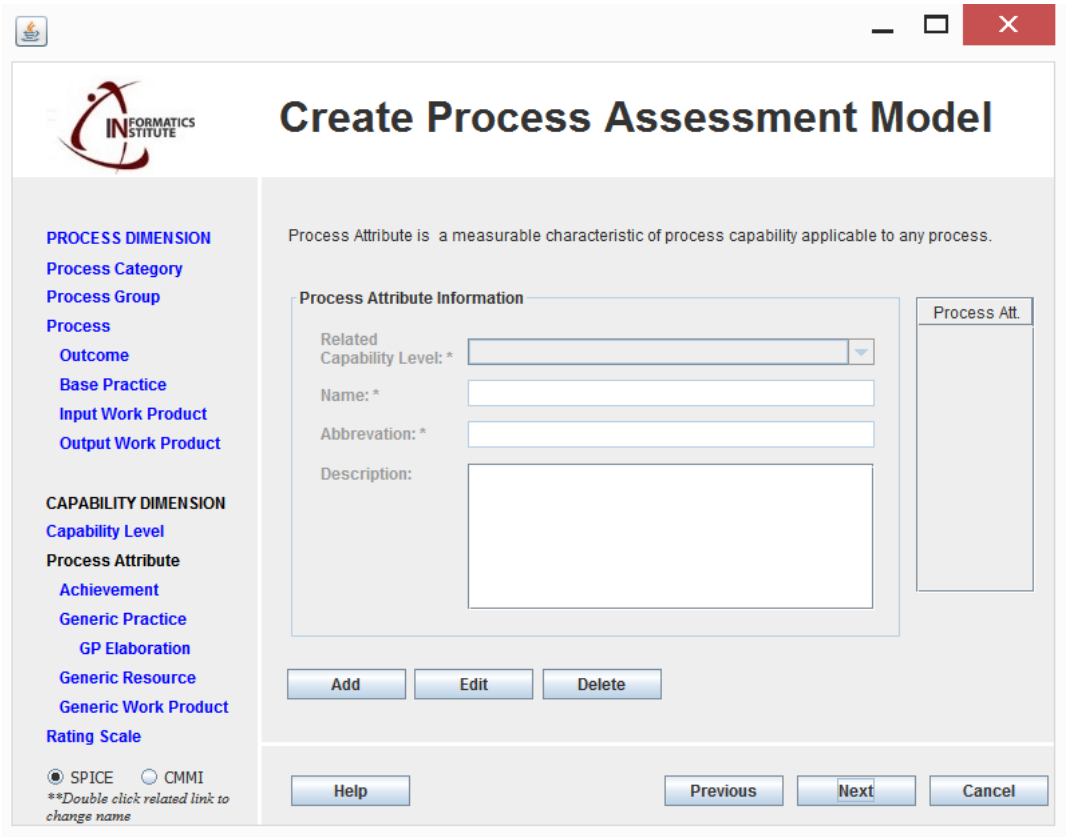


Figure 22 Process Attribute

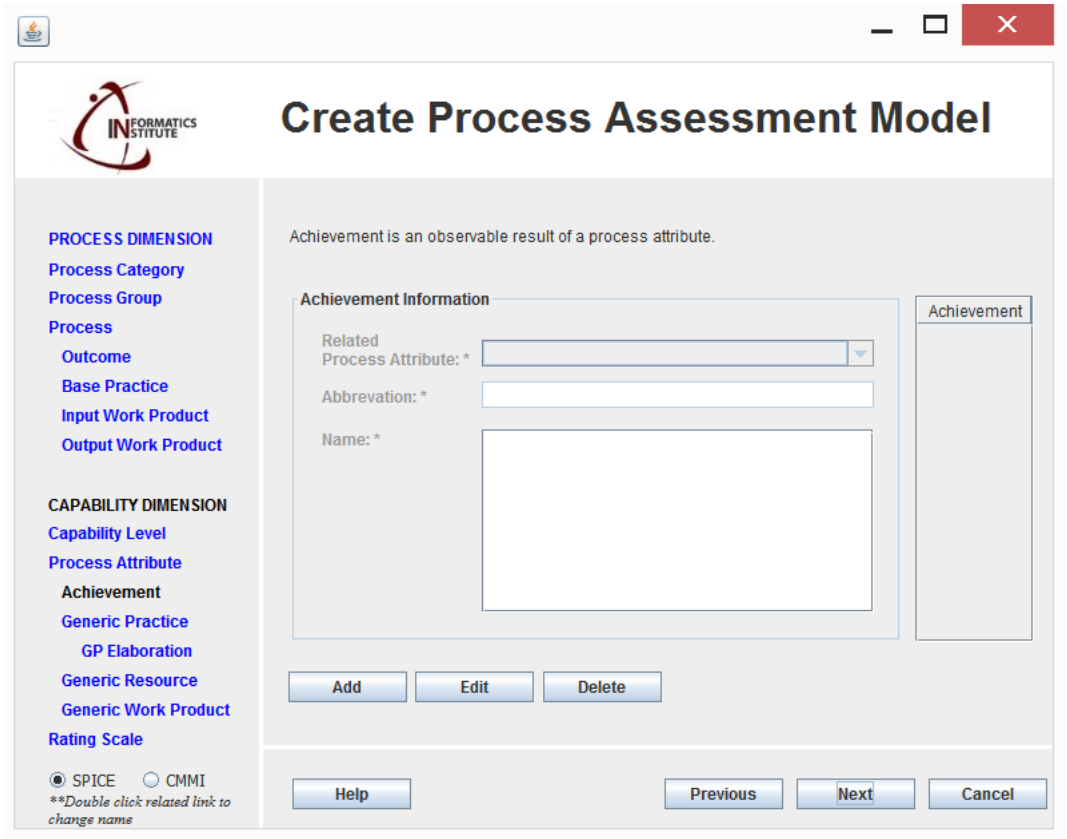


Figure 23 Achievement

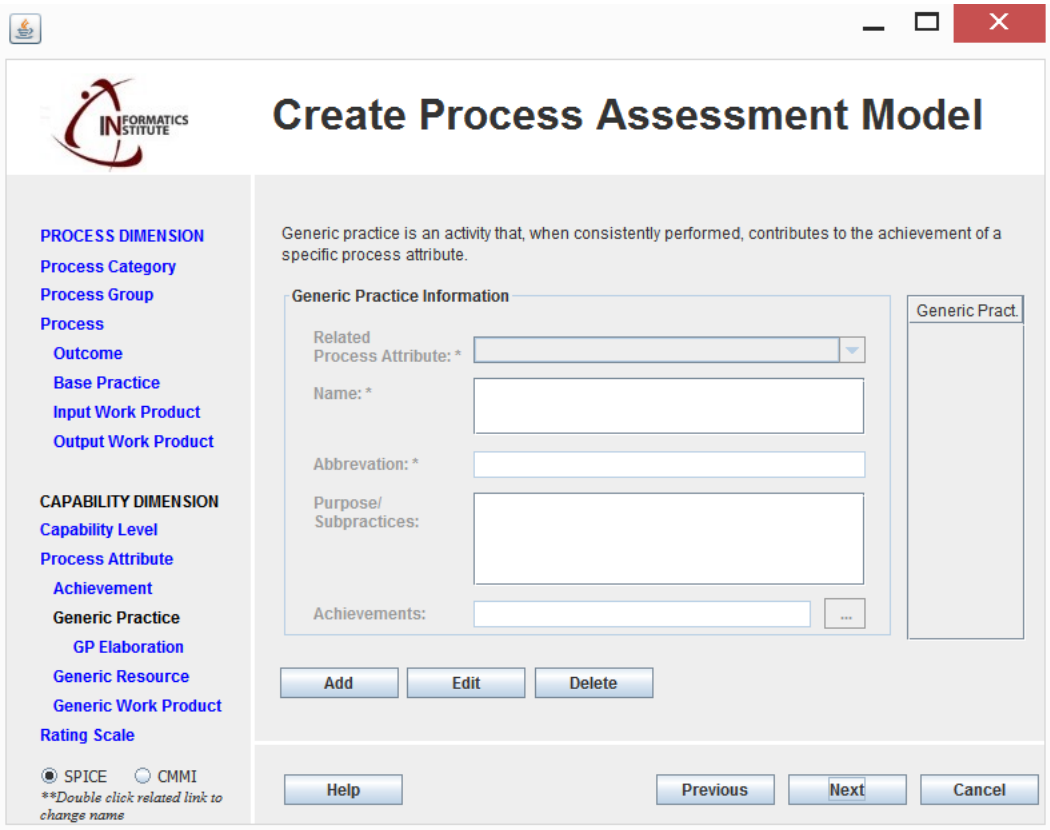


Figure 24 Generic Practice

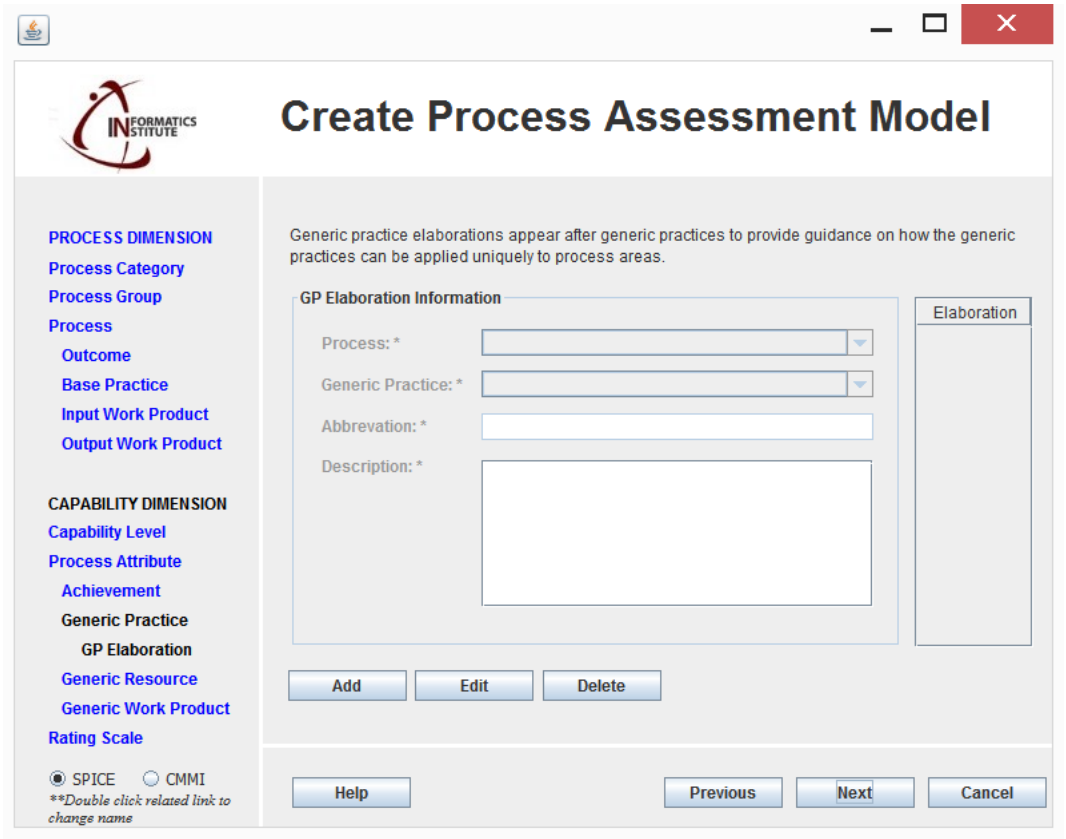


Figure 25 Generic Practice Elaboration

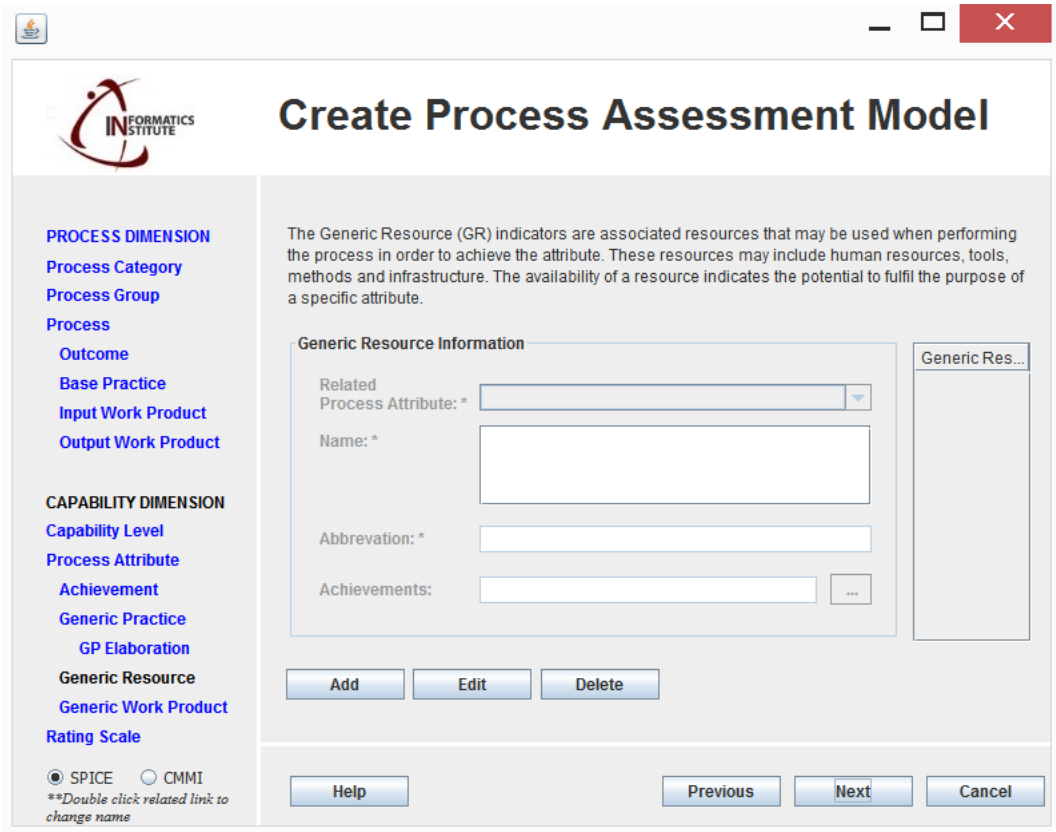


Figure 26 Generic Resource

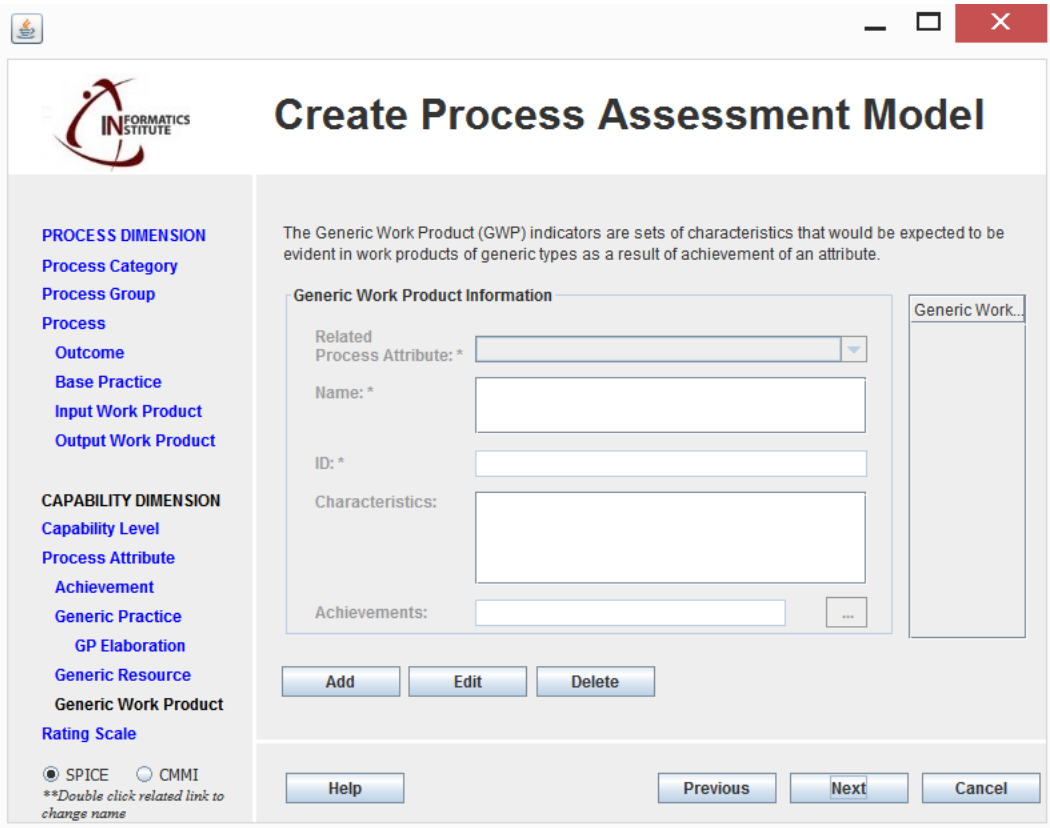


Figure 27 Generic Work Product

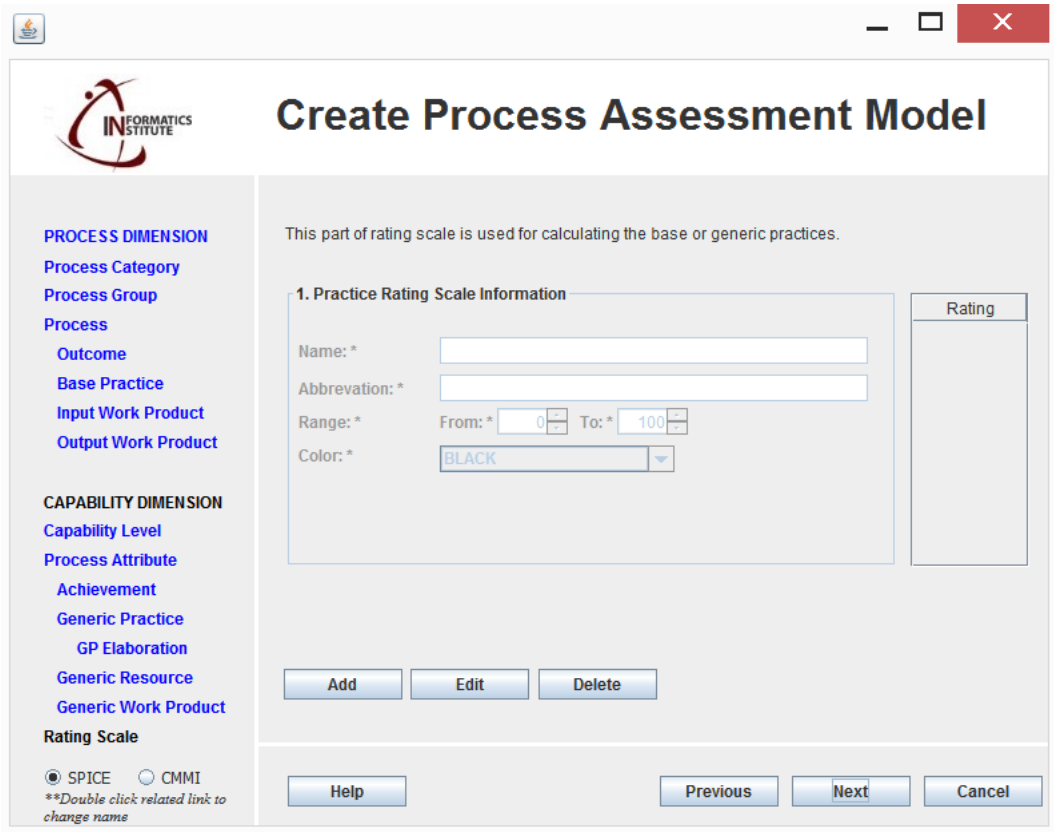


Figure 28 Practice Rating Scale

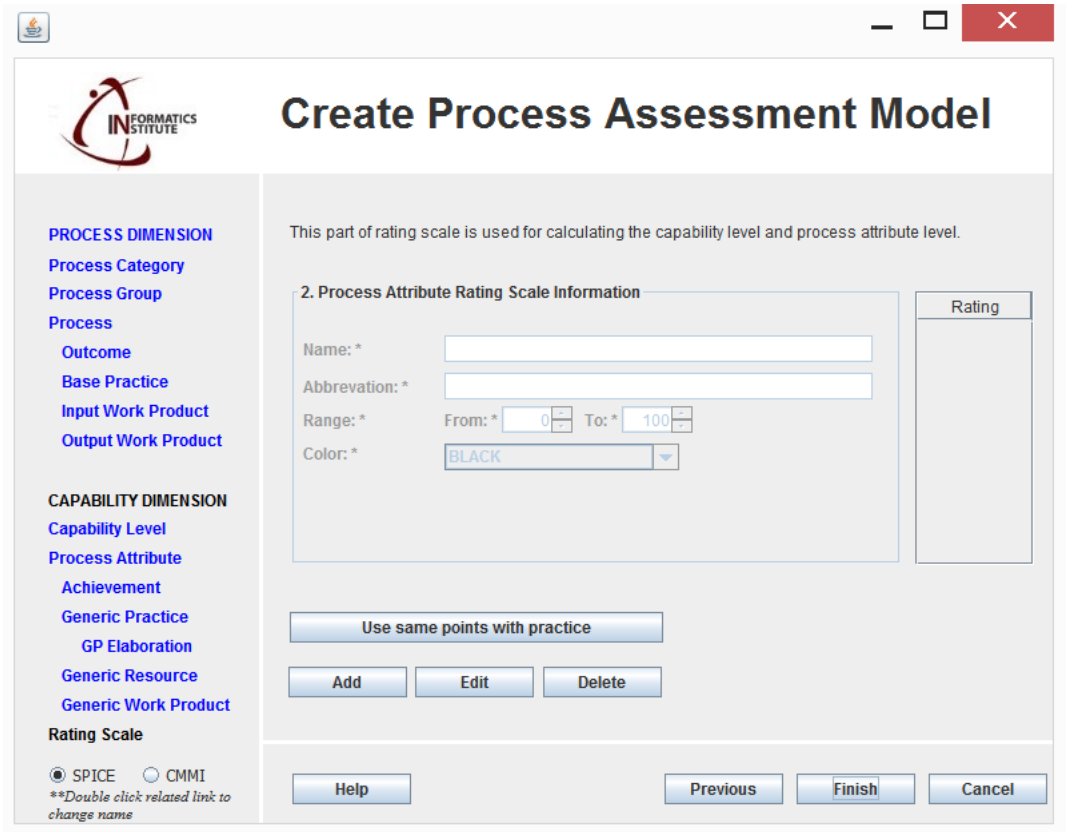


Figure 29 Goal Rating Scale

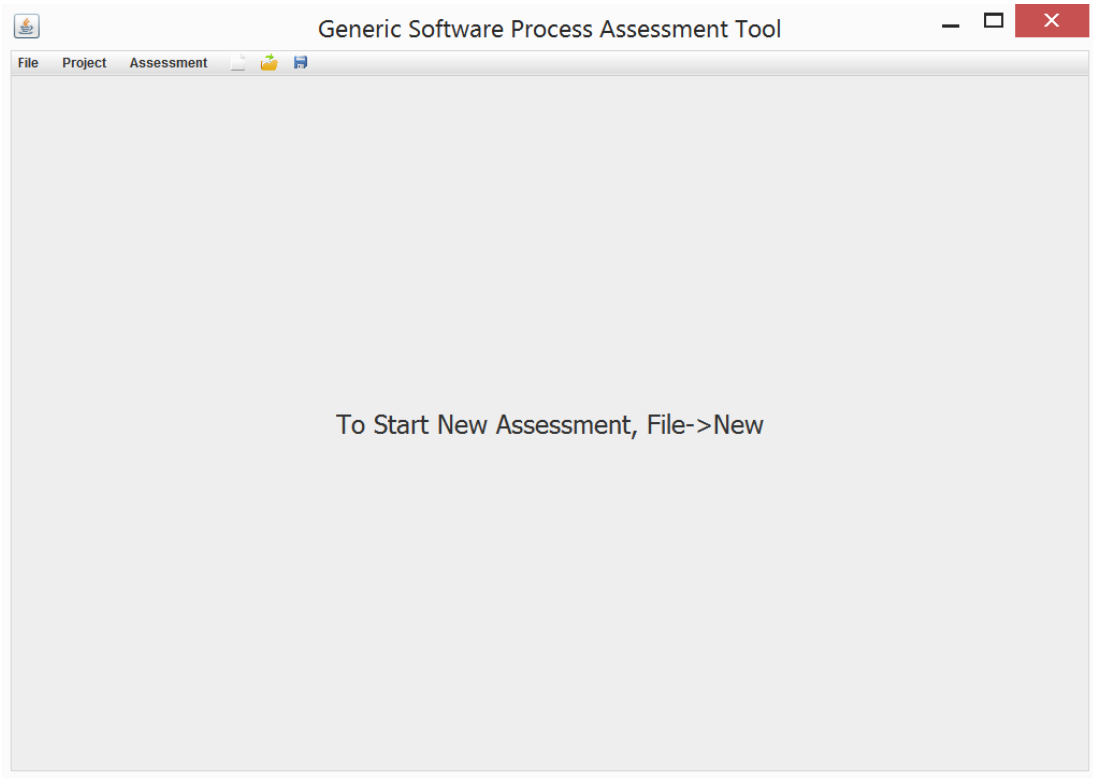


Figure 30 Generic Software Process Assessment Tool Main Page

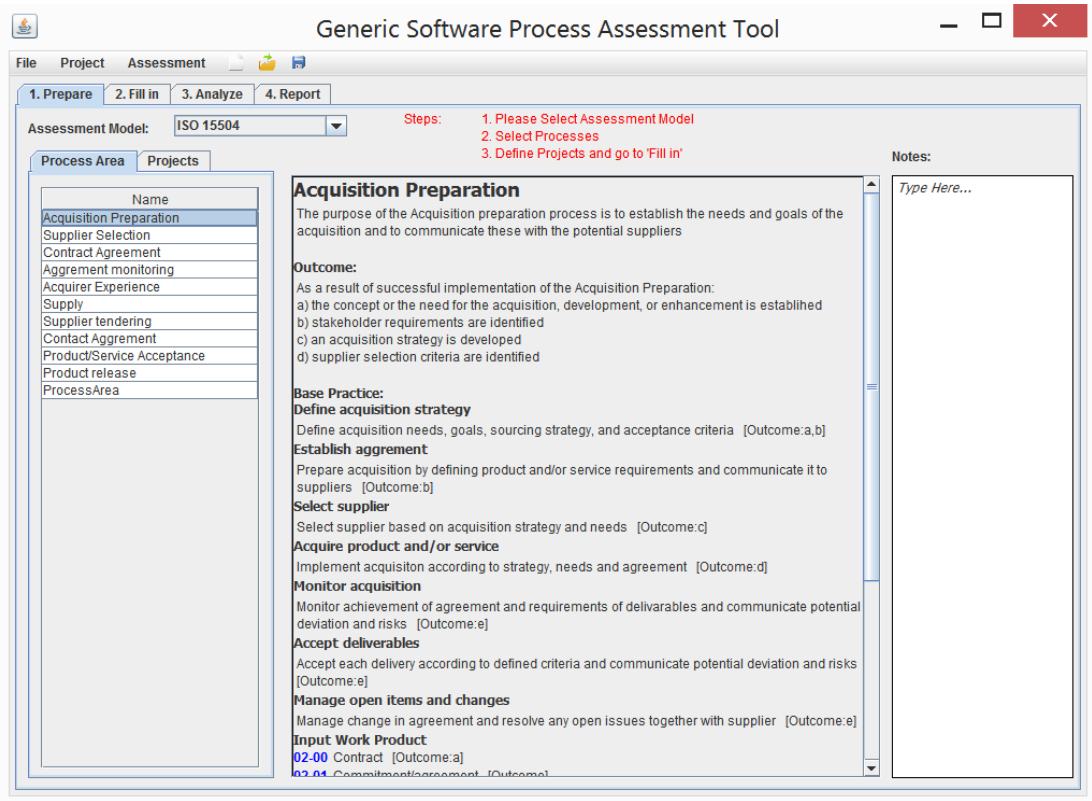


Figure 31 Prepare Processes

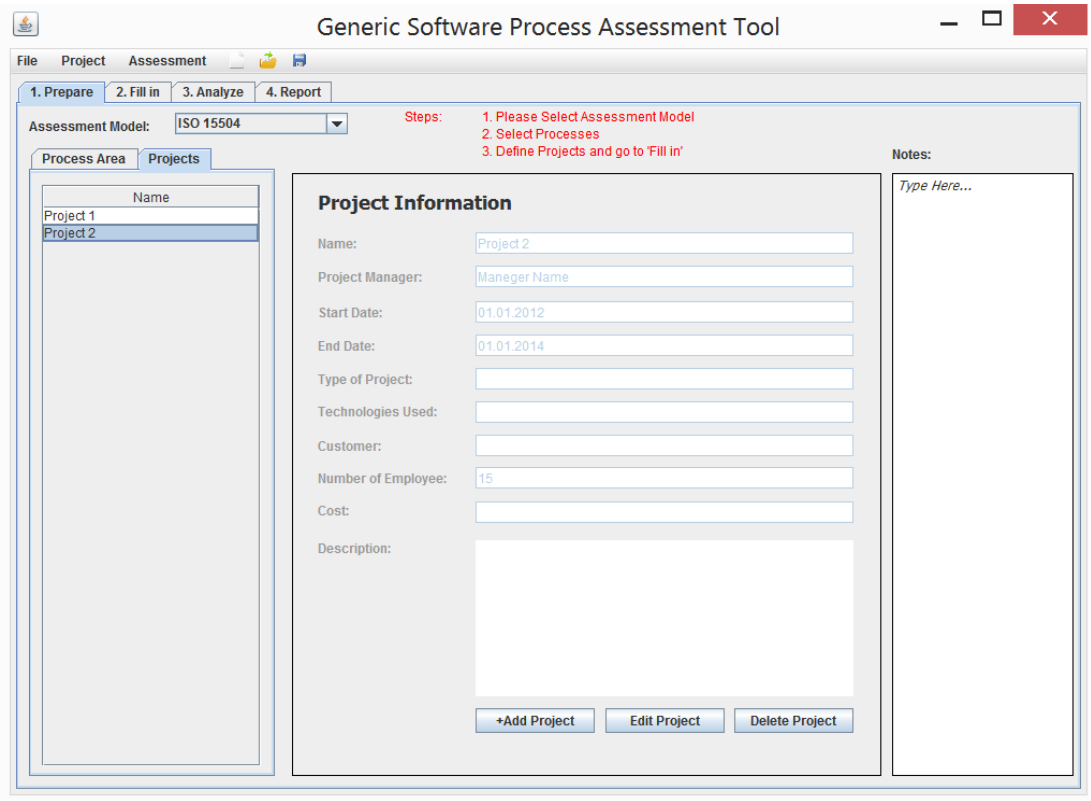


Figure 32 Prepare Projects

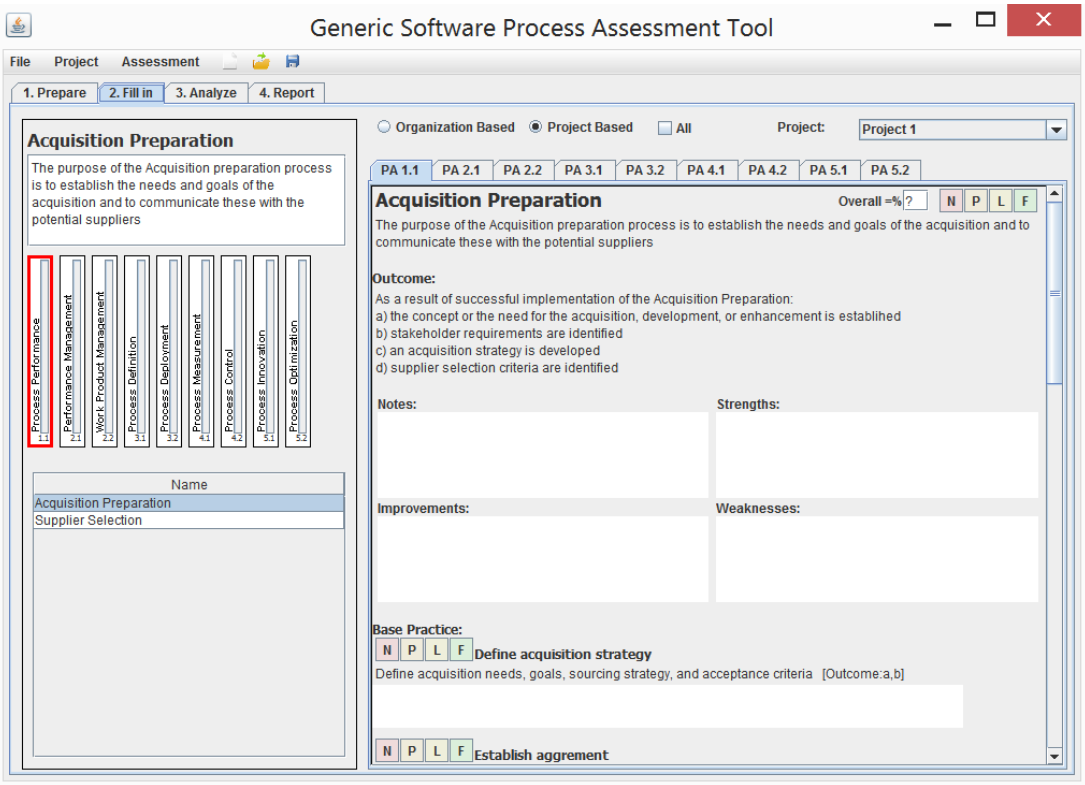


Figure 33 Fill In 1

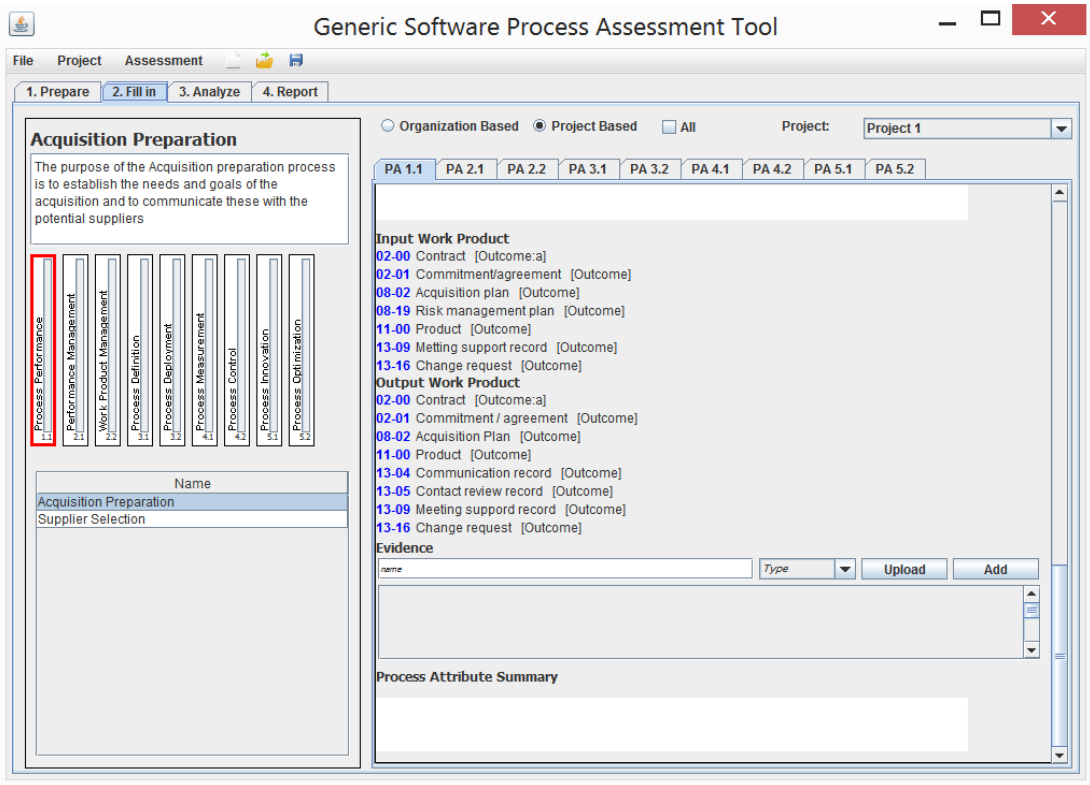


Figure 34 Fill In 2

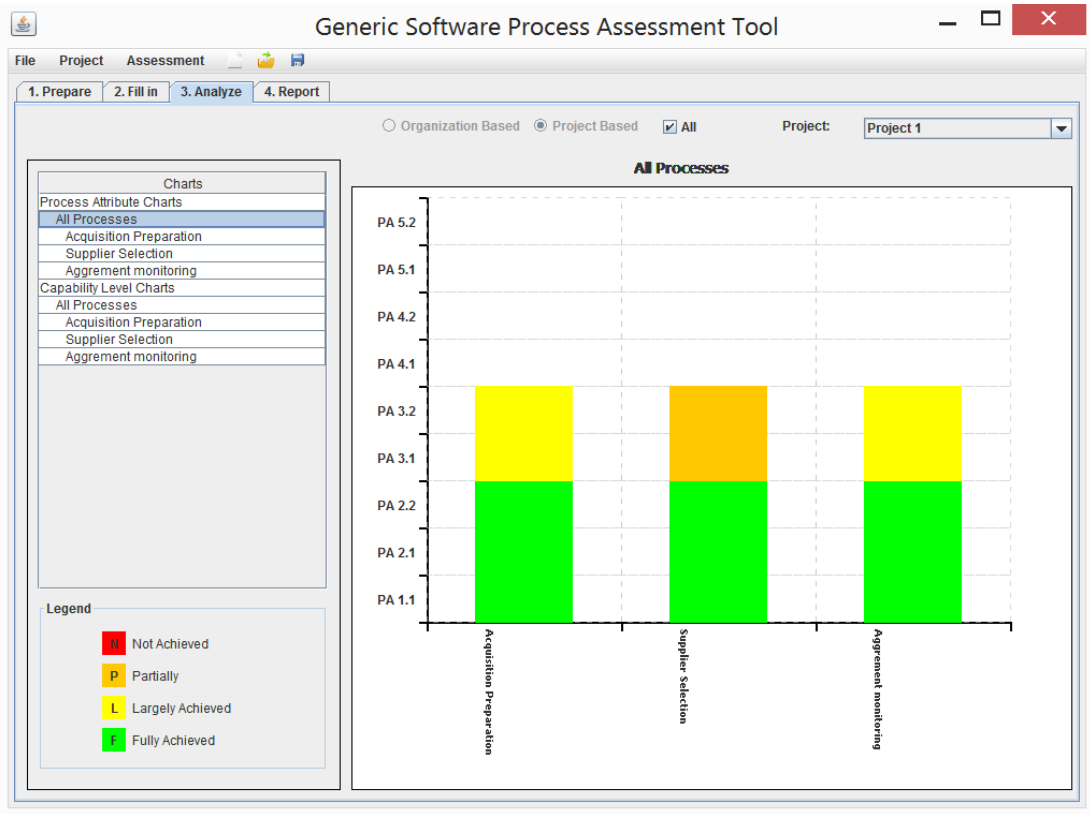


Figure 35 Analyze Process Attribute Graph

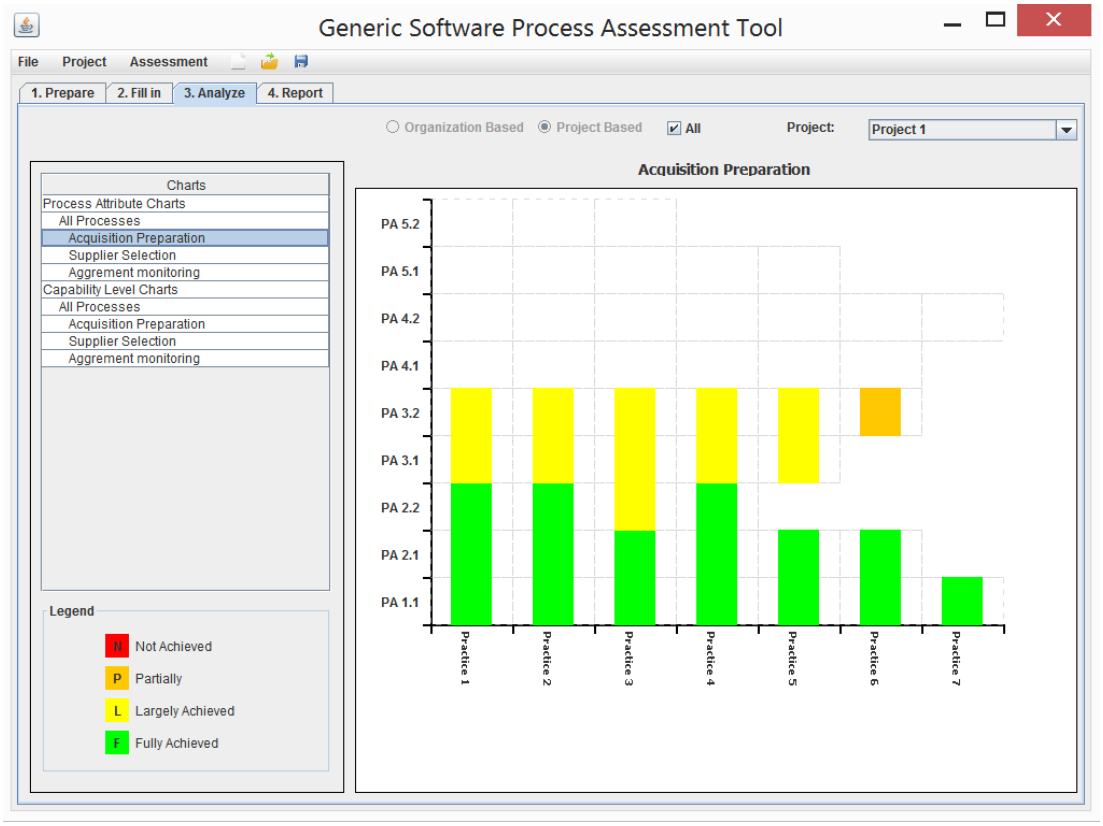


Figure 36 Practice Graph

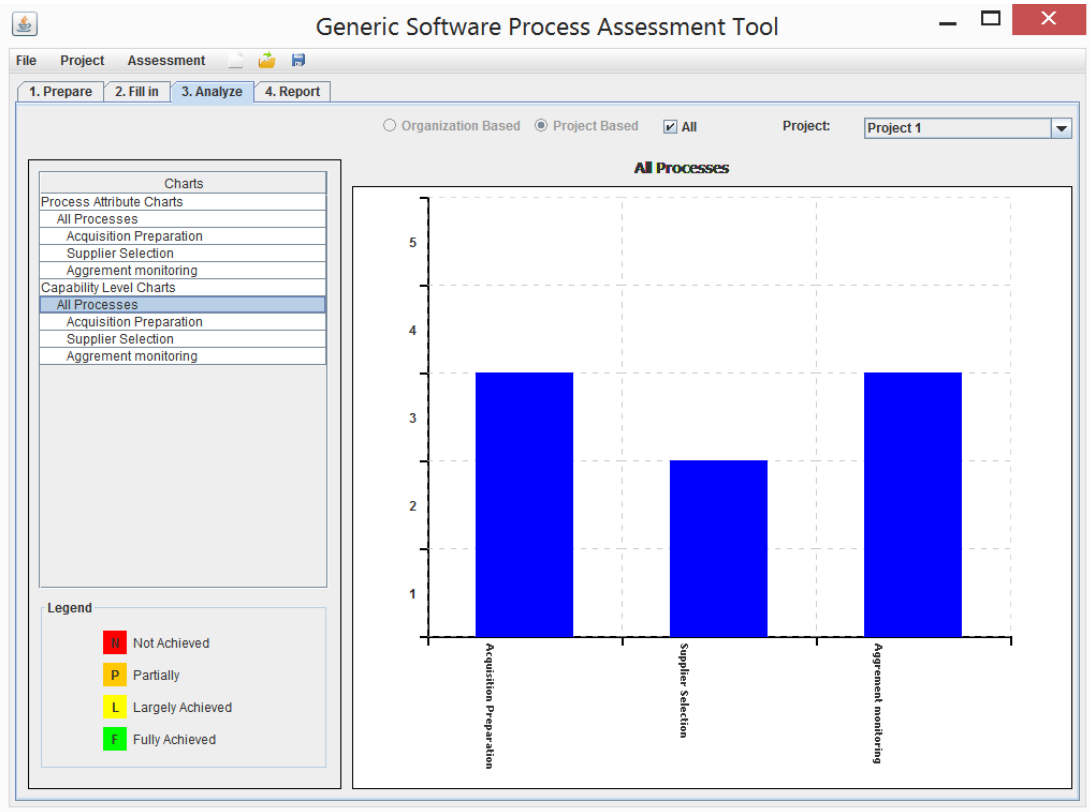


Figure 37 Capability Level Graph

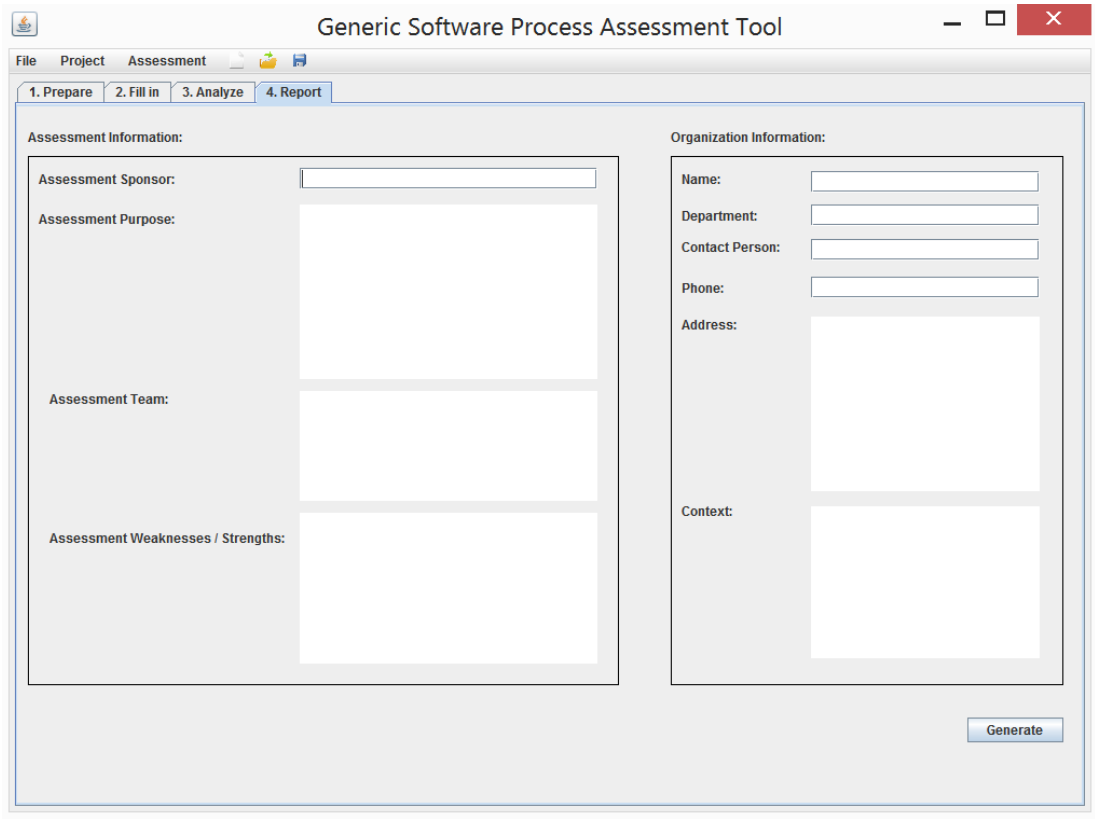


Figure 38 Report

APPENDIX B: Interview Questions

1-) Araç model tanımlamaya ne derece uygun ? Neden? N P L F

