A Web based Application for Project Performance Measurements - PRECISE

Term Thesis Report

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PHILIPS

Philips Semiconductors GmbH
Georg-Heyken-Straße 1, 21147 Hamburg, Germany

Elaborated by
Shrinivas Gadde
Matriculation No. 24170,
Information and Media Technologies,
Email: shrinivas.gadde@tuhh.de

Under the supervision of
Andreas Krause
Process Tooling, Innovation Center,
Philips Semiconductors GmbH,
Email: andreas.krause@philips.com

Under the guidance of
Prof. Dr. Joachim W. Schmidt
Software, Technology & Systems (STS)
Hamburg University of Technology,
Email: j.w.schmidt@tu-harburg.de

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STS
Arbeitsbereich
Softwaresysteme

Software Technology & Systems (STS)
Harburger Schloßstraße 20, 21073
Hamburg, Germany

TUHH
Technische Universität Hamburg-Harburg

Hamburg University of Technology
Schwarzenbergstraße 95, 21071
Hamburg, Germany.

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Shrinivas Gadde

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Acronyms and Abbreviations

BCaM	Business Creation and Management
BCP	Business Creation Process
CMM	Capability Maturity Model
CMMI	Capability Maturity Model Integration
eBIP	e-Business Infrastructure Platform
GUI	Graphical User Interface
KPI	Key Performance Indicators
LDAP	Lightweight Directory Access Protocol
Numetrics	Tool used for BCP project Benchmarking
OSRP	Overall System Realization Process
PD	(Philips) Product Division (Semiconductors)
PM	Project Management
PO	Project Office
PRECISE	Project database for Evaluation, Controlling, Inventory, Structure and Elaboration
RM	Requirements Management
SPaRC	Schedule, Project and Resource Core (Tool used for Project Planning)
SW-CMM	Capability Maturity Model for Software

1. Introduction

This chapter gives the motivation as the introduction to my Project Work. Also this chapter discusses about the project context, in which I have given description about various Project life cycle related processes on which PRECISE is based on. There is also section about Measurements and Metrics, in which I have given brief information about how Metrics can be used to record project performance measurements. PRECISE application is all about these Metrics and performance measurements.

Later at the end of this chapter I have given brief profile for PHILPS organization with its current brand positioning in the global market and about its products. This chapter also includes a section, which shows the present ongoing software development in Philips.

1.1. Motivation

The Project Office (PO) of the Innovation Center Hamburg has the responsibility to lead the management and execution of Business Creation Process (BCP) Projects. Processes are defined and in place for various steps during the complete project lifecycle.

Philips PD provides tooling for task planning, tracking, pipeline leveling of projects, document management and project benchmarking. Apart from these, PD is also concentrated on the Product Development area, mostly targeting on the Business Creation.

In Philips, projects are being setup and executed based upon the BCP. Project Management (PM) of these projects is done by planning tasks and by measuring the attributes like Cost (staff effort, phase effort and total effort), Schedule (development dates, project size and total effort) and Effort (size and complexity). Measuring these problems and use a system to apply metrics that concisely capture useful information, this can help in controlling and improving project through its complete lifecycle. These three measurements (Cost, Schedule and Effort) allow controlling the delivery date, budget spending and resource consumption on every project. Measuring metrics will make it possible to identify and resolve such problems in the projects. Also these metrics measurements can help in determining the status of corrective actions and improvements that can be taken in the development process of the project.

These measurements if taken in the initial phase of project can help in predicting the defects and failure rates for other and future projects. All projects follow established workflows, which are defined and formalize as a process. BCaM (Business Creation and Management) is one such process is used in Philips and this is discussed later.

For tracking such kind of project attributes PM tool is required for taking the performance measurements and management in the initial creation phase of the BCP Projects. In Philips PD there is currently a tool gap for recording the performance measurements and management in the initial creation phase of BCP projects.

The deliverable of this gap is a web application system, called PRECISE which is the acronym for PRoject database for Evaluation, Controlling, Inventory, Structure and Elaboration. This tool will fit into the described gap in order to offer tool support in various project processes.

The PO department is responsible for the deployment of the BCaM processes and is the local process authority for project teams. PO's Project Support group provides process related support for project deployment.

1.2. Project Context

In order to understand the requirements of the PRECISE tool, it’s important to go through the BCaM process on which PRECISE is indirectly based on. BCaM process has been evolved from CMMI and for this a brief description about CMMI as well is given.

Business Creation and Management

BCaM (Business Creation and Management) is a process that is based on the CMMI (Capability Maturity Model Integration) Level 2 concept. BCaM Process is based on two main components, BCaM program (processes) and BCaM tools. Processes and Tools will together provide the framework to target the Research and Development budget to maximum effect, which is one of the strategic priorities of the PD. Well defined processes will enable the improvement of execution and tools will form the necessary infrastructure, to support and automate the process, to make them easier to adopt and implement. BCaM tools will also help increase visibility to portfolio & projects and will improve communication. PRECISE is one such BCaM tool that will help to track performance measurements in the Project Execution process from the various BCaM processes.

Figure 1 shows the BCaM process with its components and Table 1 defines each process in more detail.

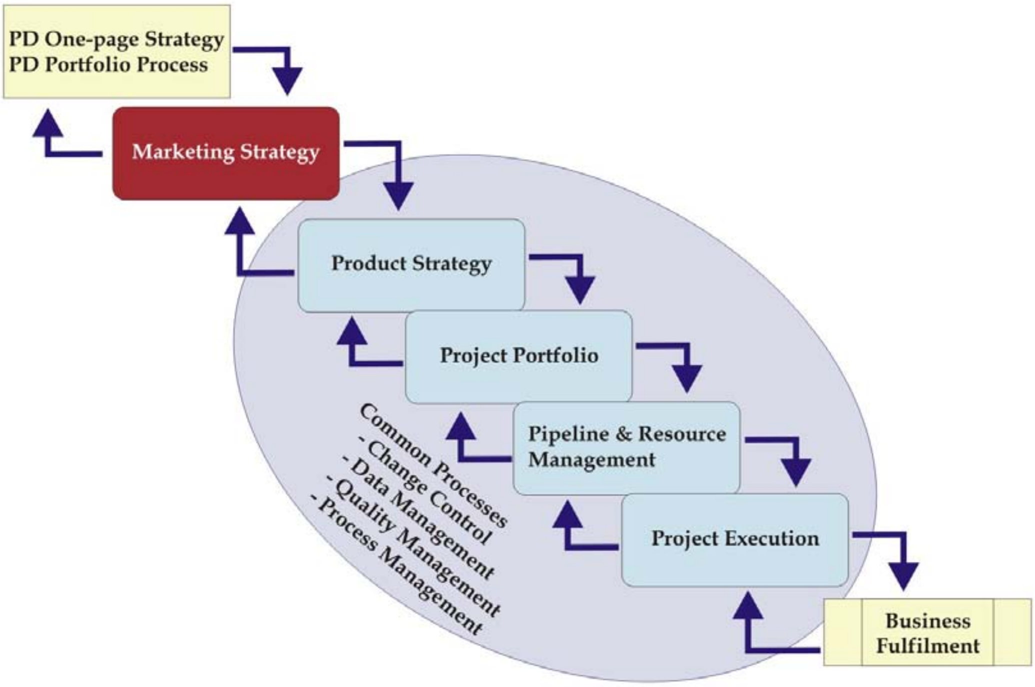


Figure 1: *BCaM Process*

Table 1: *BCaM Processes Description*

Process	Definition
Product Strategy	• Takes the market needs from the Marketing Strategy Process • Translates needs into roadmaps • Compiles the financial outlook
Project Portfolio	• Supports the product road mapping • Defines the project roadmaps and project priorities
Pipeline and Resource Management	• Supports the project roadmaps and Priorities • Assign resources to projects
Project Execution	• Aids the management of projects throughout the different phases of development

Capability Maturity Model Integration

CMMI (Capability Maturity Model Integration) models have evolved the CMM (Capability Maturity Model) concept, established by the SW-CMM (Capability

Maturity Model for Software) to a new level that enables the continued growth and expansion of the CMM concept to multiple disciplines. CMMI model is designed to help organizations improve their product and service development, acquisition, and maintenance processes. CMMI models are not processes or process descriptions and are not even same as the actual processes used in an organization structure and size. There are two standard representation of CMMI:

- **Continuous Representation:** This kind of representation allows selecting the order of improvement that best meets the organizations business objectives and mitigates the organizations areas of risk.
- **Staged Representation:** This kind of representation provides a proven sequence of improvements beginning with basic management practices and progressing through a predefined and proven path of successive levels, each serving as a foundation for the next level.

The staged representation organizes process areas into five maturity levels to support and guide process improvement. The staged representation groups process areas by maturity level, indicating which process areas to implement to achieve each maturity level. Maturity levels represent a process improvement path illustrating improvement evolution for the entire organization pursuing process improvement. Figure 2 shows the five maturity levels of Staged Representation and Table 2 lists the five maturity levels with their description.

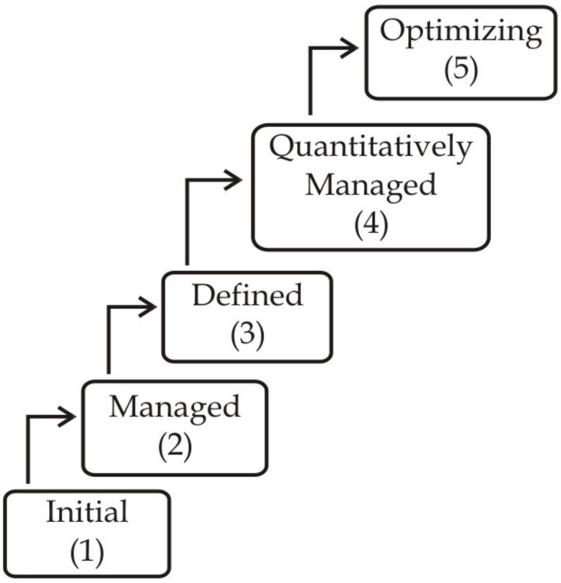


Figure 2: *CMMI Maturity Levels*

Table 2: *Maturity Level Descriptions*

Maturity Level	Name	Description
1	Initial	At the Initial Level, the organization typically does not provide a stable environment for developing and maintaining software.
2	Managed	At the Managed Level, policies for managing a project and procedures to implement those policies are established.
3	Defined	At the Defined Level, the standard process for developing and maintaining project across the organization is documented.
4	Quantitatively Managed	At this Level, the organization sets quantitative quality goals for both products and processes.
5	Optimizing	At the Optimizing Level, the entire organization is focused on continuous process improvement.

BCaM is one such process used at Innovation Center, which is based on the Staged Representation of CMMI and is concentrated only on the Level 2 of the five different maturity levels of CMMI.

1.3. Measurements and METRICS

As any project becomes bigger the expectations and demands also get increased and as a result the project quality insurance becomes more of an issue. The fundamental aim of measuring any project and project process is to increase understanding and thus increase the quality. The key reasons for measuring project performance measurements are to:

- Characterize project processes
- Evaluate project status with respect to plans
- Predict so that projects can be planned and
- Guide improvements of project engineering processes

Measurement is the only mechanism available for quantifying and identifying the characteristics needed to achieve this. Metrics indicate process or product qualities that are not directly measurable and if not addressed by metrics, are subjective and intangible. A metric can define a standard way of measuring some attribute of the software development process, such as Cost, Schedule and Effort. Metrics can range from the primitive types (directly measurable or countable, such as total number of outstanding defects) to complex and derived types (such as number of non-commented source statements per engineer per month).

Following in Table 3 is listed a real case Requirement Changes Metric Definition, which is of primitive type as an example and this Metric is actually being used in the PRECISE system.

Table 3: *Requirement Changes Metric Definition*

Metric Name	Requirement Changes
Process Area	RM
Calculation	NumberCR's
Type	Integer
Unit	Count
Measure Frequency	Monthly
Analysis Frequency	Monthly
Objective	Reduce the number of changes by gaining a better understanding on the meaning of the requirements together with the requirements providers

The purpose of Requirements Management (RM) is to manage the requirements of the project's products and product components and to identify inconsistencies between those requirements and the project's plans and work products.

RM involves establishing and maintaining an agreement with the customer on the requirements for any project. This agreement is referred to as the system requirements allocated to the project. The customer may be interpreted as the system-engineering group, the marketing group, another internal organization, or any external customer. The agreement covers both the technical and non-technical (e.g., delivery dates) requirements. The agreement forms the basis for estimating, planning, performing, and tracking the project's activities throughout the project development life cycle.

A group external may perform the allocation of the system requirements to any system components, and this group may have no direct control of this allocation. Within the constraints of the project the group takes appropriate steps to ensure that the system requirements allocated to project, which they are responsible for addressing, are documented well and controlled.

To achieve this control the system-engineering group reviews the initial and revised system requirements allocated to project to resolve issues before they are incorporated into the project. Whenever the system requirements allocated to project are changed, the affected software plans, work products, and activities are adjusted to remain consistent with the updated requirements.

PRECISE is such a Web-based system to facilitate multi user access that allows the user to record such performance measurements for their projects.

1.4. Company Profile

The foundations for what was to become one of the world's biggest electronics companies was laid in 1891 when Gerard Philips established a company in Eindhoven, the Netherlands, to manufacture incandescent lamps and other electrical products.

Whether in homes, factories, offices, airports, or on the streets, it is hard to imagine a place where Philips is absent. Some of its products are tucked away inside, like integrated circuits or CD drives. Some of them are undergoing dramatic changes in their dimensions – think of the flat screen TV, which can hang on the wall. Five of the world's top ten PC manufacturers sell monitors produced by Philips.

Philips is a global leader in color television sets, lighting, electric shavers, medical diagnostic imaging and patient monitoring and one-chip TV products. Its 166,500 employees in more than 60 countries are active in the areas of lighting, consumer electronics, domestic appliances, semiconductors, and medical systems.

Science and technology underwent tremendous development in the 1940's and 1950's, with Philips Research inventing the rotary heads, which led to the development of the Philishave electric shaver, and laying down the basis for later groundbreaking work on transistors and integrated circuits. In the 1960's, this resulted in important discoveries such as CCDs (charge-coupled devices) and LOCOS (local oxidation of silicon).

The 1990's was a decade of significant change for Philips. The company carried out a major restructuring program to return it to a healthy footing. And more recently it has been concentrating on its core activities.

Today, Philips is at the leading edge of the digital revolution, introducing world-class products that are helping to improve people's lives.

Philips Research and Department have generated many breakthrough inventions, such as the Compact Cassette system and the laser based optical disc systems CD-Audio, CD-ROM, CD-R/RW, SACD and various DVD-formats.

Philips produces over 2.4 billion incandescent lamps every year, and some 30 million picture tubes. Around 2.5 million heart procedures (scans and interventional procedures) on X-ray equipment are carried out each year using Philips technology.

Philips Semiconductors leads the car access and immobilization markets with a broad range of products for automotive system manufacturers and car key manufacturers.

Philips Identification portfolio covers a complete range of IC's for smart cards, tags, labels and readers, featuring a variety of coprocessors, security technology, memory devices and interface options. Philips produces from low-cost smart label IC's for high-volume supply chain management applications to next generation 32-bit smart-computing platform for powerful multi-application smart cards.

Philips in Software

Philips Software specializes in innovative multimedia, security and connectivity solutions for manufacturers of mobile and portable equipment. More than ever, rich, easy-to-enjoy multimedia experiences are keys to delighting consumers and maximizing average revenue per user today. By drawing on Philips world-class multimedia know-how, they enable their customers to create mobile devices that provide these compelling experiences and support exciting new services.

Throughout its history, Philips has focused on technologies that enhance people's lives. Its unrivalled expertise in multimedia has long been built into many of the world's most successful mobile and portable products in the form of embedded software. Philips Software has adapted this proven, reliable software, adapting it to provide a comprehensive portfolio tailored to the needs of the mobile multimedia industry and end-users. Philips software products truly enrich the user experience, improving voice, enhancing audio and video, and adding to the fun of mobile multimedia through features such as video editing. And all in ways that make these experiences easy to enjoy.

Developed for fast-moving, highly cost-sensitive markets, Philips advanced solutions speed product development, giving mobile phone makers and original design manufacturers a vital competitive edge. Their future-proof products enable them to meet the requirements of both network operators and consumers, today and in future.

The multimedia expertise at the heart of their solutions is unique among business-to-business ISV's and ensures Philips customers have access to innovative software based on open standards. Philips holds over 95,000 patents and has substantial on-going investment in software Research and Department. Naturally, Philips Software draws on these rich resources and many of their products are based on patents and Intellectual Property created by Philips world-renowned research organization.

Philips is also a leading player in standardization, deeply involved with many industry groups such as the OMA, DVB and MPEG. And this extensive expertise is further strengthened by Philips long experience in embedded core/DSP software optimization, real-time operating systems and mobile device system solutions.