Araç değerlendirme yapmaya ne derece uygun? Neden? N P L F

Araç ne derecede otomatik raporlama yapıyor? Neden? N P L F

Araç denetçiyi ne derece yönlendirebiliyor? Neden? N P L F

Araçta farklı projeler ne derece değerlendiriliyor? Neden? N P L F

Araç paralel değerlendirme yapmaya ne derece uygun? Neden? N P L F

Araç özelliklerini keşfedebilmeye ne derece uygun? Neden? N P L F

2-)Araç ile yapılan değerlendirmeyi kağıt tabanlıya tercih eder misiniz? Neden?

3-) Harcanan toplam işgücü kağıt tabanlı yapsaydık nasıl olurdu? Araç ile yüzde kaç azalma oldu?

4-) Aracın güçlü ve eksik yanları neler?

ISO 15504 - Case Study Assessment Report

Report generated by: Assessor1, Tue Jun 17 10:52:12 EEST 2014

This document includes assessment results.

1. Assessment Input

1.1. Assessment Sponsor
Sponsor 1

1.2. Assessment Purpose
Main goals of this PIP was listed as follows in proposal: Decrease total SCOQ from to 35% of total effort by decreasing evaluation / appraisal cost. Increase “Company Performance” which is reported by customers to 90% by increasing software product quality and decreasing total project time. In order to achieve this objectives, Quality Assurance Process assessment is conducted based on ISO/IEC 15504-5.

1.3. Assessment Scope

1.3.1. Organization Scope