By leveraging partnerships with silicon vendors, OS software companies and network providers, Philips Software offers customers choice and flexibility, and optimum interoperability and ease-of-integration. Applying Philips insight into consumer lifestyles and expertise in state-of-the-art audio, video and connectivity, their software solutions enable differentiating features that truly bring products to life.

2. Design of PRECISE

This chapter focuses on the scope of project that describes the requirements for the PRECISE Application, BCaM, which is the process type used in Philips internally and as well used by PRECISE and many other applications in Innovation Center. BCaM has been evolved from CMMI and in order to better understand BCaM, some knowledge about CMMI as well is necessary and for this section giving brief information about CMMI is also provided. Since, there are multiple user level roles that will be working and using PRECISE, there is also a section that describes all used and available user level roles in PRECISE.

Also in this chapter various models and diagrams are included which describe the artifacts, relations and their corresponding graphical representations for the PRECISE application. All the models are modeled using UML, which is the standard language that helps in specifying, visualizing, constructing, and documenting the artifacts of software systems, business modeling or any other non-software systems modeling concepts.

2.1. Requirements

The first step in leading the development of a software system are the requirements, which describes the state of the environment in which project has to exist. Here in this section I describe the requirements and achieve a common understanding of the problem for which PRECISE application is the solution and also the project deliverable.

The Project Office of the Innovation Center has the responsibility to lead the management and execution of BCP projects. Processes are defined and in place for various steps during the project lifecycle. Philips, central corporate organization provides tooling for:

- Task planning
- Tracking and pipeline leveling of projects using SPaRC
- Document management using Impulse-BCP
- Project benchmarking using Numetrics

However, there had been a tool gap for Performance Measurements and Management in the initial creation phase of BCP projects. To deliver a tool fitting into this gap is the goal of PRECISE, which is the acronym for PRoject database for Evaluation, Controlling, Inventory, Structure and Elaboration.

The primary goal for my project work was to develop such a web application called PRECISE, which will be used to provide functionality and support process areas of BCaM (discussed later).

The primary goals for the functionality of this web application are

- Deploy Measurement & Analysis CMMI Process Area within the scope of the CMMI project
- Support Project Intake Process owned by the Project Office
- Creation of an interface to gather project metric sample data
- Analyze project metric data
- Collect all running Innovation Center projects
- Provide input interface for significant project attributes for Project Managers
- Provide graph based reporting for analyzing the project with different metrics

Also this project should not cause double work to enter data in addition to these tools. Redundant data has to be taken when necessary and should be automatically getting updated on regular basis from the other Project Management tools used inside the PD.

PRECISE is planned in an incremental basis with a defined deliver plan. One of the goals is to also satisfy the releases with the desired function at each step that are shown below:

- Version 1 Release:
    - Gathering of project metric data
- Version 2 Release:
    - Analyze gathered project metric data
    - Derive Innovation Center high-level metrics
    - Replace the Excel-based Blue List project list
- Support of the project intake procedure
- Contain all running projects at Innovation Center
- Input interface for Project Teams to enter general project properties
    - Documentation: User Manual / Process Description

- Version 3 Release: Reporting of project metric data
    - Report on selected Metrics
    - Report on static project properties, including BFP-related data
    - Report controller relevant data
    - Support Bi-weekly project reporting of Project Managers

2.2. User Roles

Access to PRECISE system needs a valid user with sufficient privileges to make any modifications. These privileges are set in order to control user making any unnecessary modifications or allow them from entering or updating Metrics or Tracking Data (Cost, Schedule and Effort) for the projects not assigned to them. In PRECISE system, only Administrator has the sufficient privileges to add a new project or has the rights to assign users to projects. Table 4 lists the various user roles used in the PRECISE system, with the allowed permission for that specific user for his project and the later sections describe each user role in more detail.

Table 4: *User Roles in PRECISE System*

User Role	Read Permission	Edit/Write Permission
Administrator	Yes*	Yes*
Process Analyst	Yes*	No
Project Metrics Analyst and Project Manager	Yes**	No
Project Metrics Administrator and Quality Assurance Officer	Yes**	Yes**

*: Privileges on all Projects

**: Privileges per project basis only

Administrator Role

PRECISE system has only one Administrator whose primary role is to create new projects and assign users to projects. Apart from this, the Administrator has to also make sure that the system and the PRECISE database, which is the core of PRECISE, is always in consistent state.

Usually Administrator does not belong to any project in the PRECISE system and so they will not be interacting directly with the system. However, Administrator being the super user, by default has all the rights and privileges to access, update or enter data to any project in the whole system.

Process Analyst Role

Process Analysts are the users who have pretty much the same access privileges as Administrator with the only difference that they have read-only access to all projects in the system. In the whole PRECISE system there will be multiple users who will be assigned as the role of Process Analyst.

The primary work of Process Analysts is to evaluate the projects based upon the data entered by the user. Process Analysts can also have other roles like Quality Assurance Officer, Project Manager, Project Agent and Project Analyst for any project. For such projects, Process Analyst privileges will be overwritten by the privileges of that specific role.

Project Metrics Administrator Role

Project Metrics Administrator is responsible for storing project attributes (e.g. project team size, budget milestones etc.,) and for collecting project measurement data to store them in PRECISE system. On request (by the Project Manager or Leader or other authorized persons) Project Metrics Administrator delivers measurement, which can be generated by PRECISE system.

The Project Metrics Administrator is not necessarily owner of the measurement process. Since measurement values reflect specific aspects of the underlying processes that allow more detailed improvement analysis activities, it is common practice to involve the corresponding process owners like the Quality Assurance Officer or the Project Manager to assist and take the measurements.

Project Metrics Administrator can see and make any modifications only to the projects, which are assigned to them and are not allowed with any kind of access to other projects that are not assigned to them.

Project Metrics Analyst Role

The Project Metrics Analyst is responsible for providing process specific measurement data to the Project Metrics Administrator. These users can view all project relevant data that are stored in PRECISE System, including the project measurement values and project measurement reports.

These users have the least privileges in the complete PRECISE system and cannot make any modifications to the projects, where they have been assigned the role of Project Metrics Analyst.

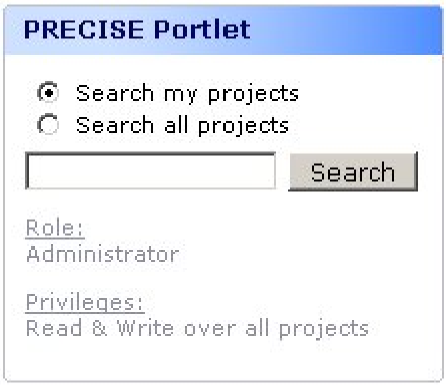
Quality Assurance Officer

Currently Quality Assurance Officer Role has not been defined and so for now these users have the same set of privileges and access rights as of Project Metrics Administrator, which had been described in the earlier section.

Project Manager

Currently Project Manager Role as well has not been defined, so for now these users have the same set of privileges and access rights as of Project Metrics Analyst, which as well has been described in earlier section.

Apart from the above given roles to the user, PRECISE system can support each user having multiple roles for different projects. PRECISE Version 2 supported only four user roles (Project Metrics Administrator, Project Metrics Analyst, Quality Assurance Officer and Project Manager) per project and so it was not possible to assign more users for a single project. However from PRECISE Version 3 this feature is made possible and it can now support unlimited number of users with any role assigned to the user. For users having multiple roles, the role with highest privileges overwrites all other roles and privileges. In PRECISE users are always displayed with there primary role and their privileges in the PRECISE Portlet. Figure 3 shows a sample screenshot of the PRECISE system where the user's Primary Role and his Privileges are displayed.



● Search my projects
○ Search all projects

Role:
Administrator

Privileges:
Read & Write over all projects

Figure 3: *User Role with his allowed Privileges*

2.3. UML Design of PRECISE

The Project Models and Diagrams are modeled using the Unified Modeling Language (UML), which is the standard language for specifying, visualizing, constructing and documenting the artifacts of any software systems. For my project, UML is used to provide views of the system design and requirements at different level of abstraction, and its artifacts provide the common view that serves as a basis for the collaborative design.

PRECISE Use cases

This view includes a use-case diagram that shows the basic functionality and overview of the system for different user roles. Use cases are a narrative operational description of how the system is used and provides an early view of the system structure.

Figure 4, Figure 5 and Figure 6 shows the use-case diagram for all available users role levels in PRECISE.

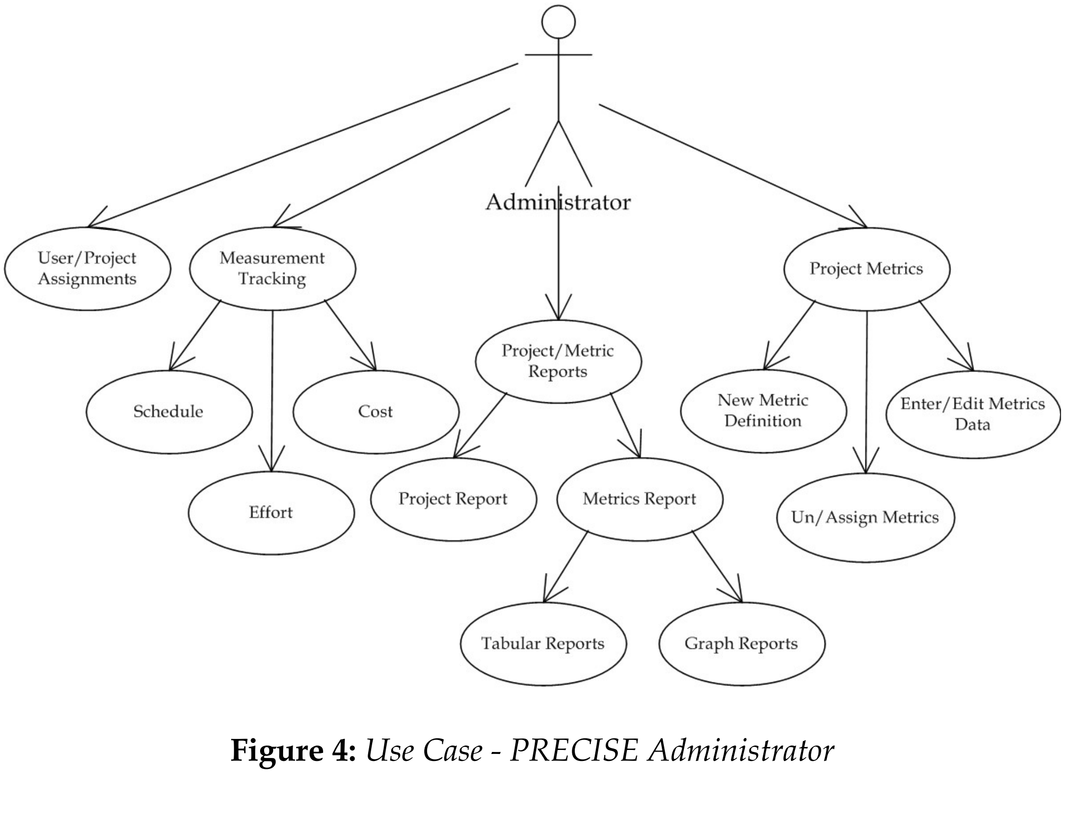


Figure 4: *Use Case - PRECISE Administrator*

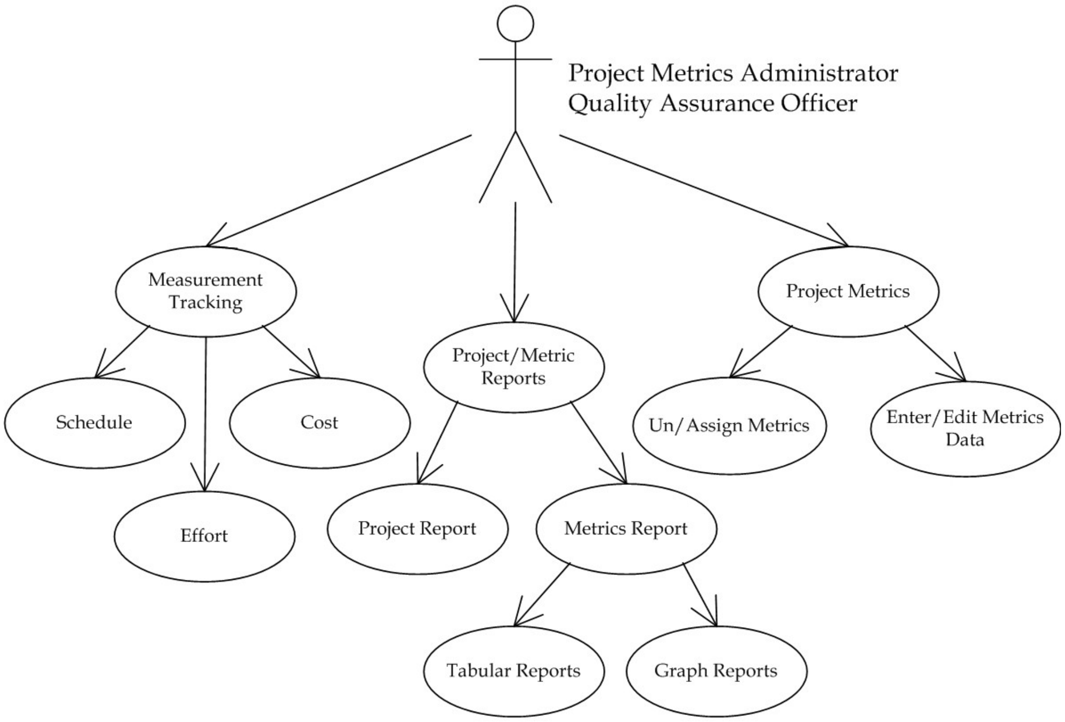


Figure 5: *Use Case - PRECISE Project Metric Admin & QAO*

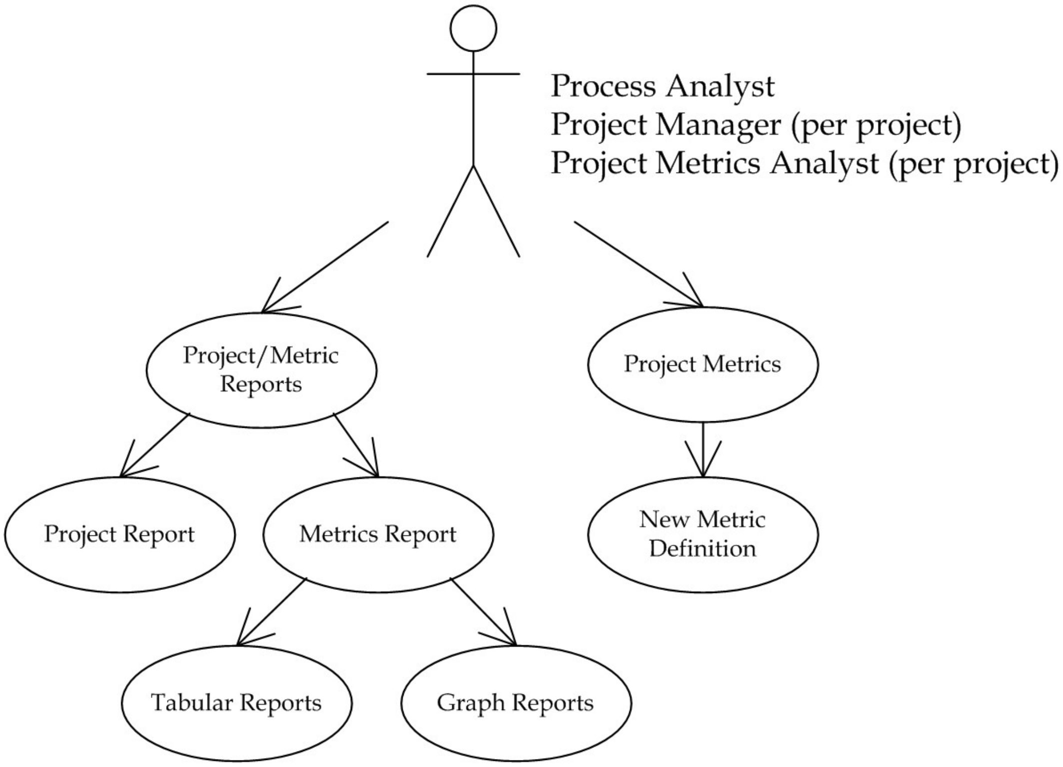


Figure 6: *Use Case - Process Analyst, Project Manager & Project Metric Analyst*

As can be seen from the use case model in Figure 4, Administrator has got complete access to the whole system in PRECISE. Next to Administrator, Project Metrics Administrator and Quality Assurance Officer are the users who have got some write privileges on the projects. Process Analyst, Project Manager and Project Metrics Analyst have got access to any project in the system but are limited only with certain number of operations. In the whole of PRECISE, only Administrator and Process Analyst have got system wide access to all Projects (but differ in access rights). Other all users have privileges based on their assignment to the project. Typical Use cases for every user role are shown in Figure 4, Figure 5 and Figure 6 and all the Use case operations are discussed below in brief.