Organization	
Name	Organization 1
Context	The company is a specialized defense software company having CMMI Level 3 certification. In order to improve software processes, in the previous phases of this SPI project, COSQ for one specific project was calculated, based on COSQ results one specific process was analyzed by using EPC charts and proposal document prepared for Quality Assurance Process Impromevent Project.
Projects	
Project 1	
Project 2	

1.3.2. Process Scope

Processes	
Quality Assurance	Project Based

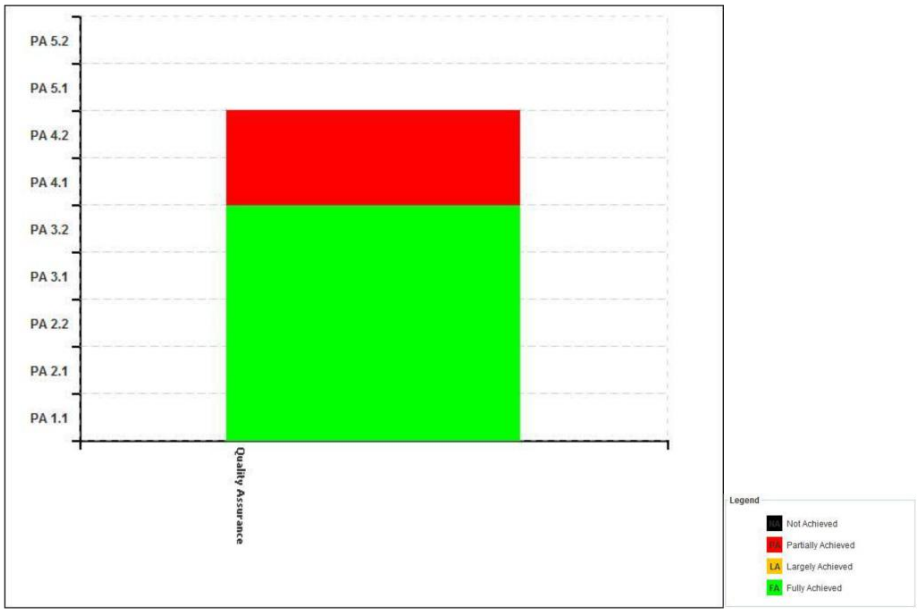
1.4. Assessment Model
ISO 15504-5

1.5. Assessment Team
Team Member 1
Team Member 2
Team Member 3

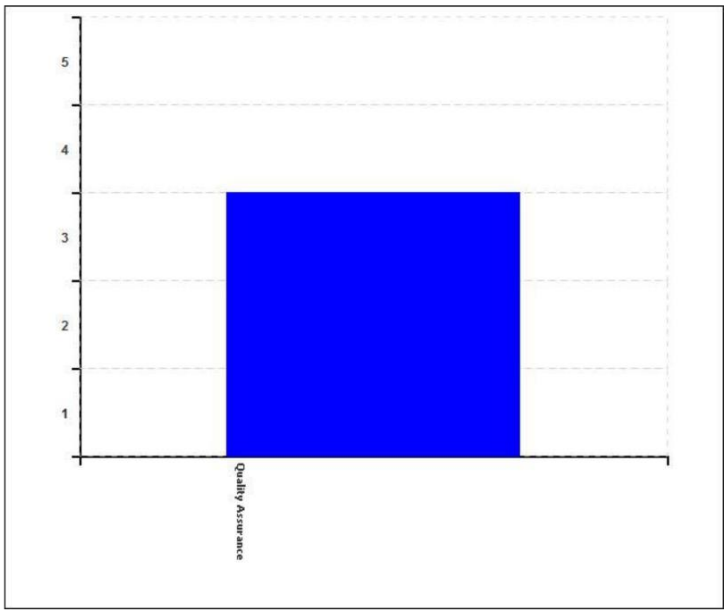
2. Assessment Results

2.1. Process Profiles

2.1.1. Process Attribute Ratings



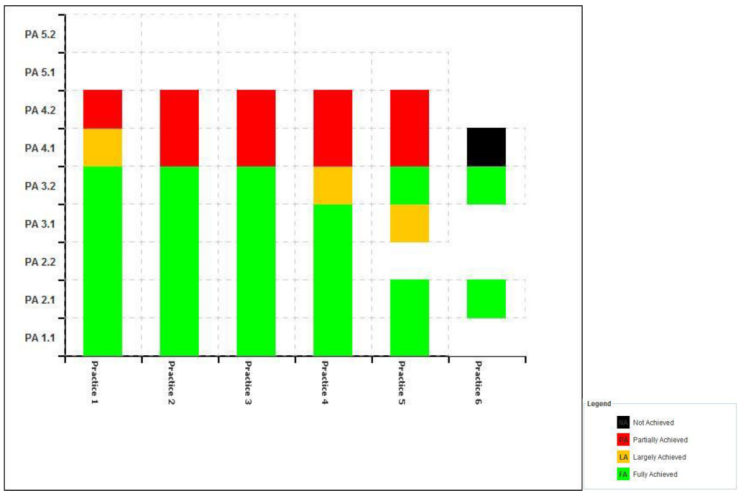
2.1.2. Process Capability Level Ratings



3. Detail Findings

Quality Assurance

Capability Level: 3



PA 1.1 Process Performance

Rating: *Fully Achieved*

Notes: Project 1:Quality Assurance process is performed in four phases: Planning and Tracking, Product Assurance, Process Assurance, Assurance of Quality Systems

Project 2:Based on the interviews conducted with Quality Director, Software Developer and Software Quality Engineer, Quality Assurance plan is established and product and process assurance activities are performed for each software project. The software projects cannot be closed without meeting the quality requirements.