User/Project Assignment: This Use case describes the operation where Administrator can do the User and Project assignments.

Measurement Tracking: This Use case operation allows the user to enter the regular project measurement data for *Schedule*, *Cost* and *Effort*.

Project Metrics: This Use case is combination of other Use cases, as it s dependent on User role. *New Metric Definition* allows the Administrator to add new Metric into the system. *Un/Assign Metric* allows the user to assign or un-assign any Metric for the selected project. *Enter/Edit Metrics* Data allows the user to enter the Metric data for the selected project and selected Metric.

Project Metric Reports: This Use case as well is combination of other Use cases, as it is also dependent on User role. *Project Report* Use case purpose is to show all the project attributes and parameters from the database. *Metrics Report* is further divided into two sub Use cases as user is independent to select the kind of report to be used. Graph Based report allow the user to generate various graph reports on the fly for the sample values he entered so far for any project selected.

User Interaction Diagram

For this view, usually one or more scenarios are included for every use case, as well as an interaction diagram for each scenario. Interaction diagram captures the dynamic behavior of objects in the system. Each diagram corresponds to a scenario. An interaction diagram is either a collaboration diagram or sequence diagram. The sequence diagram highlights the roles of objects in carrying the scenario and shows the progress of each with time. For my project work, I have used Sequence Diagrams as the model to show the interaction between the objects.

Figure 7 shows the sequence diagram for the basic login process for the user who is trying to view the list of assigned projects.

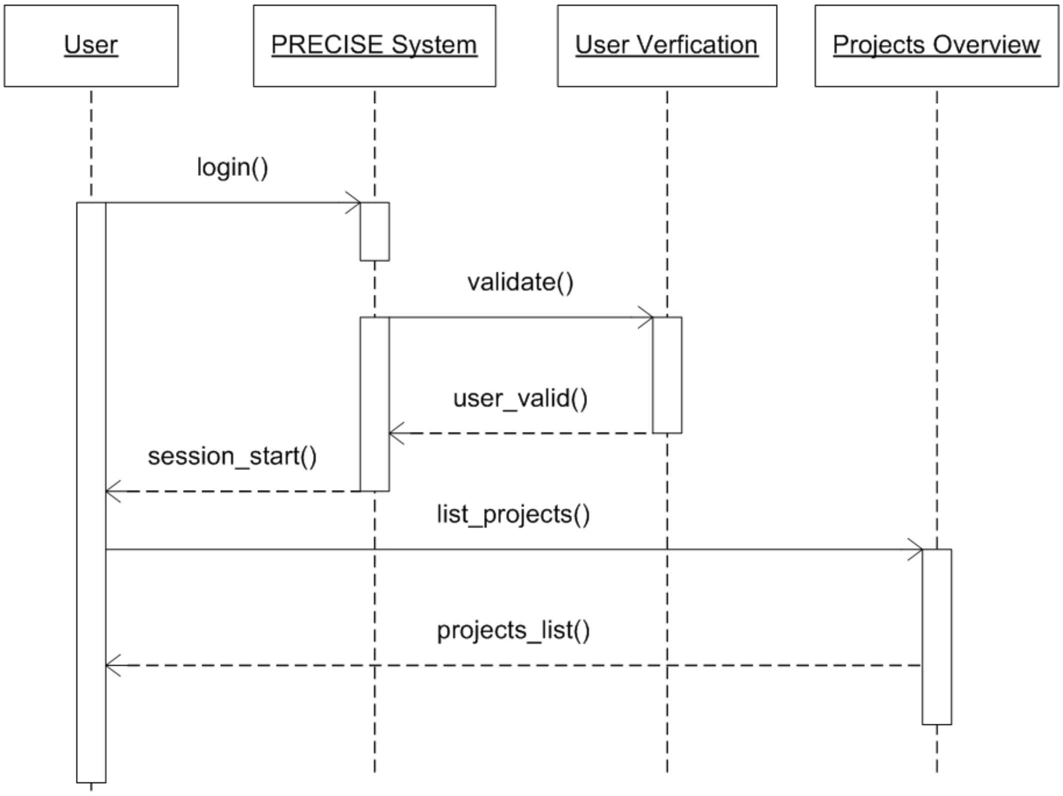


Figure 7: *Interaction Diagram - Login Process*

This diagram shows the dynamic interaction of the four objects that would be involved in executing the scenario Projects Overview. The activity starts when the user object chooses to use the PRECISE system, for which User sends the login details, which is carried out by the method login( ) that is shown in the above diagram using an arrow, which is a call from User object to the PRECISE System. In order to validate the user with the privileges granted to them, PRECISE System validates this using validate( ) method on User Verification object. The result from the User Verification object is returned to the PRECISE System with the method user_valid( ) and is shown in the above diagram using the dotted arrow. Once the PRECISE System has verified the user successfully, it starts a new session with the User. Now, after starting of a new session User will be shown with all the projects assigned to him. From here user can select any project he likes and perform any further operations he like. Figure 8 shows the dynamic interaction of the five objects that would be involved in executing the scenario Project Metrics Use case in Figure 4.

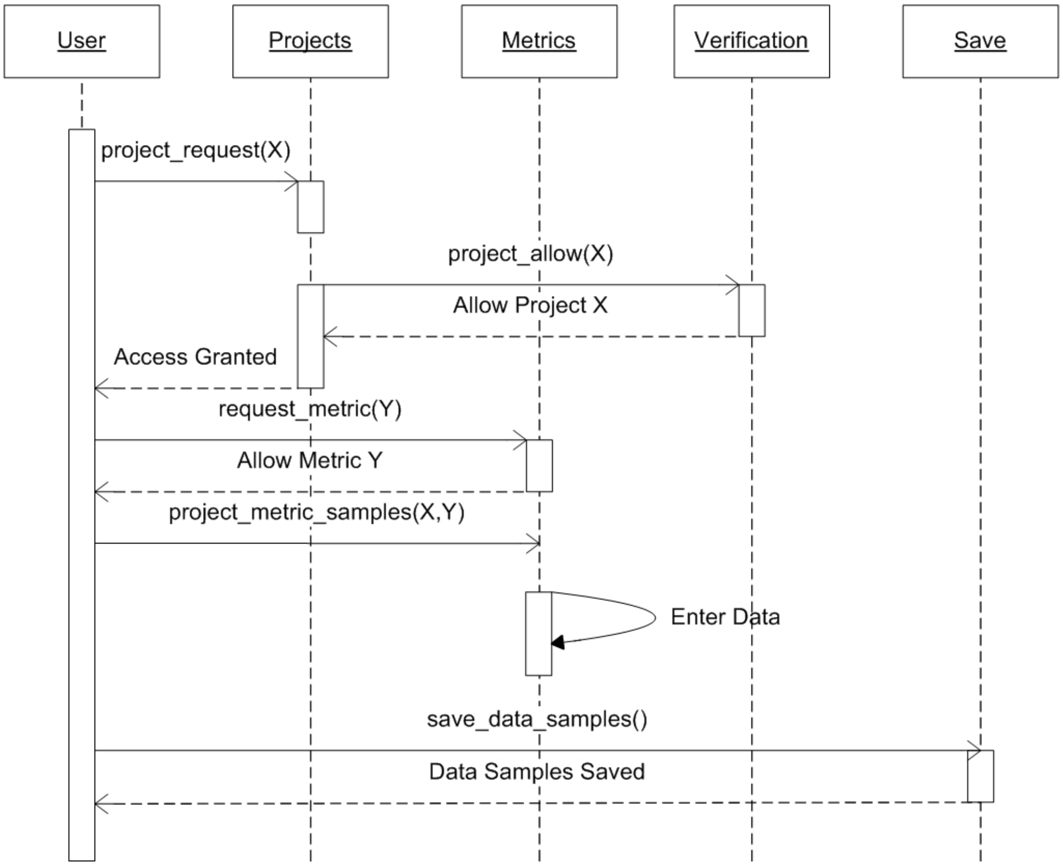


Figure 8: *Interaction Diagram - Metric measurements*

The activity in the above diagram starts when User requests for some specific project from the Projects Object. In order to allow the user to make any changes, the user must be verified to check if the user is really having enough privileges to make changes on the selected project.

The Verification object does this verification and once the user has been granted the access for the project, user can select any metric from the system and enter data into the database, which will be an iterative process. Rather than entering the sample values explicitly every time, the measurement data entering is repeated till user selects to actually save the data. The Save method is always acknowledged by a return message.

Class Diagram

Figure 9 shows the class diagrams for the PRECISE system. This view primarily shows the functional requirements of a system, the services the system is providing to its end users. The operations listed in the class diagram are discussed below and are pretty much the same as the ones in the Data Model that has been described later in much detail.

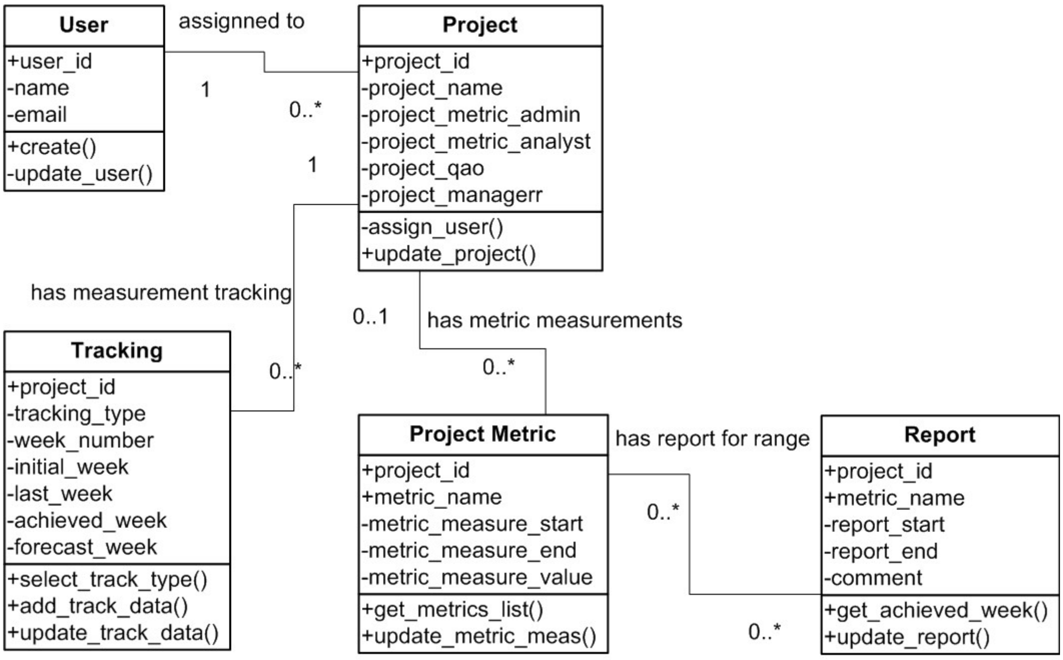


Figure 9: *Class Diagram - PRECISE*

Project: This is the main source for all the transactions performed by the user. In fact, in order to make any other operation the user has to access this class and select the project from here. This class has got two basic methods. assign_user( ) allows the Administrator to assign any number of users to any project and update_project() operation allows the user to update the project attributes and other parameters.

User: This class is used to list all the users with their default access levels. This class as well has also got two basic methods. create ( ) method allows to create new users in the system and update_user( ) is used to update any of the user defined data (like password, email address etc.,).

Tracking: This class is used to check and enter the measurement tracking information. This class has got three methods. select_track_type() is used to define the type of (schedule, cost or effort) tracking entered by user. add_track_data( ) and update_track_data( ) are used to enter/update new/old tracking data.

Project Metric: This class is one of the important classes in PRECISE. This class is used for assignment/un-assignment of any metric and also is used to record the project metric data. This class has got two methods. Get_metrics_list( ) is used to get the list of assigned metrics and update_metric_meas( ) method is used to update any old metric data.

Report: This class is used to generate reports based on the metric data entered by the user. This class has got two methods. get_achieved_week( ) is used to check for the existence of any Gate/Milestone entered by the user under Tracking. update_report( ) is used to update any parameters for any saved report.

Software Components for PRECISE

This view includes a specification of software subsystem components and their inter dependencies. Each subsystem component comprises of other subsystems or components. The architecture of a system captures the model of communication among software components including direction of data flow among the systems. The Software Components diagram in this section has the main purpose to show the structural relationships between the various components of PRECISE System.

Figure 10 shows the all the Software Components involved in the PRECISE System. PRECISE Application sits on the top of the all other software components and is comprised of Project Management, User and Role Management and Template Engine subsystems.

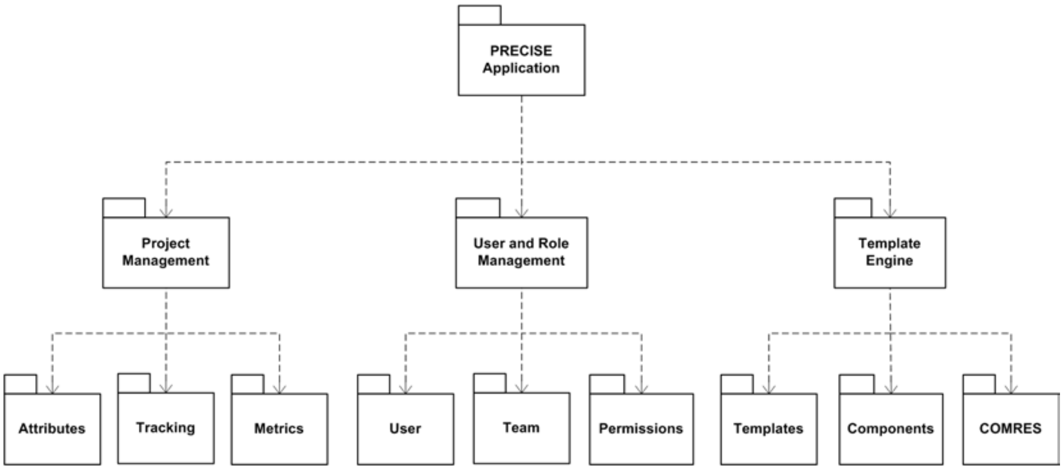


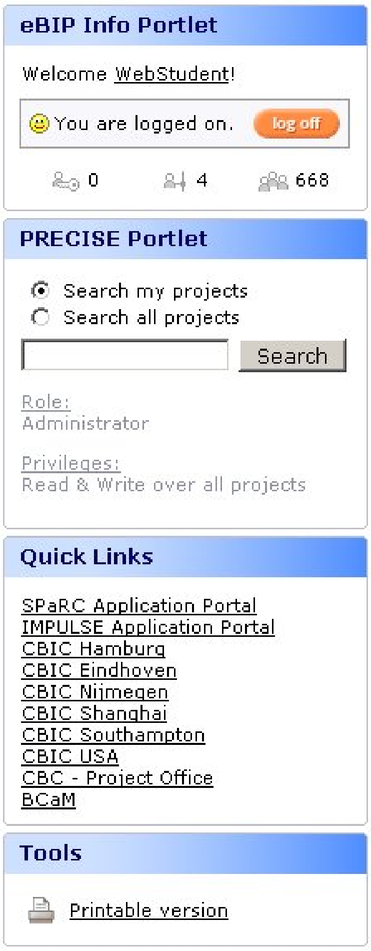
Figure 10: *Architecture View - Subsystem Model*

Each software component is subdivided and explained in more detail in the following sections.

Project Management Software Component: This component comprises of the subcomponents that are actually part of PRECISE Database system. This subsystem is used to store the Based Data which is mainly the project debrief data like characteristics, size of work products, effort, duration etc and Derived data which is mainly Key Performance Indicators (KPI, Metrics) used for performance evaluation.

User and Role Management Software Component: This component comprises of the User, Team and Role Management subcomponents. This subsystem is mostly related with User accounts creation, Team assignments and Role declarations. All the user accounts are created here, and then their assignments with their specific team and also the specific rights and privileges for each user.

Template Engine Software Component: Template Engine component comprises of Templates, Components and COMRES (default layout template content package). This subsystem is responsible for applying the style sheets and various look & feel for the PRECISE System. This subsystem is also responsible for attaching various useful components (known as Portlets in PRECISE system) like the ones shown in Figure 11. There are four Portlets (eBIP Info Portlet, PRECISE Portlet, Quick Links and Tools Portlet) shown in Figure 11 and Table 5 gives brief information about each Portlet.



eBIP Info Portlet

Welcome WebStudent!

You are logged on. log off

0 4 668

PRECISE Portlet

● Search my projects
○ Search all projects

Search

Role:
Administrator

Privileges:
Read & Write over all projects

Quick Links

SPaRC Application Portal
IMPULSE Application Portal
CBIC Hamburg
CBIC Eindhoven
CBIC Nijmegen
CBIC Shanghai
CBIC Southampton
CBIC USA
CBC - Project Office
BCaM

Tools

Printable version

Figure 11: *Portlets in PRECISE*

Table 5: *PRECISE Portlets*

Portlet Name	Description
eBIP Info Portlet	This Portlet shows the total number of users in the Innovation Center community, total number of users using PRECISE and also displays the number of users currently logged into the portal.
PRECISE Portlet	This Portlet provides the global project search facility to users and this Portlet also shows the users primary role and privileges.
Quick Links	This Portlet shows users with various quick links, which will enable the user to jump to any page from the current location.
Tools	This Portlet is used to provide users with tools, which will enable them to carry out some quick actions and tasks. Currently only Printable Version tool is provided.

Site Map Diagram

Sitemaps and site indexes are the forms of supplemental navigation. They give users a way to navigate a site without having to use the global navigation, by providing a way to visualize and understand the layout and structure of the site and definition of workflow.

Sitemaps provide a high-level or top-down view of the site. Figure 12 shows the high-level sitemap for PRECISE System.

As shown in the Figure 12, user first enters to the PRECISE system through the PRECISE Homepage link where user will have to Sign-In, in case he has not done so. Once the user login Id and password is received, it is verified with the database and a check for the Role and privileges is done. Once the verification process is successfully done, user is shown with the Projects Overview where all the projects assigned to him are listed and from here user is free to select any project from this list.

Once the user sees the projects list and based upon his role on the project he can select any task he wants. The tasks, which are not allowed for the user, will be hidden and this is managed by the PRECISE system. In Project Attributes user can enter or update the debrief data like project characteristics, size of work products etc. If the user's role is Project Metrics Administrator or Quality Assurance Officer for the selected project or if the user is Administrator himself then he will be seeing a form with all the present values for the project and then user can make any changes in the form and then make them permanent by saving them.

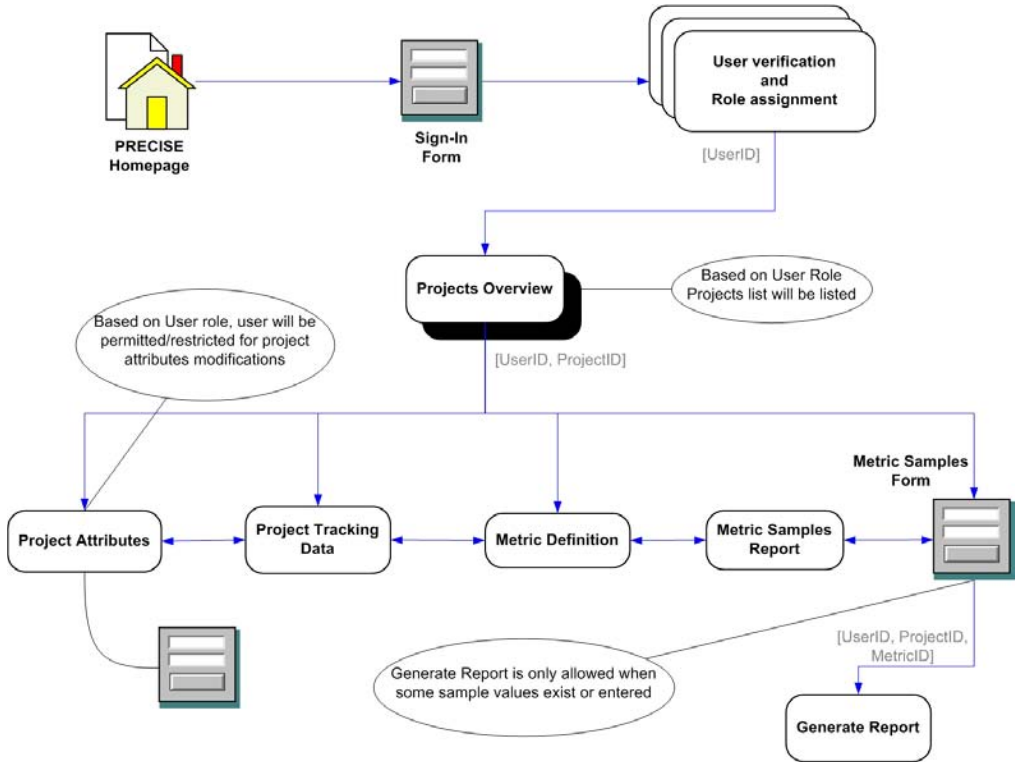

PRECISE Homepage
Sign-In Form
User verification and Role assignment
[UserID]
Projects Overview
Based on User Role Projects list will be listed
Based on User role, user will be permitted/restricted for project attributes modifications
[UserID, ProjectID]
Metric Samples Form
Project Attributes
Project Tracking Data
Metric Definition
Metric Samples Report
[UserID, ProjectID, MetricID]
Generate Report is only allowed when some sample values exist or entered
Generate Report

Figure 12: *Higher Level Site Map*

In Project Tracking Data user will be able to enter or update the regular tracking data such as Cost, Schedule and Effort attributes. For not administrative users, this page would be invisible and the user would not be able to access this page.

Metric Definition page consists of all the Metrics definitions that serve as a template for projects in the initial phase when the user has assigned Metric to his project.

For Metric Samples Form users with administrative privileges can select any Metric from the Metric Definition page and then enter the measurement values in the form and then make them permanent by saving them.

Reports for all the measurement values entered earlier can be seen using the Metric Samples Report page. Generate Report page is used for generating reports based on the measurement data for any range and for the measurement values existing in the PRECISE system.

All of the above WebPages have been explained with their screenshots in the sub-sections of Chapter 3 (Implementation part), which is being discussed next.

3. Implementation

For any software development project, there is always some planning and modeling is required as the groundwork for the actual implementation. Although, the actual implemented project might be different than the planned one. This chapter describes the actual software implementation part of the whole project work which is based on the theory discussed in sections of Chapter 2.

In this chapter, I start with describing the Software Constraints and then with the Data Model. Here I include a section describing the application runtime and the link between the User Interface and the data model. At the end I show all the User Interface components screenshots of PRECISE application and also give description for each.

3.1. Software Constraints

This section describes all the software and tools that had been used for the development and implementation of PRECISE Web Application. Development of PRECISE has been done using all open source packages and tools. These tools are also part of the Philips Product Division used tools and these are listed below with a brief description:

- PHP (recursive acronym for Hypertext Preprocessor) as the main scripting language
- MySQL and Oracle RDBMS as data storage engine (mostly MySQL)
- ezSQL as database abstraction wrapper class for performing database related operations
- PHPLIB as PHP Library for session, authentication, permission and user management
- Smarty as page layout template engine
- JavaScript as client side programming language for interface control
- COMRES as layout template content package
- Focus on functionality delivery for targets focusing on GUI issues

Apart from the software tools used, following is the list of specifications that had been given and taken care while developing this project.

- User-Interface
    - Must be via web-browser
- Data must be stored in the PRECISE, MySQL database
- Consumer Views: User-interface must be tailored to each data Consumer
    - Only data valid for the views may be displayed
    - There must be at least one view for each Consumer role
- Supplier Views: User-interface must be tailored to each data supplier
    - Only data valid for views may be displayed
    - There must be at least one view for each supplier role
- In the Consumer Views, it must be possible to
    - Sort the data in ascending or descending order
    - Export the data being displayed in the view to
        - A CSV formatted file copy
        - A printed copy
    - View and Print graphical representations of raw data
- In the Supplier View, it must be possible to
    - Insert, update and delete data
    - Inserts, updates and deletes of data are limited by the data access authority of the role
- Screen layout: Must be compliant with Philips Intranet web-page style guide

3.2. Data Model

Data modeling is the act of exploring data-oriented structures. Like other modeling artifacts data models can be used for a variety of purposes, from high-level conceptual models to physical data models. Physical data modeling is conceptually similar to design class modeling, the goal being to design the internal schema of a database, depicting the data tables, the data columns of those tables, the relationships between the tables and the operations being performed on those tables.

The model in this section describes an abstract way in which the data can be represented in an information system or a database. Figure 13 shows this data model with all relations between different tables and the corresponding operations performed on that table. The data model in Figure 13 also defines the set of specific constraints like Primary Keys and Foreign Keys.

The data model show in Figure 13 is actually a combination of Oracle and MySQL Database. Tables EBIP_USER, EBIP_PERM, EBIP_USERPERM, EBIP_TEAM and EBIP_TEAMUSER belong to Oracle database and rest all tables belong to MySQL database. For better understanding, each table is divided into subsections and has been explained later in more detail.

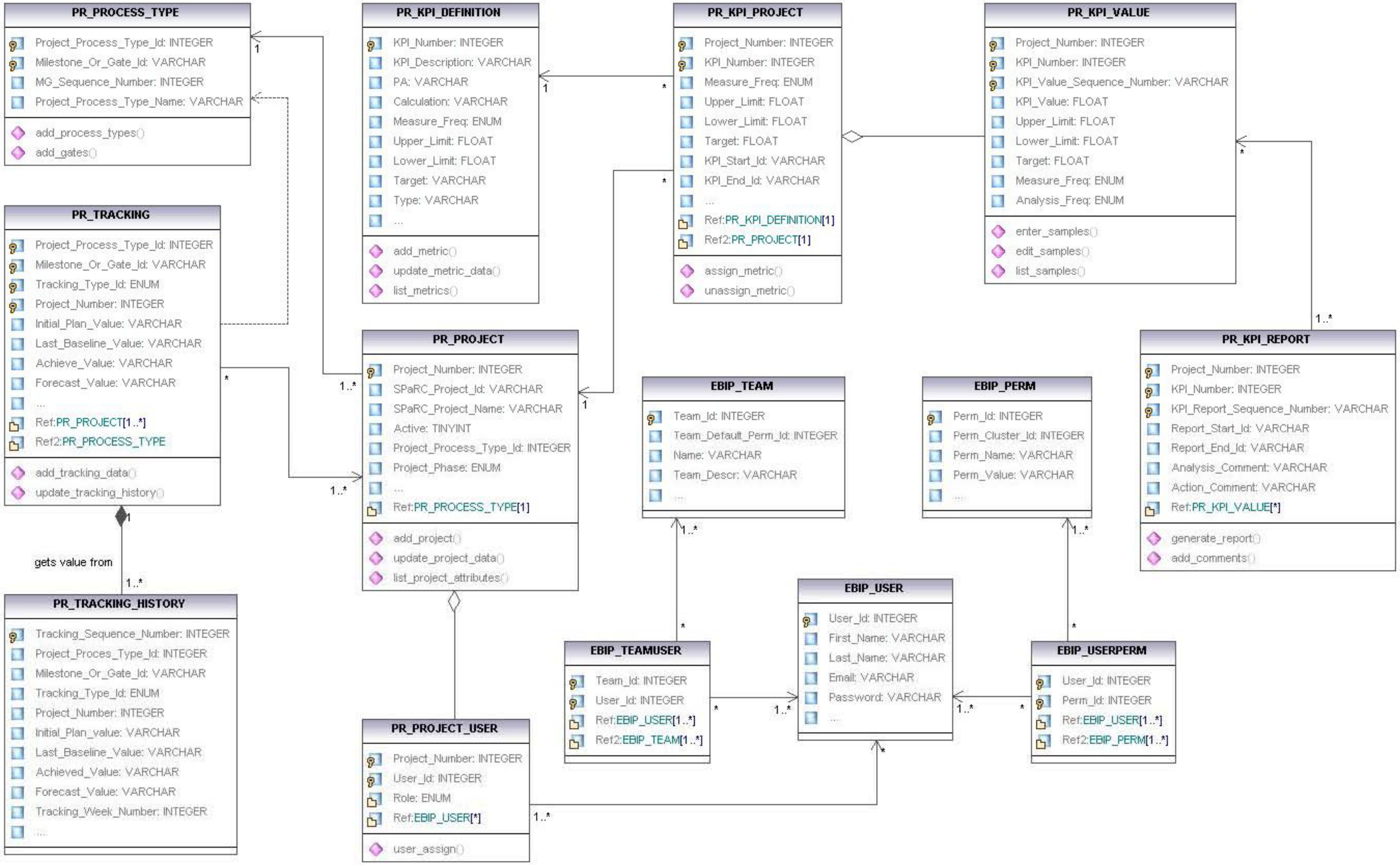


Figure 13: *Data Model for PRECISE*

For realization of the real case some values from the PRECISE database are listed in Appendix for the tables listed in Figure 13.

EBIP_USER: This table is used to store all the user related static information like user name, email address, password etc. For regular Innovation Center, Hamburg users the authentication is usually done through the LDAP server but for the external users, the authentication is checked through the password field in this table. Uniqueness in this table is maintained by assigning User_Id as Primary Key. The value for this field is always a unique auto-generated identity. This field will be used to link and reference other tables.

In PRECISE, all user values are taken from this table only and so there is the dependency relationship between the PR_PROJECT_USER and EBIP_USER tables. PR_PROJECT_USER table is used to store project and its assigned user information.

EBIP_PERM: This table is used to store data related to various permissions and privileges that are to be defined and used later in the applications. The important fields in this table are Perm_Id, Perm_Cluster_Id, Perm_Name and Perm_Value field is the Primary Key and is used to maintain the uniqueness in this table. Perm_Cluster_Id is used to store the Team_Id of the EBIP_TEAM table, and the purpose of this field is to indicate the team for which these permissions were actually created. Perm_Name is used to give a common name for the permission and Perm_Value is used to set the actual permission value.

These permissions are then combined with the User_Id of EBIP_USER in a common EBIP_USERPERM table. Uniqueness in this table is also maintained by assigning Perm_Id as Primary Key. The value for this field is always a unique auto-generated identity. This field will be used to link and reference other tables.

EBIP_TEAM: In Innovation Center all users are assigned to different groups or teams and the purpose of this table to store such groups or teams. In order to use and work on PRECISE, it is necessary that users must belong to the PRECISE Team. The important fields in this table are Team_Id, Team_Default_Perm, Name and Team_Descr. Uniqueness in this table is maintained by assigning Team_Id as Primary Key. The value for this field is a unique auto-generated identity. Team_Default_Perm is used to indicate the default permission level for its respective Team_Id. Name field indicates the common name assigned to the Team and Team_Descr field is used to store brief information about the Team.

Usually for all users Team_Default_Perm is applied as the default permission level. But, for assignment of special privileges EBIP_USERPERM table is used. Assignments of all users to their teams are done in EBIP_TEAMUSER table.

EBIP_USERPERM: This table combines the permissions of EBIP_PERM table with the users from EBIP_USER table. Users who have to be given special permissions other than the default one which is assigned in the Team_Default_Perm field of the EBIP_TEAM table must be assigned here.

This table has got only two fields User_Id and Perm_Id. User_Id is taken as a reference from the EBIP_USER table and Perm_Id values are taken from the EBIP_PERM table. Both the fields User_Id and Perm_Id are set as Primary Keys to maintain the uniqueness and keep the table in consistent state. Like said earlier in the description of EBIP_TEAM, users who are not assigned to any Team in EBIP_TEAMUSER will not be able to access PRECISE even if the user might have been assigned with the permissions here in this table.

EBIP_TEAMUSER: This table combines the Teams defined in EBIP_TEAM with the users from EBIP_USER table. This table is used to assign users to their teams. In order to use and work with PRECISE, all users must be assigned to the PRECISE Team_Id.

Like EBIP_USERPERM table, this table has also got only two fields User_Id and Team_Id. User_Id is taken as a reference from the EBIP_USER table and Team_Id values are taken from the EBIP_TEAM table. Both these fields are set as Primary Keys to maintain the uniqueness and keep the table in consistent state.

PR_PROJECT: This is the main table for PRECISE application that contains all the important static project attributes like Project_Number, SPaRC_Project_Name (Project Name) and Active etc. Since there are many fields related to project like Finance Information, Project phases etc not all fields are mentioned in the Figure 13. Uniqueness in this table is maintained by assigning Project_Number as Primary Key. The value of this field is always a unique auto-generated identity. This field will be used to link and reference in almost all tables.

Two important fields of this table are the Active and Project_Process_Type_Id. Active is a field that indicates if the project is in working state or not. If the project is not in working state then the user is not allowed to make any modifications for the project. Project_Process_Type_Id shows the process for the project and this field shows the currently set process type. Processes for PRECISE are defined in the PR_PROCESS_TYPE table (explained later).

This table has the three primary operations add_project( ), update_project_data( ) and list_project_attributes( ). add_project( ) operation is used and can be executed only by administrator for inserting project into database. update_project_data( ) operation is used for the users having administrative privileges to update project attribute values. The third operation list_project_attributes( ) can be accessed by any privileged user in PRECISE system. And the purpose of this operation is to extract list of the projects from the database that belong to the active user.