Strengths: Project 1:

Project 2:

Improvements: Project 1:

Project 2:

Weaknesses: Project 1:

Project 2:

1. **Develop a strategy for product and process quality assurance.**

   Satisfaction: *Fully Achieved*

   Findings: Project 1:Fully Achieved Notes:

   Project 2:Fully Achieved Notes:

2. **Define quality records.**

   Satisfaction: *Fully Achieved*

   Findings: Project 1:Fully Achieved Notes:

   Project 2:Fully Achieved Notes:

3. **Assure the quality of project process activities and project work products.**

   Satisfaction: *Fully Achieved*

   Findings: Project 1:Fully Achieved Notes:

   Project 2:Fully Achieved Notes:

4. **Identify and record problems and non-conformances**

   Satisfaction: *Fully Achieved*

   Findings: Project 1:Fully Achieved Notes:

Project 2:Fully Achieved Notes:

5. **Act on non-conformances.**

Satisfaction: *Fully Achieved*

Findings: Project 1:Fully Achieved Notes:

Project 2:Fully Achieved Notes:

Evidences: Project 1: Quality Director

Project 1: Software Quality Engineer

Project 1: Project Plan

Project 1: Quality Assurance Plan

Project 1: JIRA Defect

Project 2: JIRA

Project 2: SVN

Project 2: Intranet

Project 2: E-mail