PR_PROJECT_USER: This table contains all user assignments with their specific role given to their projects. To maintain uniqueness the fields Project_Number, User_Id and Role are set as the Primary Key. In order to maintain consistency Role was also selected as a combination for the Primary Key with the Project_Number and User_Id field. Doing this will stop the multiple assignments of the same user with the same project.

This table PR_PROJECT_USER is aggregate to the PR_PROJECT table because if the project is deleted or does not exist in the PR_PROJECT table then there should not be any users who are still assigned to a project that actually is not in the system. If this condition were allowed then it would lead the system to an inconsistent state.

This table has only one primary operation, which can be accessed only by administrator, and the purpose of this is to assign users to their projects.

PR_PROCESS_TYPE: This table contains all the defined process types such as OSRP and BCaM that are used in Innovation Center. These processes are of very much importance for PRECISE and their main purpose is to control the project phases through the complete project lifecycle. Earlier in section 0 BCaM process has been described in more detail.

Uniqueness of this table is maintained by keeping two fields of this table, Project_Process_Type_Id and Milestone_Or_Gate_Id as Primary Key fields. Project_Process_Type_Id field is used to give a unique identity for the process types and Milestone_Or_Gate_Id field is used to have the Gates/Milestone name. MG_Sequene_Number is a numeric field and is used to order the Gates/Milestone of the Milestone_Or_Gate_Id. Project_Process_Type_Name defines the process name for that Gate/Milestone.

This table has got two operations and only administrator can execute both of them. add_process_type( ) operation is used to add new processes into the system. And add_gates( ) operation is used to add new gates for existing processes.

PR_TRACKING: Performance Measurement data such as Cost, Schedule and Effort (discussed earlier in the section 1.2) are stored in this table. This table is used to store the measurement data for the Gates/Milestone of the process type defined in the PR_PROJECT table. New Measurement values that are taken on a regular interval basis are recorded in this table. For existing measurement values, they are moved to the PR_TRACKING_HISTORY table.

Uniqueness of this table is maintained by setting the Primary Key on the fields Project_Number, Project_Process_Type_Id, Milestone_Or_Gate_Id and Tracking_Type_Id. Project_Number is selected so that we can make sure that the measurement data is recorded on specific project basis. Project_Process_Type_Id indicates the process type and Milestone_Or_Gate_Id indicates the Gate/Milestone being used for that specific project. Tracking_Type_Id is an enumerated type field with predefined values of Cost, Schedule and Effort. Tracking_Type_Id is used to differentiate performance measurement values that are being tracked.

Initial_Plan_Value, Last_Baseline_Value, Achieved_Value and Forecast_Value are the fields that store the actual measurement values. Week_Number indicates the week on which these values were actually recorded.

This table has got two operations and any user who is having administrative privilege on the selected project can access both of these. add_tracking_data( ) is the operation that allows the user to record new measurement data for a new project. update_tracking_history( ) operation is used to overwrite measurement data that already exists. This operation will also move the old data to PR_TRACKING_HISTORY table.

PR_TRACKING_HISTORY: This table is used only as a backup or repository for the PR_TRACKING table. Whenever user updates or tries to overwrite existing measurement values in the PR_TRACKING table then the old measurement values get moved to this table and then the new values get inserted into the PR_TRACKING table. In this table Tracking_Sequence_Number is set as Primary

Key for maintaining the uniqueness. Since this table is used for backup for an existing consistent table, the fields other than Tracking_Sequence_Number are not set or checked for uniqueness.

This table PR_TRACKING_HISTORY is aggregate to PR_TRACKING table because if there were no tracking data in PR_TRACKING table then there would not be any data for copying to PR_TRACKING_HISTORY table. This table does not have any operations, as no user (even administrator) interact directly with the data in this table. The update_tracking_history( ) operation for the PR_TRACKING table takes care of updating records in this table.

PR_KPI_DEFINITION: This table is used to store all the Metric definitions and all attributes like PA (Process Area), Calculation, Measure_Freq (Measurement Frequency) etc., for its Metric. Metric definitions are nothing but a way to evaluate the performance and other characteristics for the projects. Metrics are also known by the term Key Performance Indicators (KPI's).

These metrics will be used to assign with projects and record measurement data for these metrics to evaluate the project performance. In earlier section, I have given description about KPI's or Metrics in detail. Here in this table KPI_Number is used as the Primary Key for this table. KPI_Number is an auto-generated number and this is used as an identity for identifying and relating Metrics with other tables. Other fields are the default attributes for the Metrics and are given with some standard default values.

This table has got three operations add_metric( ), update_metric_data( ) and list_metrics( ). add_metric() and update_metric_data( ) operations can be accessed only by Administrator or Process Analyst users. Process Analysts are the actual users who are responsible for setting up the new Metric definitions. add_metric( ) operation is executed when a new Metric definition has to be inserted and update_metric_data() operation is executed when there has been any Metric definition attributes change request. list_metrics( ) operation can be accessed by all users and the result of this operation is to list out all the Metric definitions with its attributes from the database.

PR_KPI_PROJECT: This table combines the Metrics definitions of the PR_KPI_DEFINITION table with the projects from PR_PROJECT table. For any project there can be any number of metrics available from PR_KPI_DEFINITION can be assigned. For the first time all the default pre-defined values of the Metric are copied to this table and later these values will be overwritten by user-entered values.

Uniqueness of this table is maintained by setting the Primary Key on the fields Project_Number and KPI_Number. Rests of the fields in this table are similar to the ones in the PR_KPI_DEFINITION table. For the first time when user assigns a Metric to any Project these field values will be copied to this table and later when user actually starts entering measurement values, its left to the user to modify these values or not.

This table has got two operations assign_metric( ) and unassign_metric( ). Users can access these two operations with administrative privileges on the selected project. assign_metric( ) operation is used for the assignment of the Metrics defined in PR_KPI_DEFINITION table and unassign_metric( ) operations purpose is to remove or Un-assign any Metric that has been assigned for the selected project.

PR_KPI_VALUE: In this table all the performance measurement values for each Metric are stored. All these measurement values have to be valid and must comply with the attributes set in PR_KPI_PROJECT table. Some of the important fields in this table are Measure_Frequency which is of enumerated type with values Bi-Weekly, Monthly and Gate/Milestone is used to know the frequency of measurement to be taken for the selected metric. Other important fields in this table include KPI_Value_Sequence_Number that is used to store the measurement date or Gate/Milestone dependency on the type set in Measure_Frequency and other important field is KPI_Value that is used to store the project Metric performance records.

Uniqueness in this table is maintained by setting the Project_Number, KPI_Number (Metric) and KPI_Value_Sequence_Number (Measurement Date or Gate/Milestone) as Primary Key.

This table has a weak aggregation relationship with PR_KPI_PROJECT table because all the values for this table can be executed only if there is a Metric assignment to the project. This table has got three operations enter_samples( ), edit_samples( ) and list_sampels(). enter_samples( ) and edit_samples( ) operations require that user has got administrative privileges on the selected project. enter_samples( ) operation purpose is to record measurement data entered by user. This operation also makes sure that the data, which is entered by the user, is in consistent state. edit_samples ( )

operation is used to modify old measurement values. list_sampels( ) operation is used to list all the measurement data for any selected Metric of a selected project.

PR_KPI_REPORT: In this table performance measurement values required to generate graph reports are stored. Reports are usually created on the fly for various range values that are taken from the KPI_VALUE_Sequence_Number of PR_KPI_Value table. This table only stores the values and later whenever user wants to review report, the graph is generated again on the fly based on those values. Users with any privilege for any project are allowed to generate and save reports. Users can also give comments for the graph reports they have generated.

Uniqueness in this table is maintained by assigning Primary Key to the Project_Number, KPI_Number and KPI_Report_Sequence_Number. These values are copied from the PR_KPI_Value table as they are with the only exception of KPI_Report_Sequence_Number field that stores the value of KPI_Value in PR_KPI_VALUE table.

This table has got only one operation generate_report( ), which is used to generate new reports or existing ones from the database. In case of old reports, a check for the existence of the values in the PR_KPI_Value is done.

3.3. Runtime Structure

The foundation of any Web application is the database. In a well-factored application, the database is protected by a set of objects contained within the *database access layer*. On top of this layer is the *business object layer*, which implements the business rules. During execution, the *user interface layer* communicates with the business object layer. These three code layers form the structure of a three-tier Web application server. Two-tier servers merge the business logic into either the database layer or the user interface.

In either topology, the database access layer is a focal point for the application because it provides a level of abstraction between the customer view of the data and its implementation within the database. Because of this, the robustness of the application as a whole is partially dependent upon the robustness of the database access layer at the bottom of the technology stack.

There are number of tools available to build database layers for PHP automatically and PRECISE uses one such database layer called ezSQL. ezSQL allows the database to perform atomic operations and also combines all the database abstraction methods into one single class file for easy include and direct access to the database.

The main reason to use such database access layer is to use the quality and consistency benefits of generation to make a strong foundation for the application. Abstraction is a technique which simplifies something complex. It does this by removing non-essential parts of the object and allowing the programmer to concentrate on the important parts of application.

In PRECISE ezSQL serves as a wrapper for all the main application logic and allows to easily access the database server other important database functions. Figure 14 shows the screenshot of the complete PRECISE Runtime structure with the ezSQL wrapper.

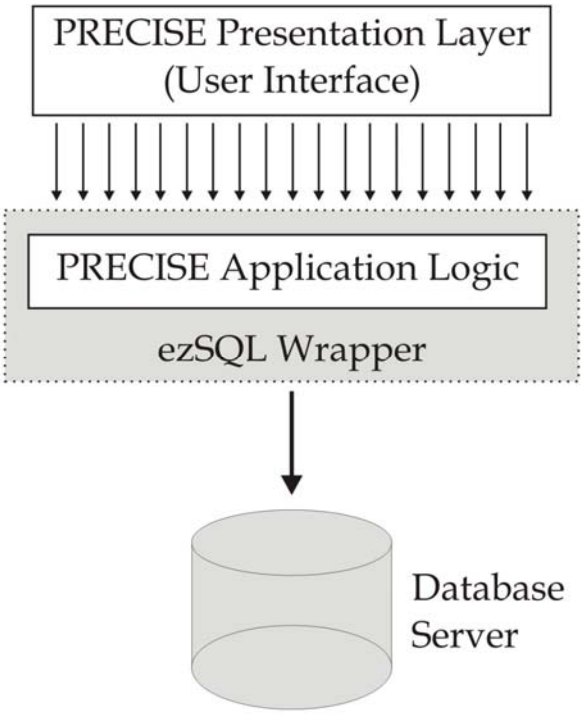
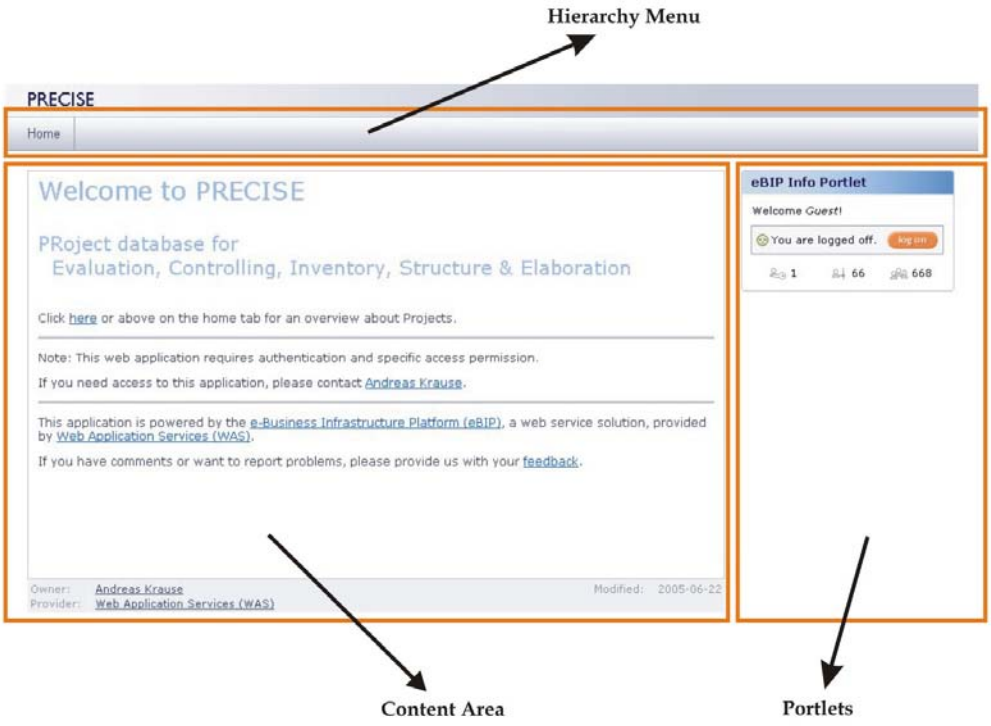


Figure 14: *PRECISE Runtime Structure*

3.4. PRECISE User Interface

This section describes the actual working of PRECISE application from user's point of view and also shows some sample screenshots for some test projects with test user accounts.

PRECISE application environment consists mainly of three parts Hierarchy Menu, Content Area and Portlets. These three parts are shown in Figure 15 and have been briefly described in Table 6.



Welcome to PRECISE

PRoject database for
Evaluation, Controlling, Inventory, Structure & Elaboration

Click here or above on the home tab for an overview about Projects.

Note: This web application requires authentication and specific access permission.

If you need access to this application, please contact Andreas Krause.

This application is powered by the e-Business Infrastructure Platform (eBIP), a web service solution, provided by Web Application Services (WAS).

If you have comments or want to report problems, please provide us with your feedback.

Owner: Andreas Krause
Provider: Web Application Services (WAS)
Modified: 2005-06-22

Welcome *Guest*!

You are logged off.

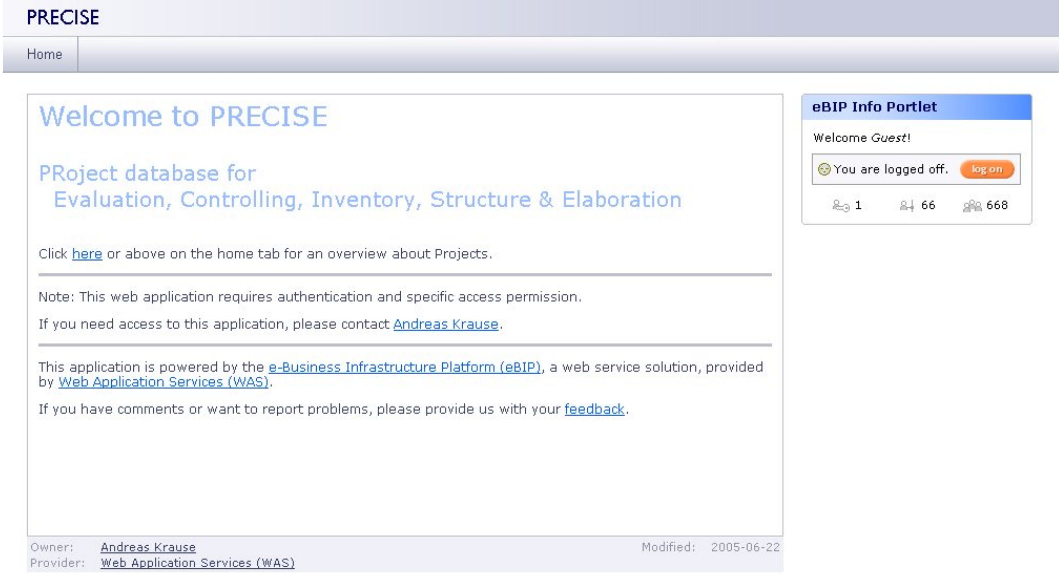
1 66 668

Figure 15: *PRECISE Application Parts*

Table 6: *PRECISE Application Parts Description*

Part Name	Description
Hierarchy Menu	Here in this location, user will see a dynamic menu. The behavior of this menu is based on the content Area.
Portlets	In this part user will be able to access some useful tools and can carry out some quick actions and tasks. Portlets have been discussed earlier in section 2.3.4.3
Content Area	This is the main part of the application where user will input data or will see the output based on his actions.

In order to start using PRECISE application for any user, it is necessary that user is assigned to the PRECISE Team Group (discussed earlier) and that user has been assigned to some project. Also, it has to be made sure that user is set with sufficient privileges to access projects. Users can start PRECISE using the Innovation Center intranet links or by manually entering the PRECISE URL. For any users who are trying to start PRECISE, are welcomed with the index webpage. The screenshot for this index webpage is shown in Figure 16.



Welcome to PRECISE

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Click here or above on the home tab for an overview about Projects.

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If you need access to this application, please contact Andreas Krause.

This application is powered by the e-Business Infrastructure Platform (eBIP), a web service solution, provided by Web Application Services (WAS).

If you have comments or want to report problems, please provide us with your feedback.

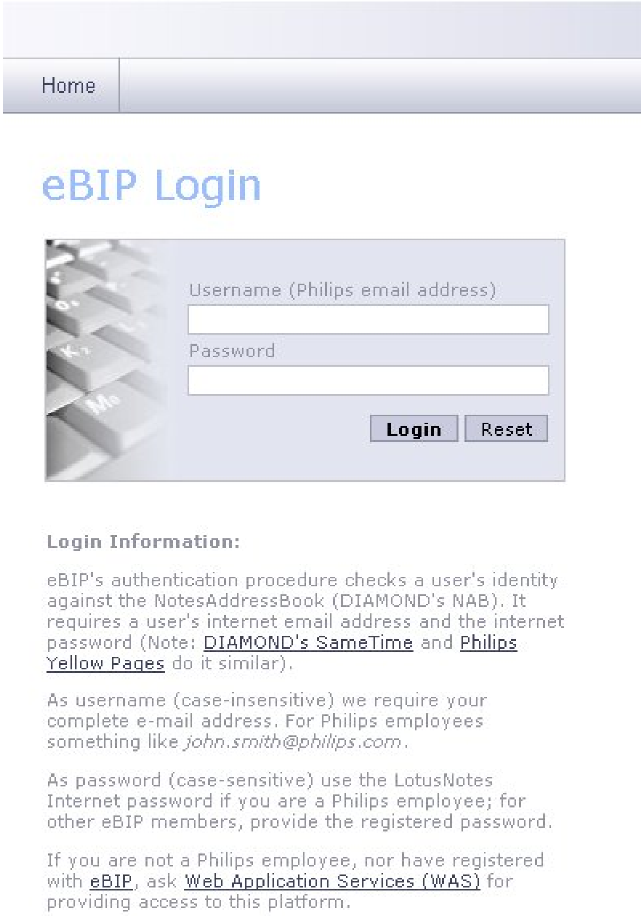
Owner: Andreas Krause Modified: 2005-06-22
Provider: Web Application Services (WAS)

Welcome *Guest*!

You are logged off.

Figure 16: *PRECISE Welcome Webpage*

In order to proceed from the index webpage, user must click on either the Home Tab (Hierarchy Menu) or on the here link (Content Area) or on the log on link (eBIP Info Portlet) to go the Projects Overview webpage, where user can view all the projects assigned to them. Figure 17 shows the screenshot for the eBIP login webpage. Since PRECISE system is based upon eBIP platform and if user is already logged into eBIP then user need not login again. PRECISE checks for any existence of user session and if it finds user session active then user are taken directly to Projects Overview webpage. For better understanding, I have described all the main WebPages and parts of the PRECISE web application in multiple subsections.



Login Information:

eBIP's authentication procedure checks a user's identity against the NotesAddressBook (DIAMOND's NAB). It requires a user's internet email address and the internet password (Note: DIAMOND's SameTime and Philips Yellow Pages do it similar).

As username (case-insensitive) we require your complete e-mail address. For Philips employees something like *john.smith@philips.com*.

As password (case-sensitive) use the LotusNotes Internet password if you are a Philips employee; for other eBIP members, provide the registered password.

If you are not a Philips employee, nor have registered with eBIP, ask Web Application Services (WAS) for providing access to this platform.

Figure 17: *eBIP Login Screen*

Hierarchy Menu

This is a dynamic menu for PRECISE application and is mostly dependent on the content user is browsing and on user role. When user selects any project or metric, the value gets stored in the session and the Hierarchy Menu uses this session variables to enable or disable some menu items. Figure 18 shows the screenshot of the main menu items contained in the Hierarchy Menu of PRECISE application. Each menu has been explained briefly in following sub-sections.

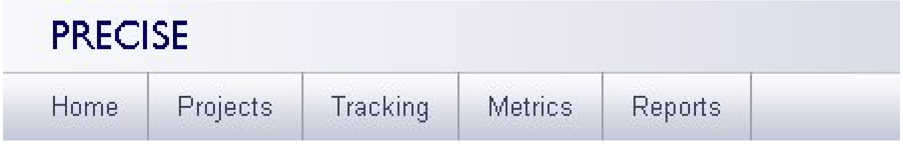


Figure 18: *Hierarchy Menu in PRECISE*

Home Hierarchy Menu: Clicking on Home link will take the user to Projects Overview webpage, which by default will list all the active projects. Projects Overview is described in more detail in section 3.2.2. Home is a static link in the Hierarchy Menu and is always linked to Projects Overview.

Projects Hierarchy Menu

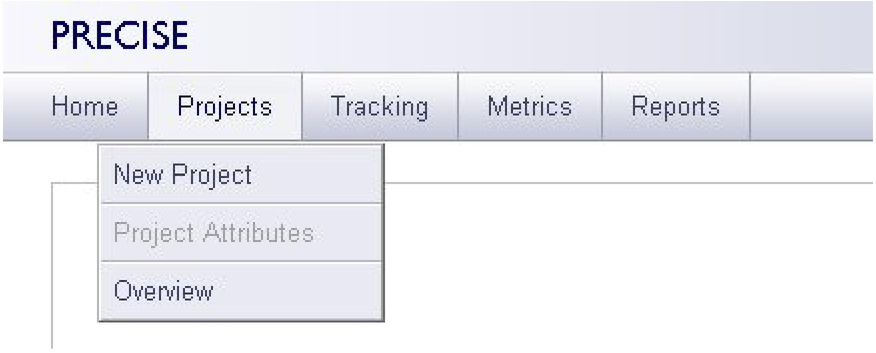


Figure 19: *Hierarchy Menu - Projects (for Administrator)*

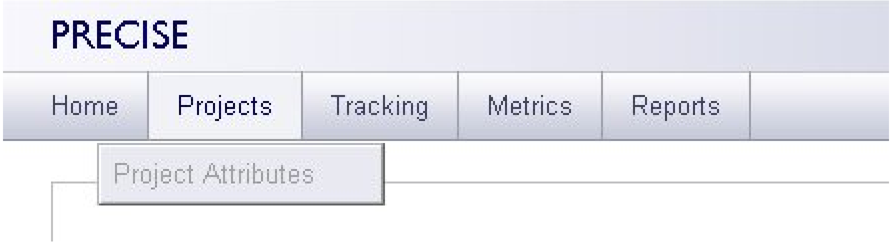


Figure 20: *Hierarchy Menu - Projects*

Projects menu is dynamic and is dependent on the user role and session variables. Figure 19 and Figure 20 shows the Projects menu screenshot for administrator and for normal users. In both menus, Project Attributes is common and is linked to the page where user can view or modify the static project attributes. Project Attributes link can be accessed by any user, but is dependent on the project session variable. User must select some project, and then only user will be able to access Project Attributes under this menu.

New Project is used for adding new projects and as can be seen from the Figure 19 screenshot, this item is enabled only for administrator. Overview link is the clone for Home link, which when clicked will take the user to Projects Overview webpage.

Tracking Hierarchy Menu:

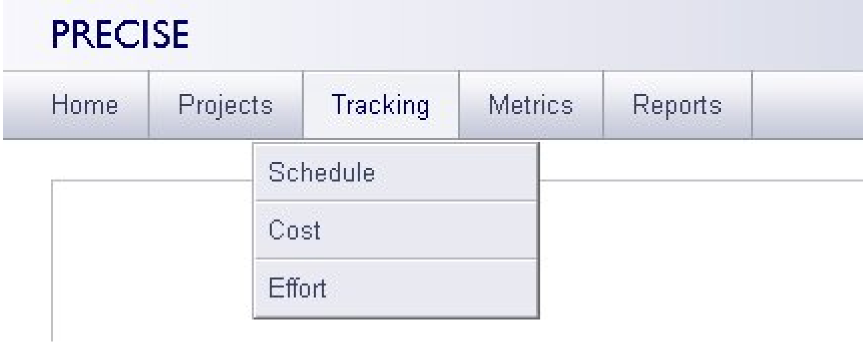


Figure 21: *Hierarchy Menu - Tracking*

Tracking menu also consists of three items, which are Schedule, Cost and Effort. Figure 21 shows the screenshot of this menu. Tracking is used to store performance measurement values like Schedule, Cost and Effort for the selected project. This menu is common for every logged in user and these three items link to the same page with the only difference that each links to a separate measurement type in the projects tracking webpage. Tracking is explained in more detail with sample screenshots in later section.

Metrics Hierarchy Menu:

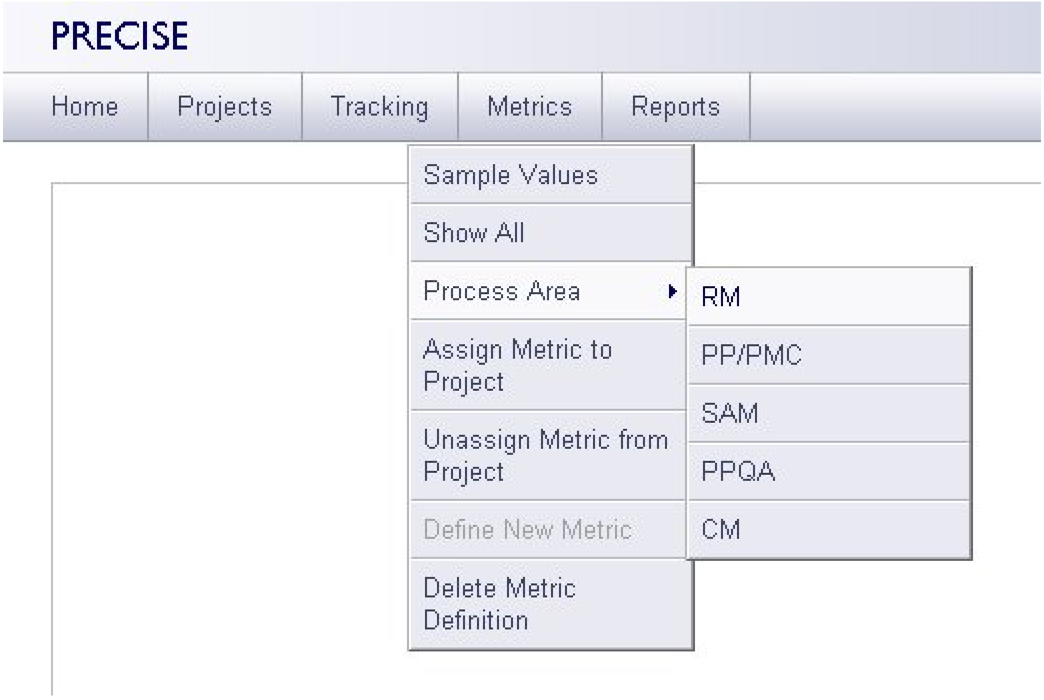


Figure 22: *Hierarchy Menu - Metrics*

Metrics menu consists of seven items and all of these can be seen in the Figure 22 Metrics screenshot. Sample Values link will take the user to the webpage where user can enter and save the project related metrics data. Show all links the user to metric definitions page, where user can browse through the Metric attributes before they can actually assign them to their projects. Process Area is also similar to the Show All link with the only difference that user can directly browse the metric definitions based upon some common Process Area. Assign Metric to Project and Un-assign Metric from Project, both link to the same page with the difference that, one is used to assign metrics where as other is used to Un-assign or remove metrics for the selected project. Define New Metric link is used to add new metric definition in PRECISE and this link is enabled only for Administrator or Process Analysts role based users. Delete Metric Definition is used to remove or delete any metric definition from PRECISE. Both of these links are enabled only for the administrator or for the users having Process Analyst role. All of these operations have been described in later sections.

Reports Hierarchy Men:

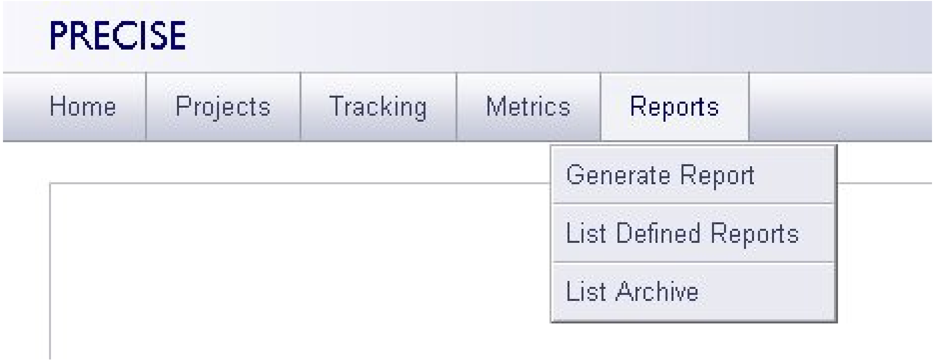


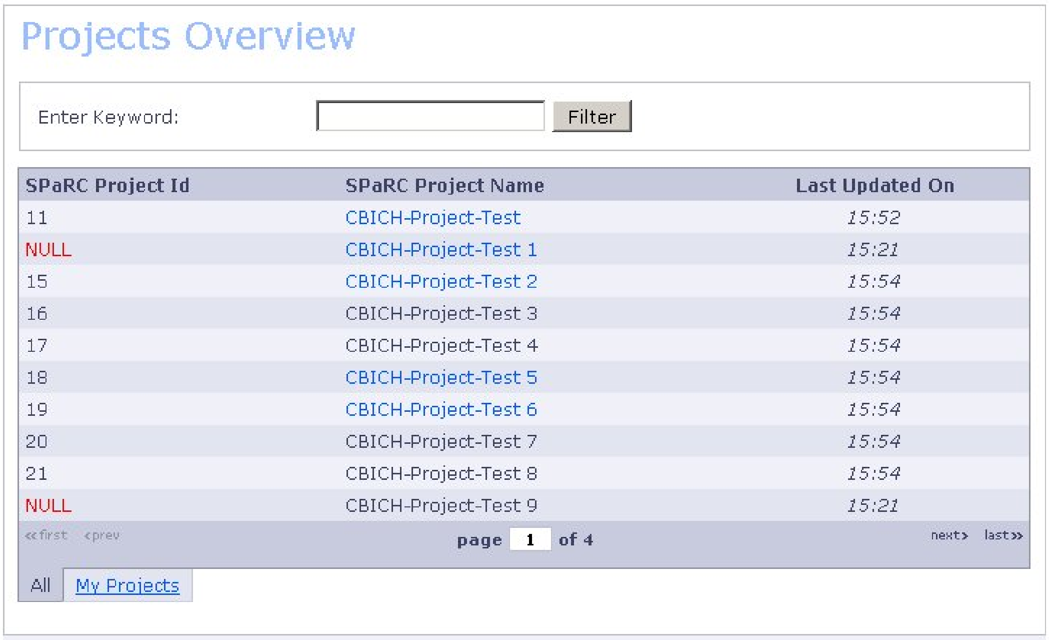
Figure 23: *Hierarchy Menu - Reports*

Reports menu consists of three items and these are shown in Figure 23. Generate Report links to the webpage where user can generate graph-based reports. Generate Report is explained in more detail in later section. List Defined Reports shows the list of all the values for every metric. List Archive lists all the graph-based reports generated before.

Projects Overview

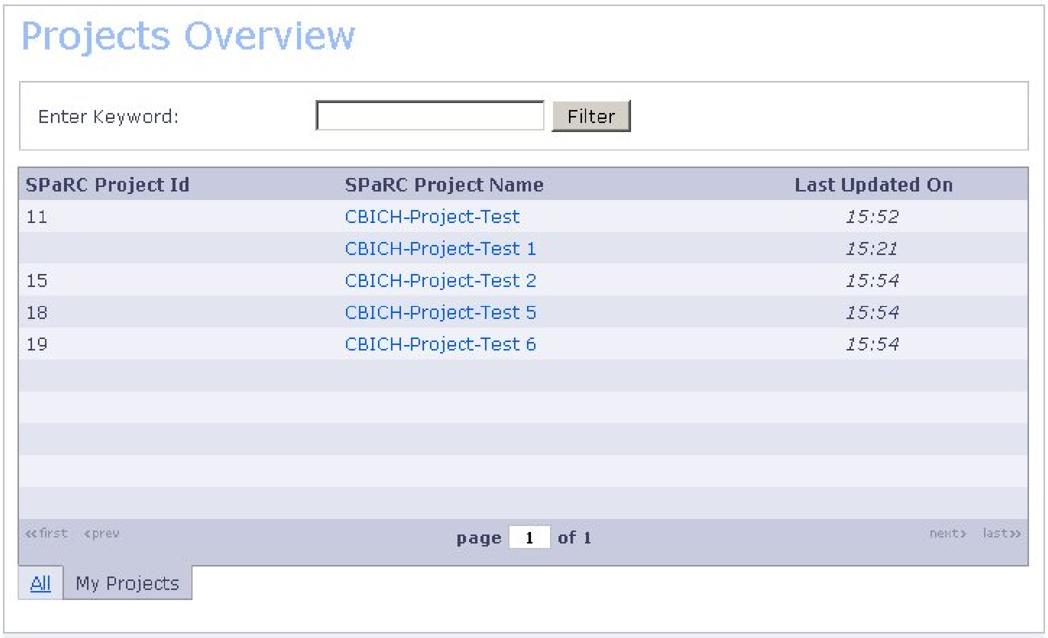
Once the user has successfully logged into the eBIP and clicks on for PRECISE then user is shown with this webpage. Projects Overview webpage is the central point for the whole PRECISE application. From here user can browse through all the Active projects, but can perform actions only on the projects, which are assigned to them. Since Administrator being the super user, it is possible for this user to even browse non-active projects.