Project 2: PAR (Preventive Action)

Project 2: CAR(Corrective Action)

PA 2.1 Performance Management

Rating: *Fully Achieved*

Notes: Project 1:

Project 2:

Strengths: Project 1:

Project 2:

Improvements: Project 1:

Project 2:

Weaknesses: Project 1:

Project 2:

1. **Identify the objectives for the performance of the process.**

Satisfaction: *Fully Achieved*

Findings: Project 1:Fully Achieved Notes:Quality assurance is mentioned in Company Strategy. For all projects “Quality Assurance Plan” is prepared and distributed, including quality objectives.

Project 2:Fully Achieved Notes:In Quality Assurance Plan, all quality assurance objectives such as acceptable defect rates, PIR rates are identified in detail.

2. **Plan and monitor the performance of the process to fulfil the identified objectives.**

Satisfaction: *Fully Achieved*

Findings: Project 1:Fully Achieved Notes:Project Plan & Quality Assurance Plan include necessary plan for this process.

Project 2:Fully Achieved Notes:In order to monitor process performance, periodic reviews are conducted.

3. **Adjust the performance of the process.**

Satisfaction: *Fully Achieved*

Findings: Project 1:Fully Achieved Notes:If quality performance objectives are not achieved in time, both project plan and quality assurance plan are revised.

Project 2:Fully Achieved Notes:

4. **Define responsibilities and authorities for performing the process.**

Satisfaction: *Fully Achieved*

Findings: Project 1:Fully Achieved Notes:One of the entry criteria of project start is assignment of

quality responsibilities.
Project 2:Fully Achieved Notes:All responsibilities are defined in “Roles and Responsibilities” document.

5. **Identify and make available resources to perform the process according to plan.**
   Satisfaction: *Fully Achieved*
   Findings: Project 1:Fully Achieved Notes:Project Plan is maintained in MS Project.
   Project 2:Fully Achieved Notes:All non-compliances are managed in software “JIRA”. All effort value is recorded in “Primavera”.
6. **Manage the interfaces between involved parties.**
   Satisfaction: *Fully Achieved*
   Findings: Project 1:Fully Achieved Notes:Coordination of interfaces is managed by project manager.
   Project 2:Fully Achieved Notes:Quality Assurance Responsible coordinates all review meetings.

Evidences: Project 1: MS Project
Project 1: Intranet
Project 1: JIRA
Project 1: Project Plan
Project 1: Project Schedule
Project 2: Primavera
Project 2: SVN
Project 2: e-mail
Project 2: FTP
Project 2: Work breakdown structure

PA 2.2 Work Product Management

Rating: *Fully Achieved*
Notes: Project 1:
Project 2:
Strengths: Project 1:
Project 2:
Improvements: Project 1:
Project 2:
Weaknesses: Project 1:
Project 2:

1. **Define the requirements for the work products.**
   Satisfaction: *Fully Achieved*
   Findings: Project 1:Fully Achieved Notes:Quality requirements are defined in Quality Plan by regarding Quality Policy. Quality criteria are identified in Quality Plan and Project Plan.
   Project 2:Fully Achieved Notes:There is Review Methods Document detailing appropriate review and approval criteria for the work products. General quality requirements are identified in Quality Manual.
2. **Define the requirements for documentation and control of the work products.**
   Satisfaction: *Fully Achieved*
   Findings: Project 1:Fully Achieved Notes:Documents required by the quality management system are released and controlled according to Quality System Documents method. This method contains the activities, regarding to plan, design, develop, produce, edit, distribute, and maintain those documents needed by all concerned people such as managers, engineers, and users of the system or

software product. With the execution of these methods, the company ensures the establishment and control of internal documentation standards in electronic media.

Project 2:Fully Achieved Notes:"Roles and responsibilities" document explains who is responsible for documentation and control of the work products. Quality plan also includes requirements for distribution, identification of the work products and their components traceability. Revision Control System deals with documentation processes. Project Management Plan explains dependencies between work products. This is conducted in the tool "Primavera".

3. **Identify, document and control the work products.**

   Satisfaction: *Fully Achieved*

   Findings: Project 1:Fully Achieved Notes:The list of quality records and method for controlling are detailed in quality and configuration plans. These are controlled with internal audits. System quality, quality metrics, test preparation, test records and related customer meeting records are kept by quality department. Any record related to contractual issues is kept by contracts department. All documents produced during project life cycle and provided by customer and/or supplier which affect the product quality is maintained by configuration management team.

   Project 2:Fully Achieved Notes:Project management and financial records are kept by project managers in the folders with need-to-know principle. "Audits Method" document defines the work products to be controlled. In "Review Methods" document, there is an explanation about how change control is established. The versions of each work product are recorded in each document and they are updated in Revision Control System (SVN).

4. **Review and adjust work products to meet the defined requirements.**

   Satisfaction: *Fully Achieved*

   Findings: Project 1:Fully Achieved Notes:Company conducts internal audits to determine whether the quality management systemconforms to the planned activities, to the requirements of the quality managementsystem. Internal audits also meet the contractual and/or regulatory requirements.

   Project 2:Fully Achieved Notes:Management Reviews Method and Review Method documents explain the methodology to be followed. Quality assurance plan also includes how this process is performed.

Evidences: Project 1: Review Management Method
Project 1: SVN Review Methods
Project 1: Project Plan
Project 2: Intranet
Project 2: SVN
Project 2: Primavera

PA 3.1 Process Definition

Rating: *Fully Achieved*

Notes: Project 1:
Project 2:

Strengths: Project 1:
Project 2:

Improvements: Project 1:
Project 2:

Weaknesses: Project 1:
Project 2:

1. **Define the standard process that will support the deployment of the defined process.**

   Satisfaction: *Fully Achieved*

Findings: Project 1:Fully Achieved Notes: Quality Assurance Process and Quality Assurance Manual are two fundamental documentations for this process.
Project 2:Fully Achieved Notes:These procedures explain deployment activities in detail. These procedures, related methods, forms, templates are all available to everyone in "intranet" for usage when needed.

2. **Determine the sequence and interaction between processes so that they work as an integrated? system of processes.**
Satisfaction: *Fully Achieved*
Findings: Project 1:Fully Achieved Notes:
Project 2:Fully Achieved Notes:Quality Assurance Process definition includes all interactions between other processes by showing the sequence for interaction.

3. **Identify the roles and competencies for performing the standard process.**
Satisfaction: *Fully Achieved*
Findings: Project 1:Fully Achieved Notes: There are two documents used for this purpose. First one is "Roles and Responsibilities", second one is "Job Analysis- Quality System".
Project 2:Fully Achieved Notes:They explain all roles and competencies needed to perform Quality Assurance process.

4. **Identify the required infrastructure and work environment for performing the standard process.**
Satisfaction: *Fully Achieved*
Findings: Project 1:Fully Achieved Notes: All details for facilities and network topology are defined in related methods as "IT Infrastructure", "Backup and Recovery".
Project 2:Fully Achieved Notes:All tools for work environment are listed in "Quality Assurance Manual".

5. **Determine suitable methods to monitor the effectiveness and suitability of the standard process.**
Satisfaction: *Largely Achieved*
Findings: Project 1:Largely Achieved Notes: All related methods for assuring effectiveness of Quality Process are listed in both "Quality Assurances Procedure" and "Quality Assurance Manual".
Project 2:Largely Achieved Notes:Most specific method for this is "Process Assurance Procedure".

Evidences: Project 1: Primavera
Project 1: JIRA
Project 1: Review Methods
Project 1: Audit Methods
Project 1: Failure Tracking
Project 1: Measurement Method
Project 1: Quality Assurance Manual
Project 1: JIRA issue records
Project 2: Primavera
Project 2: JIRA
Project 2: Review Methods
Project 2: Audit Methods
Project 2: Failure Tracking
Project 2: Measurement Method
Project 2: Quality Assurance Manual
Project 2: JIRA issue records

PA 3.2 Process Deployment

Rating: *Fully Achieved*

Notes: Project 1:
Project 2:

Strengths: Project 1:
Project 2:

Improvements: Project 1:
Project 2:

Weaknesses: Project 1:
Project 2:

1. **Deploy a defined process that satisfies the context specific requirements of the use of the standard process.**
   Satisfaction: *Fully Achieved*
   Findings: Project 1:Fully Achieved Notes: Quality Assurance sub-processes and related methods are tailored form main "Quality Assurance Procedure".
   Project 2:Fully Achieved Notes:Conformance of all related process methods are verified based on "Process Definition Procedure".
2. **Assign and communicate roles, responsibilities and authorities for performing the defined process.**
   Satisfaction: *Fully Achieved*
   Findings: Project 1:Fully Achieved Notes: Project team assignment is established via mail to all related parties.
   Project 2:Largely Achieved Notes:Furthermore, as an evidence these assigned employees are registered as resources in "Primavera", "Project Management Plan", and "Quality Assurance Plan".
3. **Ensure necessary competencies for performing the defined process.**
   Satisfaction: *Fully Achieved*
   Findings: Project 1:Fully Achieved Notes:
   Project 2:Fully Achieved Notes:Necessary training are listed in "Annual Training Plan", and evaluated by trainers. There exist related records in "Assist".
4. **Provide resources and information to support the performance of the defined process.**
   Satisfaction: *Largely Achieved*
   Findings: Project 1:Largely Achieved Notes: All necessary human resources are defined and made available based on "Project Management Plan", and "Quality Assurance Plan".
   Project 2:Fully Achieved Notes:As evidence, Primavera records can be seen.
5. **Provide adequate process infrastructure to support the performance of the defined process.**
   Satisfaction: *Fully Achieved*
   Findings: Project 1:Fully Achieved Notes: Information Technologies topology is available in intranet. Disaster recovery practices are conducted periodically.
   Project 2:Fully Achieved Notes:Tools used for Quality Assurance process are maintained by "Engineering Support Team" and consultants when required.
6. **Collect and analyze data about performance of the process to demonstrate its suitability and effectiveness.**
   Satisfaction: *Fully Achieved*
   Findings: Project 1:Fully Achieved Notes:
   Project 2:Fully Achieved Notes:For all projects, metrics like audits, review reports are available in projects' folders and JIRA issues.

Evidences: Project 1: Customer Satisfaction Report
Project 1: Delivery Performance Report (as feedback mechanisms)
Project 1: Process Assurance Methods
Project 1: Project Management Plan
Project 1: Quality Assurance Plan
Project 2: Intranet

Project 2: Primavera
Project 2: JIRA
Project 2: Review Methods
Project 2: Audit Methods
Project 2: Failure Tracking
Project 2: Measurement Method
Project 2: Annual Training Plan
Project 2: JIRA Audit
Project 2: Review reports
Project 2: Issues
Project 2: Assist Training Evaluation Records

PA 4.1 Process Measurement

Rating: *Partially Achieved*

Notes: Project 1:
Project 2:

Strengths: Project 1:
Project 2:

Improvements: Project 1:
Project 2:

Weaknesses: Project 1:
Project 2:

1. **Identify process information needs, in relation with business goals.**
   Satisfaction: *Largely Achieved*
   Findings: Project 1:Largely Achieved Notes:Quality Assurance objectives according to business goals are established in "Quality Assurance Manual". These objectives are defined in quantitative figures as Quality Assurance Objectives in "Annual Business Strategic Plan".
   Project 2:Partially Achieved Notes:Example objectives from manual are as follows: Improve productivity of projects completed in this year and beyond, Utilize improvement suggestions, Reduce rework ratio, Peer Review Effectiveness levels shall be above predefined threshold
2. **Derive process measurement objectives from process information needs.**
   Satisfaction: *Partially Achieved*
   Findings: Project 1:Partially Achieved Notes:Process information needs are not directly derived from process measurement objectives. Objectives are derived from business goals, but are not used for sub-level processes.
   Project 2:Partially Achieved Notes:Process information needs are less dynamic and defined by process responsible.
3. **Establish quantitative objectives for the performance of the defined process, according to alignment of the process with the business goals.**
   Satisfaction: *Partially Achieved*
   Findings: Project 1:Partially Achieved Notes:Quantitative Quality Assurance objectives are established to all business management team in annual Strategic Plan Meeting. Furthermore this strategic plan is available in intranet to all users.
   Project 2:Partially Achieved Notes:However, these quantitative objectives are defined by Quality Director with the help of Quality Team. Software team is not included in this definition activity. Therefore, these objectives are not realistic most of the time, so cannot be used effectively.
4. **Identify product and process measures that support the achievement of the quantitative objectives for**

process performance.

Satisfaction: *Partially Achieved*

Findings: Project 1:Partially Achieved Notes:The company monitors and measures the characteristics of the product to verify that product requirements are fulfilled. The assurance of the quality characteristics like reliability, maintainability and usability is realized with the controls at appropriate stages of the product realization process in accordance with the planned arrangements and activities. These characteristics are defined in detail in "Quality Assurance Plan". Data collection frequency, audit and review periods, algorithms and methods are all specified in "Quality Assurance Plan".

Project 2:Partially Achieved Notes:A project cannot be closed without performing all predefined characteristics in "Quality Assurance Plan". However, all of the necessary characteristics related to process requirements are not defined properly. Processes are checked if performed or not, effectiveness cannot be properly measured and verified.