For any user other than Administrator there will be two tabs shown All and My Projects by default. All Active projects in the PRECISE system are listed in the All tab, where as under My Projects tab only the projects where user has got some role assignments are displayed.



SPaRC Project Id	SPaRC Project Name	Last Updated On
11	CBICH-Project-Test	15:52
NULL	CBICH-Project-Test 1	15:21
15	CBICH-Project-Test 2	15:54
16	CBICH-Project-Test 3	15:54
17	CBICH-Project-Test 4	15:54
18	CBICH-Project-Test 5	15:54
19	CBICH-Project-Test 6	15:54
20	CBICH-Project-Test 7	15:54
21	CBICH-Project-Test 8	15:54
NULL	CBICH-Project-Test 9	15:21

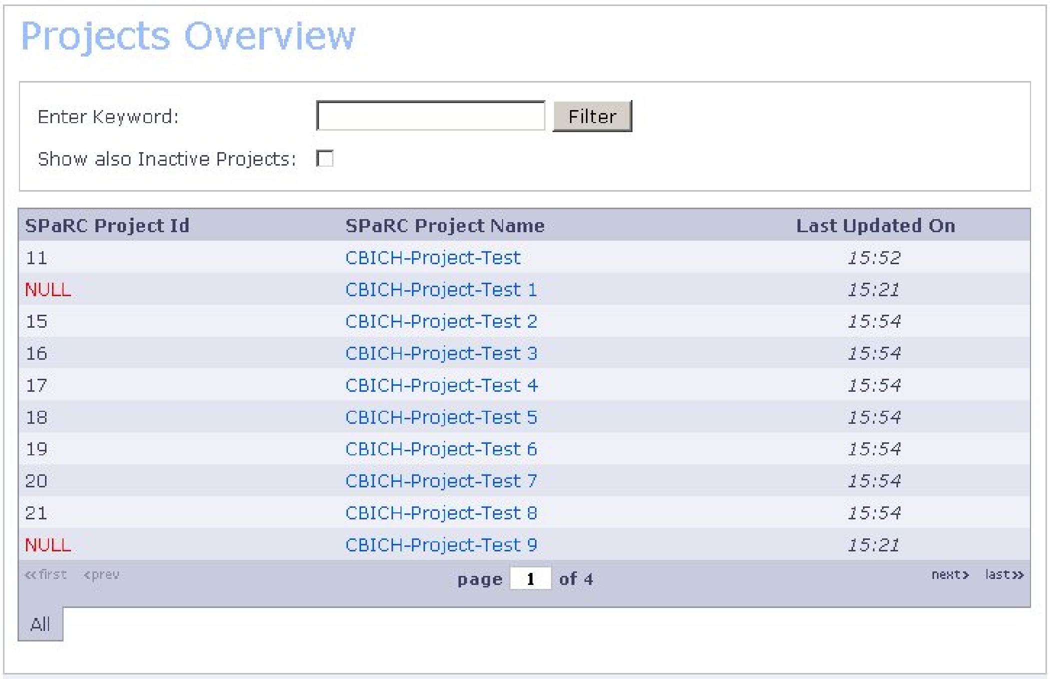
Figure 24: *Projects Overview - All tab*



SPaRC Project Id	SPaRC Project Name	Last Updated On
11	CBICH-Project-Test	15:52
	CBICH-Project-Test 1	15:21
15	CBICH-Project-Test 2	15:54
18	CBICH-Project-Test 5	15:54
19	CBICH-Project-Test 6	15:54

Figure 25: *Projects Overview – My Projects tab*

Since Administrator has got full access to all projects he will not see My Projects tab and so in All tab this user will see the list of all Active and Inactive projects. Figure 24 and Figure 25 show the screenshots of Projects Overview webpage for a nonadministrator role level user, and Figure 26 shows the screenshot for the Administrator.



Projects Overview

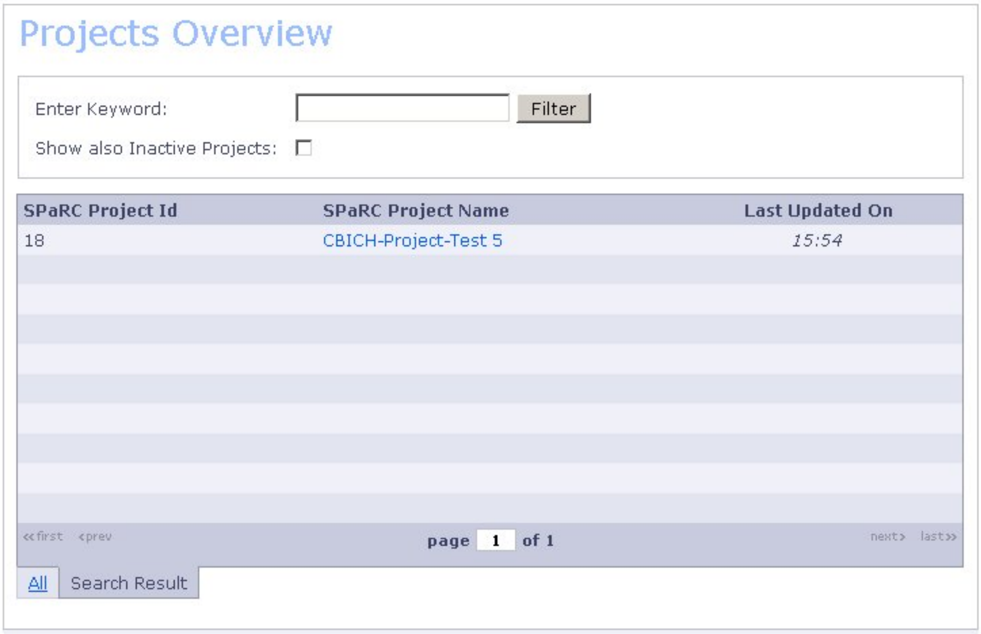
Enter Keyword: [Filter]

Show also Inactive Projects: □

SPaRC Project Id	SPaRC Project Name	Last Updated On
11	CBICH-Project-Test	15:52
NULL	CBICH-Project-Test 1	15:21
15	CBICH-Project-Test 2	15:54
16	CBICH-Project-Test 3	15:54
17	CBICH-Project-Test 4	15:54
18	CBICH-Project-Test 5	15:54
19	CBICH-Project-Test 6	15:54
20	CBICH-Project-Test 7	15:54
21	CBICH-Project-Test 8	15:54
NULL	CBICH-Project-Test 9	15:21

Figure 26: *Projects Overview- All tab (for Administrator)*

In Projects Overview it is also possible, for any user to filter out for any project using some keywords related to project. This filtration is applied in the selected tab. Apart from this filtration there is a search available for users, which is located in the PRECISE Quick Launch Portlet (shown in Figure 3 and Figure 11). Using this, user can search for any of the project from anywhere in PRECISE. This Portlet search opens a new tab in Projects Overview and lists all search results based on the criteria selected from the radio buttons. This search term is stored in session and so it would be possible for the user to visit back to this search result. Figure 27 shows the search tab screenshot for a test project search.



Projects Overview

Enter Keyword: Filter

Show also Inactive Projects: □

SPaRC Project Id	SPaRC Project Name	Last Updated On
18	CBICH-Project-Test 5	*15:54*

Figure 27: *Projects Overview - Search tab*

From Projects Overview webpage user can select any task or operation that user wants to perform for the projects assigned. When user moves the mouse pointer on the project name, a pop-up menu is displayed. This pop-up is dynamic and the contents of it are shown based upon the role user is having for the project where user has rolled his mouse. Figure 28 and Figure 29 shows the screenshots for the two kinds of pop-up menus, which will be displayed according the user role for the project he is rolling over. Each operation in the pop-up menu is linked to other webpage's. Description of each operation is briefly given in Table 7.

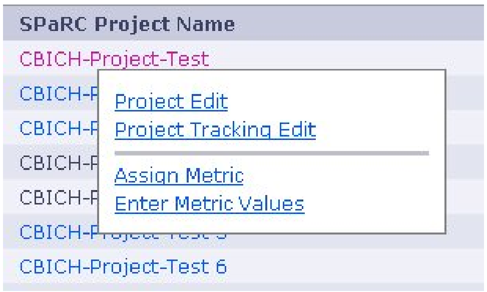


Figure 28: *Pop-Up Menu for Admin Users*

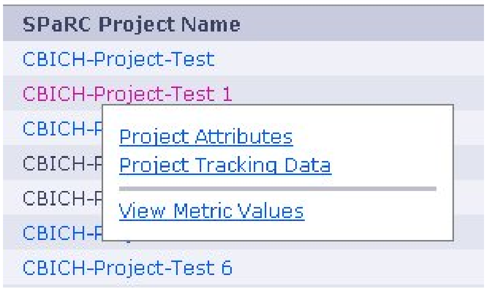


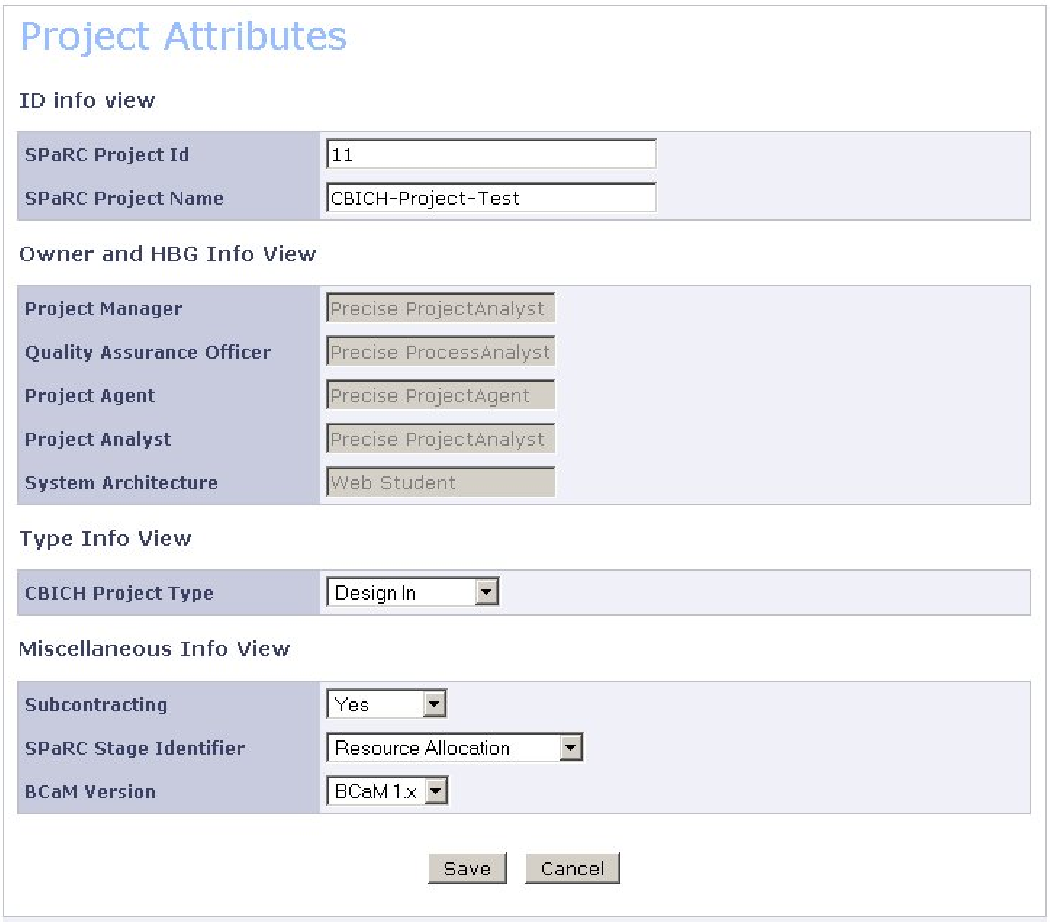
Figure 29: *Pop-Up Menu for non-admin Users*

Table 7: *Pop-up menu operations description*

Operation Name	Description
Project Edit	This link will take the user to webpage where user can either edit/view project attributes. More description and screenshots for this are given in next section.
Project Tracking Edit	Using this link, user can go to the webpage where user can enter/edit/view basic measurement data like Schedule, Cost and Effort. More description and screenshots for this are give in section 3.2.4.
Assign Metric	Users can do the assignment and un-assignment of metrics for the projects using this link. More description and screenshot for this are given in section 3.2.6.
Enter Metric Values	This link will take the user to webpage where user can enter and save the project metrics data. More description and screenshots for this are given in 3.2.7.

Project Attributes

When clicked on either Project Attributes link in the pop-up menu or under the Hierarchy Menu user will see the static project attributes. There are two views for this webpage and each view is dependent on the user role. Users other than Administrator having the role of Project Metrics Administrator and Quality Assurance Officer only can modify the attributes in this page. Other users will only be able to view the attributes in read-only mode. Figure 30 shows sample screenshot of the Project report for the non-administrative privileged users.



Project Attributes

ID info view

SPaRC Project Id	11
SPaRC Project Name	CBICH-Project-Test

Owner and HBG Info View

Project Manager	Precise ProjectAnalyst
Quality Assurance Officer	Precise ProcessAnalyst
Project Agent	Precise ProjectAgent
Project Analyst	Precise ProjectAnalyst
System Architecture	Web Student

Type Info View

CBICH Project Type	Design In

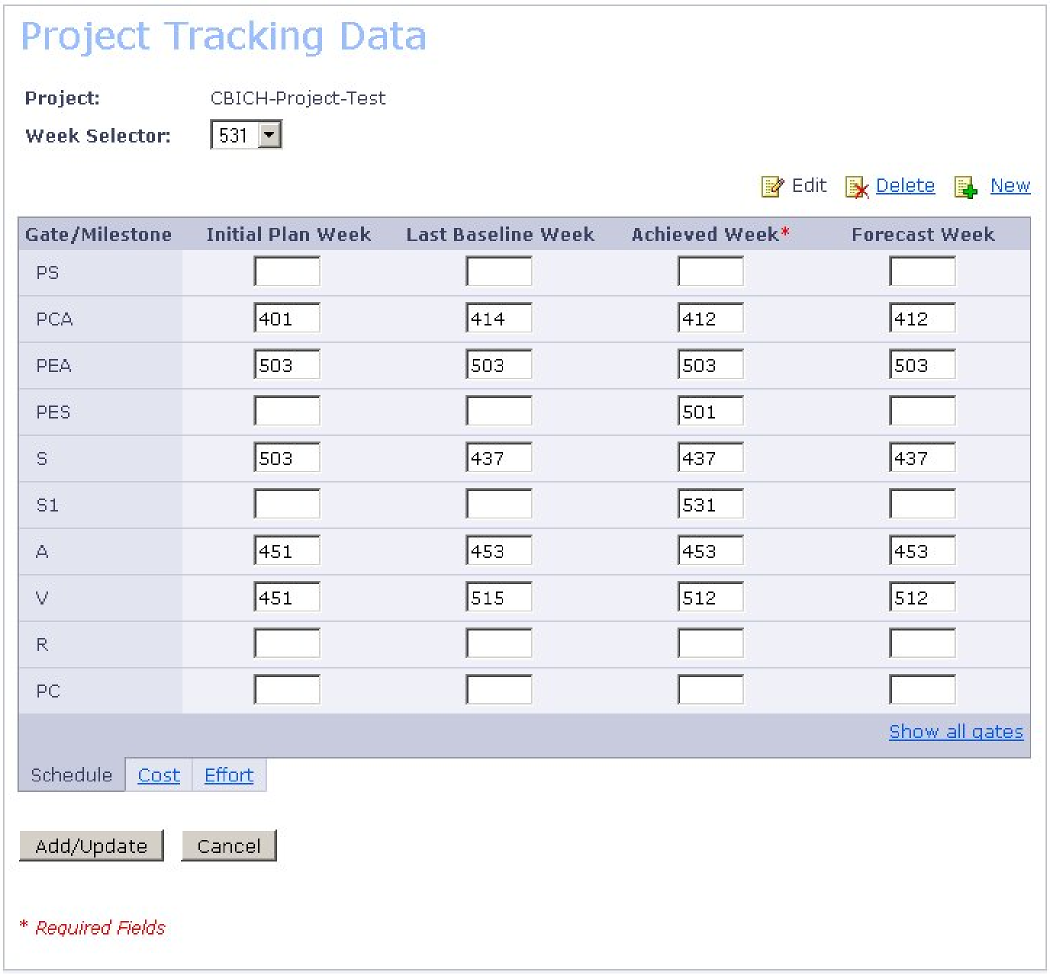
Miscellaneous Info View

Subcontracting	Yes
SPaRC Stage Identifier	Resource Allocation
BCaM Version	BCaM 1.x

Figure 30: *Project Attributes*

Project Tracking Data

This webpage will be used for entering and storing project measurement data like Schedule/Cost/Effort. Users other than Administrator having the privileges of Project Metrics Administrator and Quality Assurance Officer only can only enter/update the Project Tracking data. Other users can only view the Tracking information. Figure 31 and Figure 32 shows the screenshot for the Project Tracking Data for users having and not having administrative privileges.