5. **Collect product and process measurement results through performing the defined process.**

   Satisfaction: *Partially Achieved*

   Findings: Project 1:Partially Achieved Notes:There is a defined "Measurement Method" including also quality assurance objective's measurements.

   Project 2:Partially Achieved Notes:Measurement results are established in Project Review Meetings.

6. **Use the results of the defined measurement to monitor and verify the achievement of the process performance objectives.**

   Satisfaction: *Not Achieved*

   Findings: Project 1:Not Achieved Notes:Measurement results are reported at the end of the projects, but are not analyzed with statistical or similar techniques.

   Project 2:Not Achieved Notes:

Evidences: Project 1: JIRA
Project 1: Primavera
Project 1: Measurement Method
Project 1: Annual Strategic Plan (Quality Assurance Objectives)
Project 1: Quality Assurance Plan
Project 1: Quality Report (Project Closure)
Project 2: e-mail
Project 2: intranet
Project 2: JIRA Audit
Project 2: Review Reports
Project 2: Primavera
Project 2: Customer Satisfaction Report

PA 4.2 Process Control

Rating: *Partially Achieved*

Notes: Project 1:
Project 2:

Strengths: Project 1:
Project 2:

Improvements: Project 1:
Project 2:

Weaknesses: Project 1:
Project 2:

1. **Determine analysis and control techniques, appropriate to control the process performance.**

   Satisfaction: *Partially Achieved*

   Findings: Project 1:Partially Achieved Notes:Quality Assurance process analysis and control techniques are defined in related methods as “Process Control” and forms as “Process Control Plan”.
   Project 2:Partially Achieved Notes:However these techniques are not validated against process control objectives.

2. **Define parameters suitable to control the process performance.**

   Satisfaction: *Partially Achieved*

   Findings: Project 1:Partially Achieved Notes:Standard process definitions mostly cover all related parameters. If any parameter necessary for process objective is not included in standard process definition, process definition is revised. However, control limits are not defined for parameters. Instead, exact parameter figures are defined and reported at the end of projects.
   Project 2:Partially Achieved Notes:There is no defined activity as corrective or preventive action activities if parameter is not in control limits.

3. **Analyse process and product measurement results to identify variations in process performance.**

   Satisfaction: *Partially Achieved*

   Findings: Project 1:Not Achieved Notes:There is no defined method for analyzing quality assurance objectives’ measurement results.
   Project 2:Partially Achieved Notes:The results are shared with responsible employees to take actions, however statistical analysis are not performed.

4. **Identify and implement corrective actions to address assignable causes.**

   Satisfaction: *Partially Achieved*

   Findings: Project 1:Partially Achieved Notes:Corrective Action System Method explains the identification, tracking and removal of the causes in JIRA.
   Project 2:Partially Achieved Notes:Necessary corrections and implementation are realized on JIRA. These requests are followed up to the closure in JIRA, Management Reviews, Material Review Board, and Internal Audits.

5. **Re-establish control limits following corrective action.**

   Satisfaction: *Partially Achieved*

   Findings: Project 1:Partially Achieved Notes:
   Project 2:Partially Achieved Notes:Since control limits are not defined clearly, they cannot be re-established.

Evidences: Project 1: JIRA
Project 1: Process Control Plan, Quality Report
Project 2: Corrective Action System Method
Project 2: Process Control
Project 2: JIRA CAR issues
Project 2: JIRA PAR issues

APPENDIX D: CMMI Case Study Assessment Report

CMMI-Case Study Assessment Report

Report generated by: Assessor 2, Fri Jun 20 14:27:15 EEST 2014

This document includes assessment results.

1. Assessment Input

1.1. Assessment Sponsor
Sponsor 1

1.2. Assessment Purpose
The purpose of this assessment is to measure capability levels of organization processes.

1.3. Assessment Scope

1.3.1. Organization Scope

Organization	
Name	Organization 3
Context	The organization in which assessment is performed is working on defense industry and the total number of employee is 55.
Projects	
Project 1	
Project 2	
Project 3	

1.3.2. Process Scope

Processes	
Project Planning	Project Based
Organizational Training	Organization Based

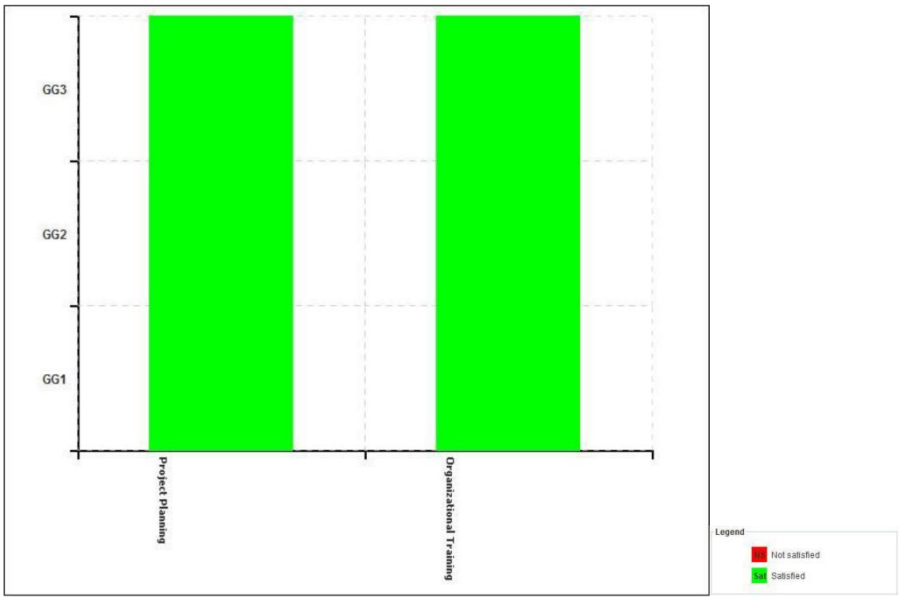
1.4. Assessment Model
CMMI

1.5. Assessment Team
Team Member 1

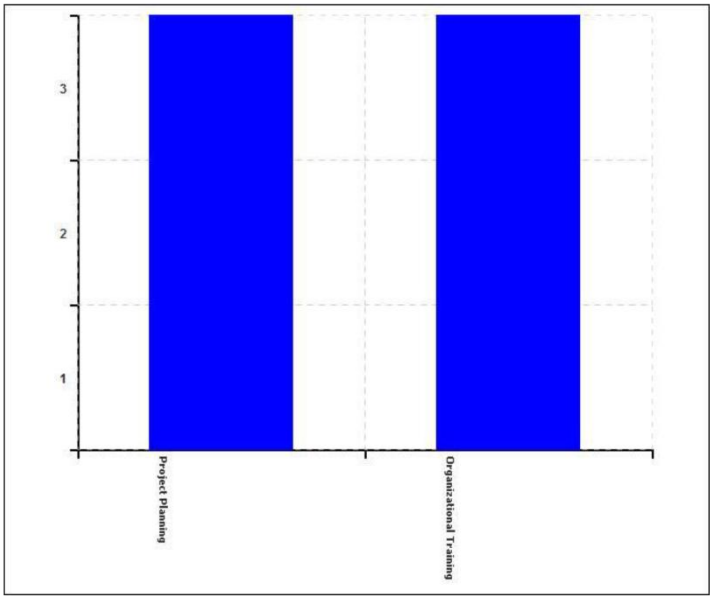
2. Assessment Results

2.1. Process Profiles

2.1.1. Process Attribute Ratings



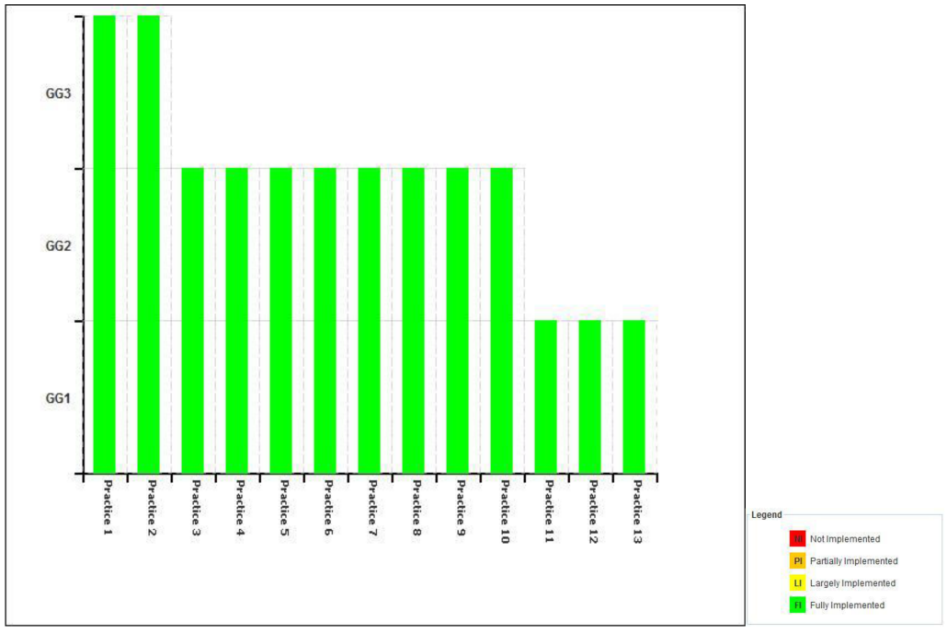
2.1.2. Process Capability Level Ratings



3. Detail Findings

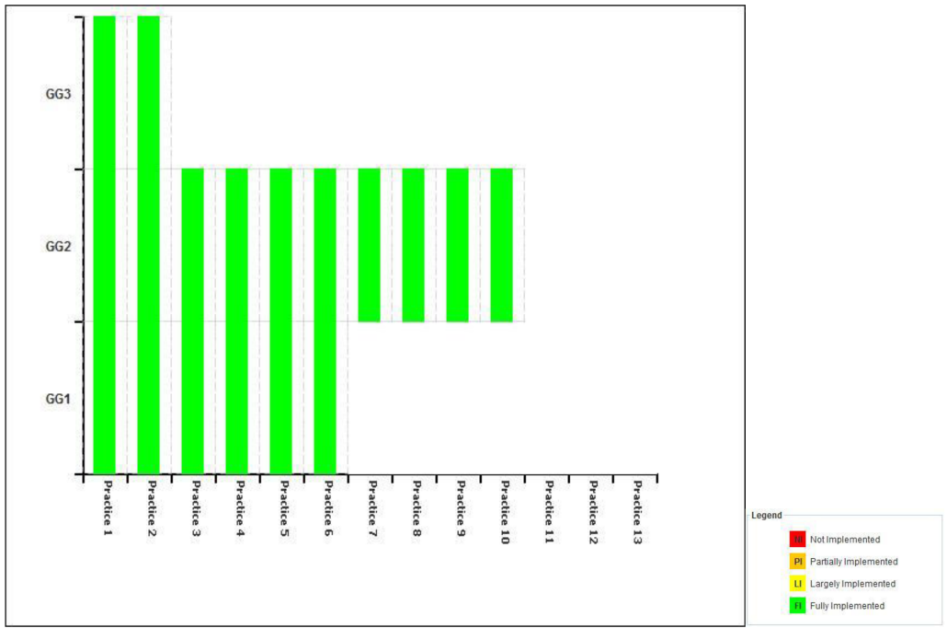
Project Planning

Capability Level: 3



Organizational Training

Capability Level: 3



APPENDIX E: Agility Assessment Model Case Study Assessment Report

Software Agility Assessment Model Assessment Report

Report generated by: Assessor 3, Wed Jun 25 12:49:34 EEST 2014

This document includes assessment results.

1. Assessment Input

1.1. Assessment Sponsor

Sponsor 1

1.2. Assessment Purpose

This assessment aims to measure the agility of aspects indicated in Aspect Scope section.

1.3. Assessment Scope

1.3.1. Organization Scope

Organization	
Name	Organization 3
Context	The organization is a government organization developing web based applications and having 60 employees.
Projects	
Project 1	
Project 2	

1.3.2. Aspect Scope

Aspects	
Exploration	Project Based
Transition	Project Based

1.4. Assessment Model

Software Agility Assessment Model

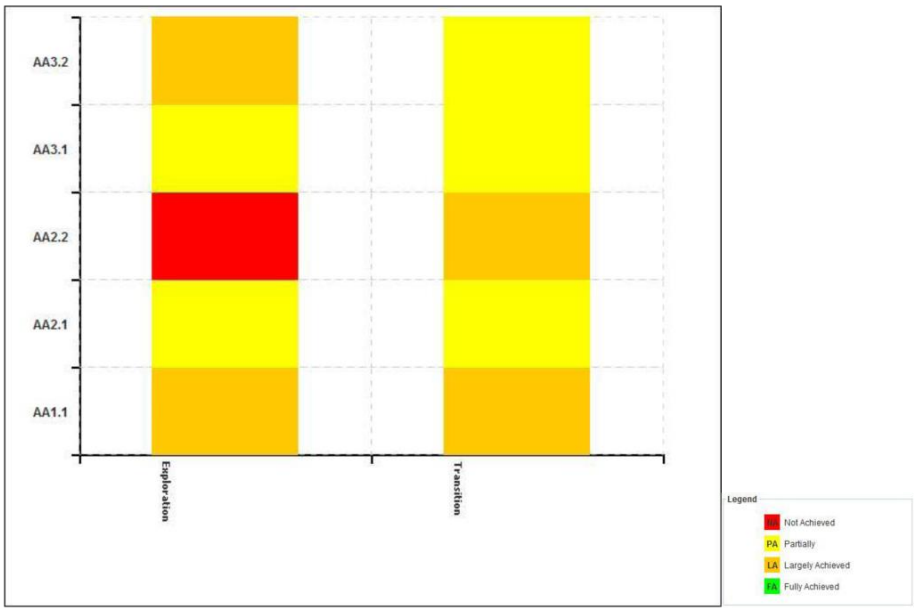
1.5. Assessment Team

Team Member 1

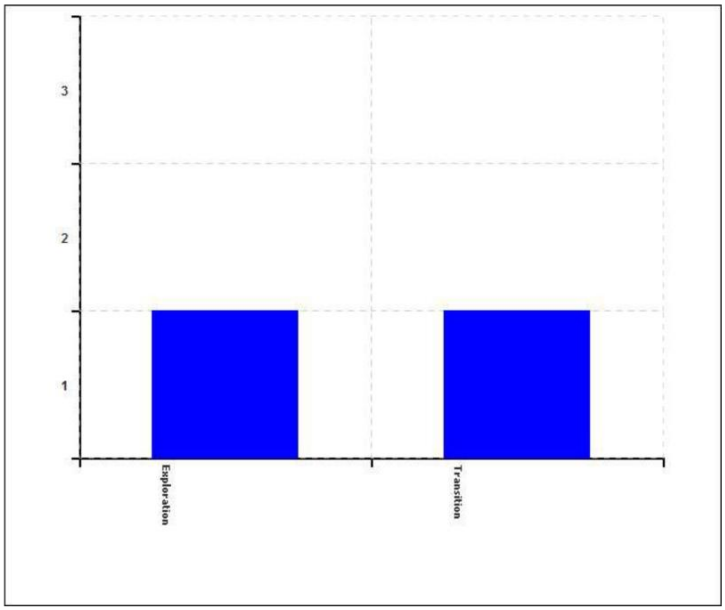
2. Assessment Results

2.1. Process Profiles

2.1.1. Aspect Attribute Ratings



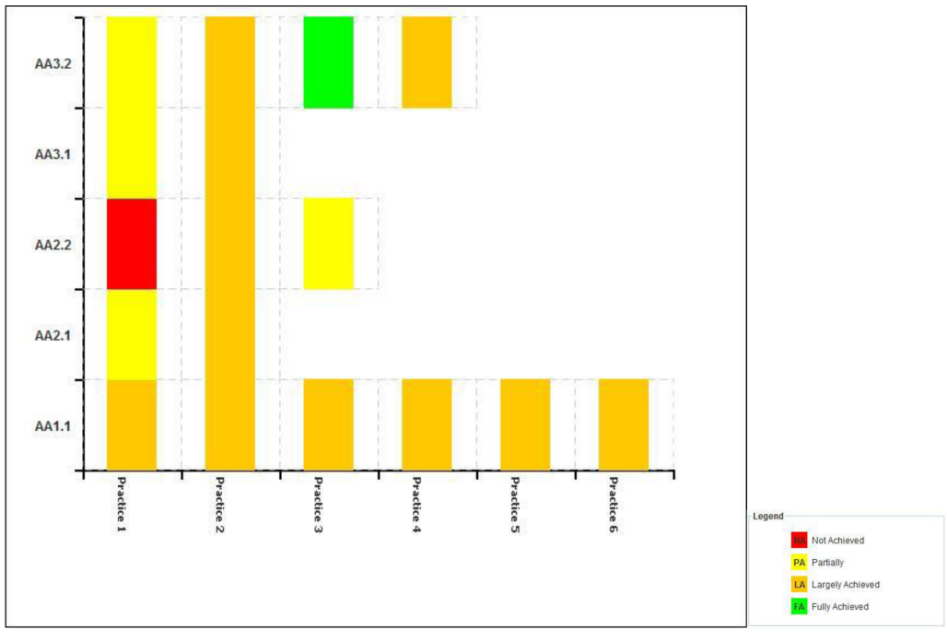
2.1.2. Aspect Agility Level Ratings



3. Detail Findings

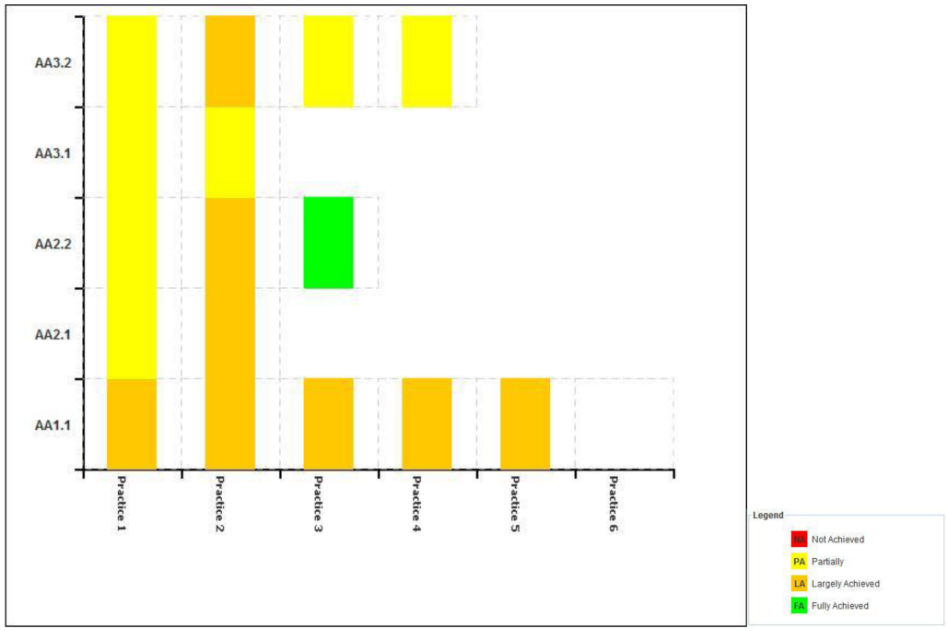
Exploration

Agility Level: 1



Transition

Agility Level: 1



APPENDIX F: ER Diagram

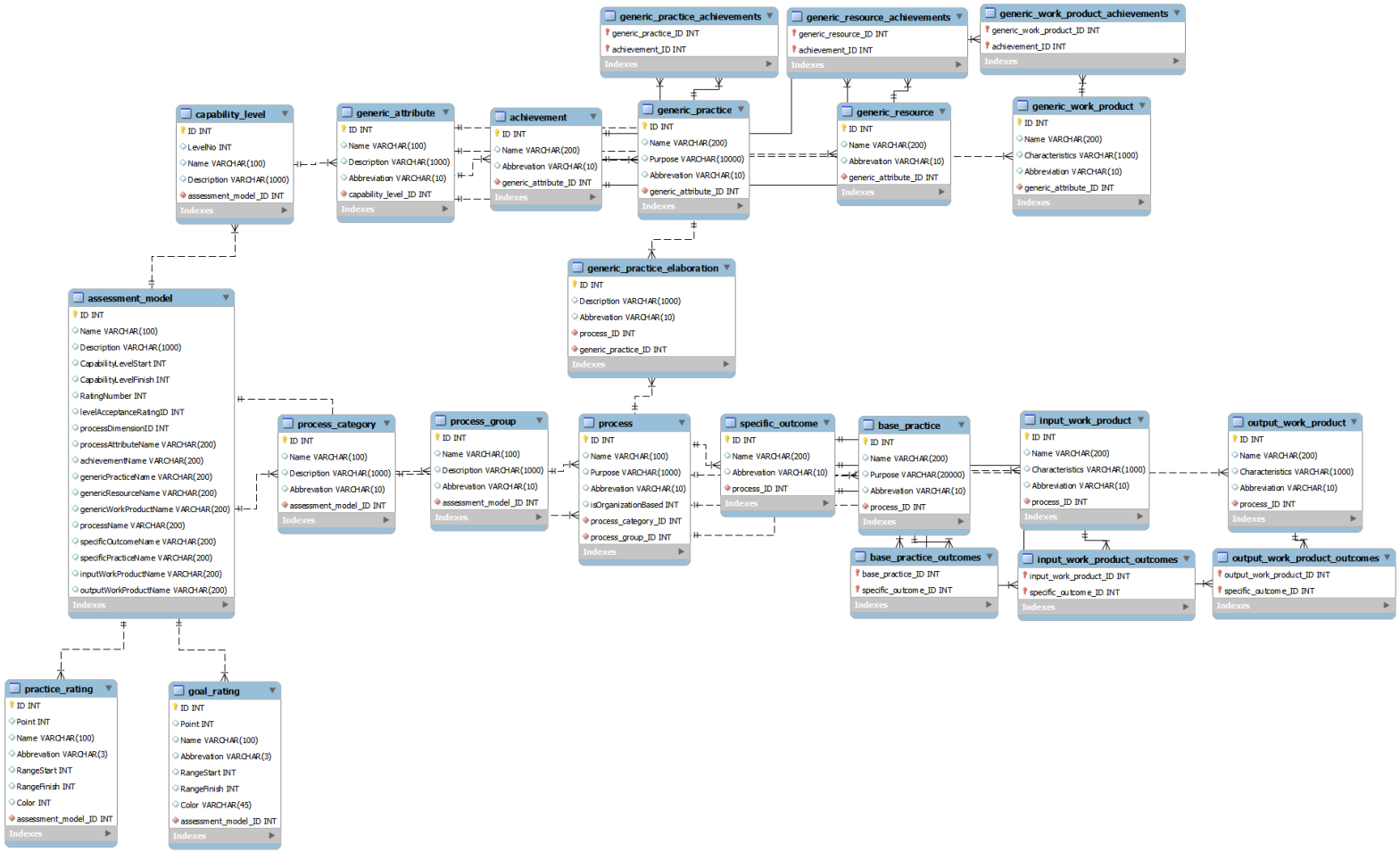


Figure 39 ER Diagram