Project Tracking Data

Project: CBICH-Project-Test

Week Selector: 531

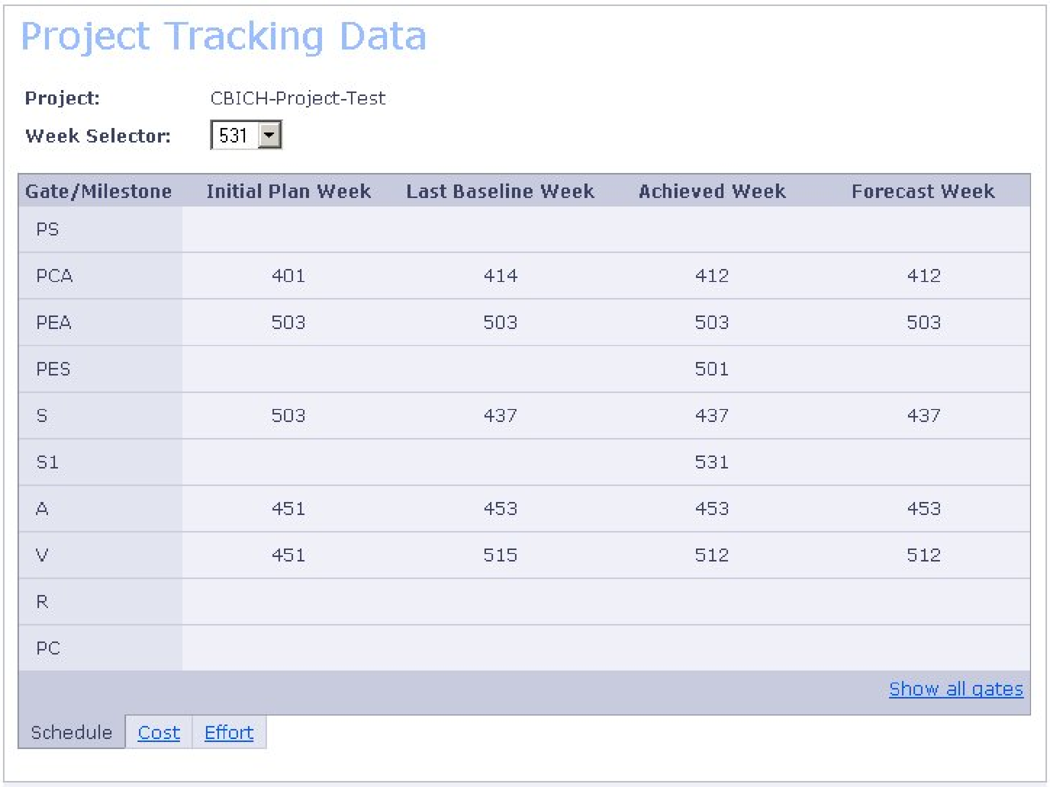
Gate/Milestone	Initial Plan Week	Last Baseline Week	Achieved Week*	Forecast Week
PS				
PCA	401	414	412	412
PEA	503	503	503	503
PES			501	
S	503	437	437	437
S1			531	
A	451	453	453	453
V	451	515	512	512
R				
PC				

* Required Fields

Figure 31: *Project Tracking Data for admin privileges users*

Users with administrative privileges see three icons with links on the top of the Tracking information. Using Edit, users can edit the tracking values of any week and using New, users can enter the new Tracking information for some new week, which as well will be entered by the user. Delete link, can be used to delete the Tracking information for any week.

From the Week Selector drop down menu shown in Figure 31 and Figure 32, users can select any historic week number and browse the Tracking data for the old values that are stored in PR_TRACKING_HISTORY table (described earlier).



Project Tracking Data

Project: CBICH-Project-Test

Week Selector: 531

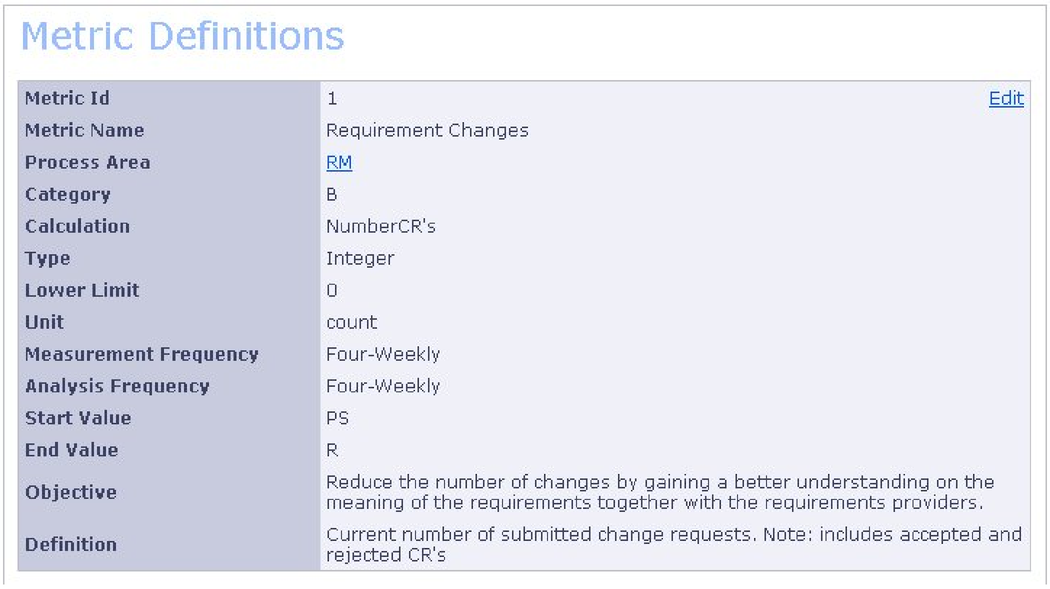
Gate/Milestone	Initial Plan Week	Last Baseline Week	Achieved Week	Forecast Week
PS				
PCA	401	414	412	412
PEA	503	503	503	503
PES			501	
S	503	437	437	437
S1			531	
A	451	453	453	453
V	451	515	512	512
R				
PC				

Figure 32: *Project Tracking Data for non-admin privileges user*

Metric Definitions

This webpage will be used for viewing the defined Metrics with their attributes in PRECISE. Administrator and Process Analyst role based users will have an extra option of editing the Metric Definition. Figure 33 shows the screenshot for the Requirement Changes Metric Definition.

Any users can view the Metric Definition for any specific Metric or also can view based on some specific Process Area. To view any specific Metric Definition, user can click on the name of the Metric in PRECISE and they will be linked to this page. For viewing Definitions based on specific Process Area, user can click on the specific Process Area found under the Metric Hierarchy Menu. Users can assign these Metrics to their projects using the Metric Assign/Un-assign page, which is discussed in the next section.

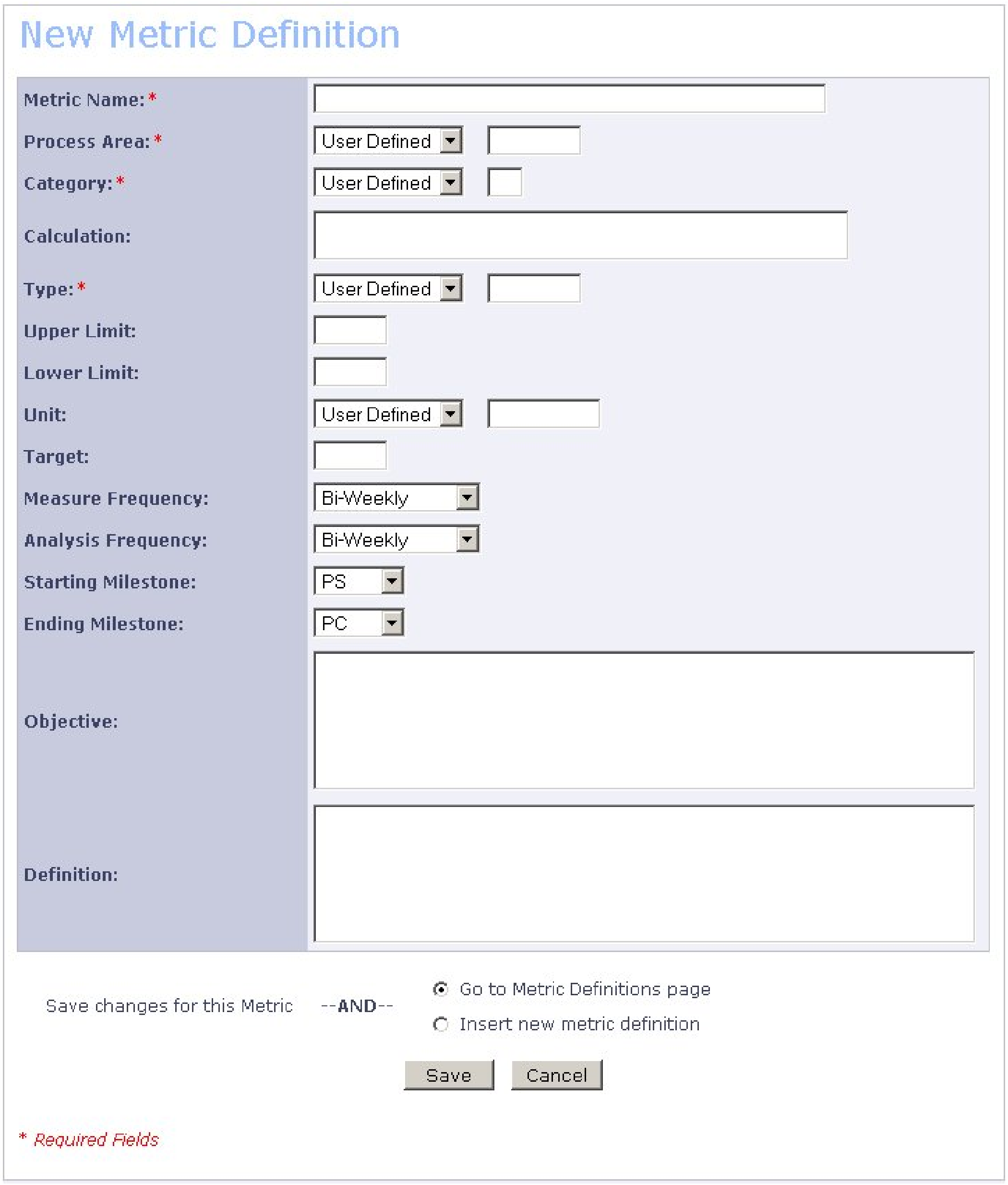


Metric Definitions

Metric Id	1 Edit
Metric Name	Requirement Changes
Process Area	RM
Category	B
Calculation	NumberCR's
Type	Integer
Lower Limit	0
Unit	count
Measurement Frequency	Four-Weekly
Analysis Frequency	Four-Weekly
Start Value	PS
End Value	R
Objective	Reduce the number of changes by gaining a better understanding on the meaning of the requirements together with the requirements providers.
Definition	Current number of submitted change requests. Note: includes accepted and rejected CR's

Figure 33: *Metric Definition for Administrator and Process Analysts*

Apart from normal users, Administrator and Process Analysts have got the rights to add a Metric Definition into PRECISE system. Figure 34 shows the screenshot for the New Metric Definition Webpage.



New Metric Definition

Metric Name:*	
Process Area:*	User Defined
Category:*	User Defined
Calculation:	
Type:*	User Defined
Upper Limit:	
Lower Limit:	
Unit:	User Defined
Target:	
Measure Frequency:	Bi-Weekly
Analysis Frequency:	Bi-Weekly
Starting Milestone:	PS
Ending Milestone:	PC
Objective:	
Definition:	

Save changes for this Metric --AND-- ● Go to Metric Definitions page ○ Insert new metric definition

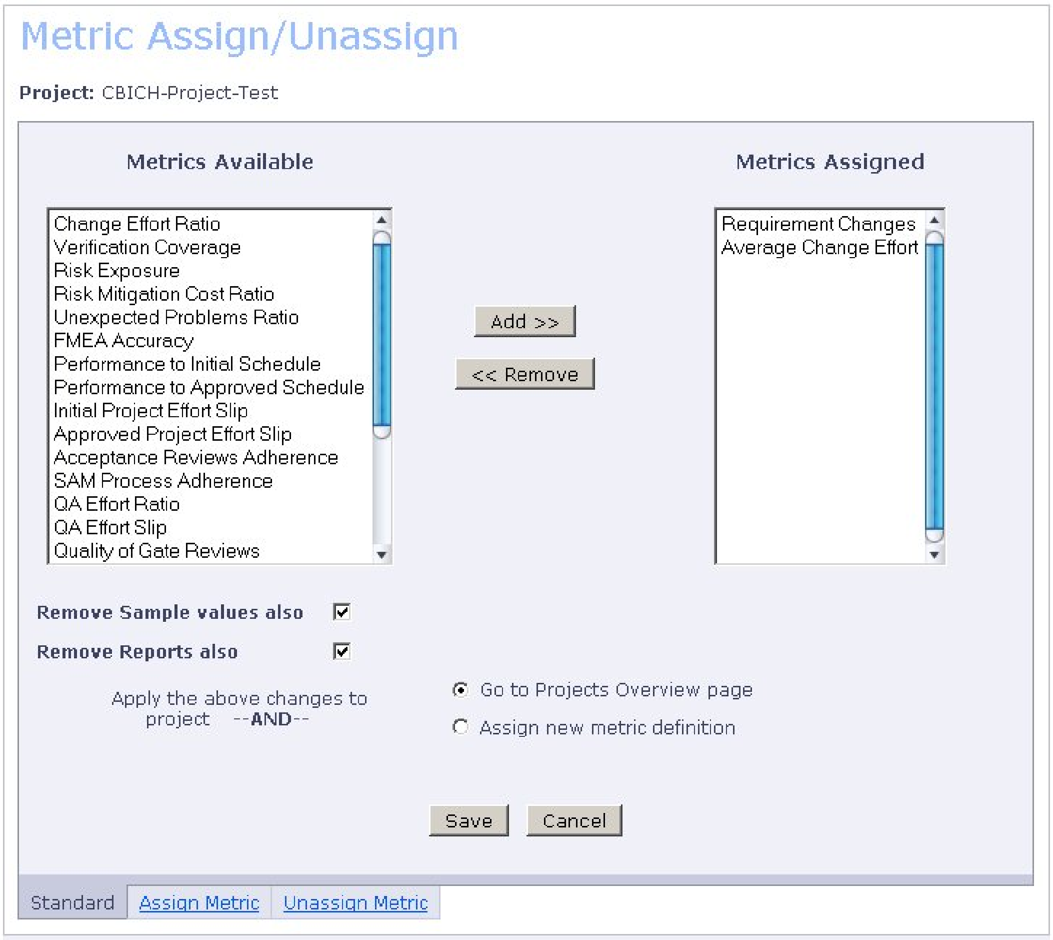
* Required Fields

Figure 34: *New Metric Definition*

If Administrator or Process Analyst clicks on the Edit link in the Metric Definition page, then they will come to the Edit Metric Definition Webpage, which is the same page of New Metric Definition page with the difference that all the Metric Definition values will be pre-filled with the form for editing.

Metrics Assignment/Un-assignment

For entering and measuring Metric values, it is necessary that user assign a Metric first to their project. Metrics Assignment and Un-assignment is provided in a single webpage with three tabs for each operation. Figure 35, Figure 36 and Figure 37 show the screenshot for each tab.



Metric Assign/Unassign

Project: CBICH-Project-Test

Metrics Available

- Change Effort Ratio
- Verification Coverage
- Risk Exposure
- Risk Mitigation Cost Ratio
- Unexpected Problems Ratio
- FMEA Accuracy
- Performance to Initial Schedule
- Performance to Approved Schedule
- Initial Project Effort Slip
- Approved Project Effort Slip
- Acceptance Reviews Adherence
- SAM Process Adherence
- QA Effort Ratio
- QA Effort Slip
- Quality of Gate Reviews

Metrics Assigned

- Requirement Changes
- Average Change Effort

Remove Sample values also ☑

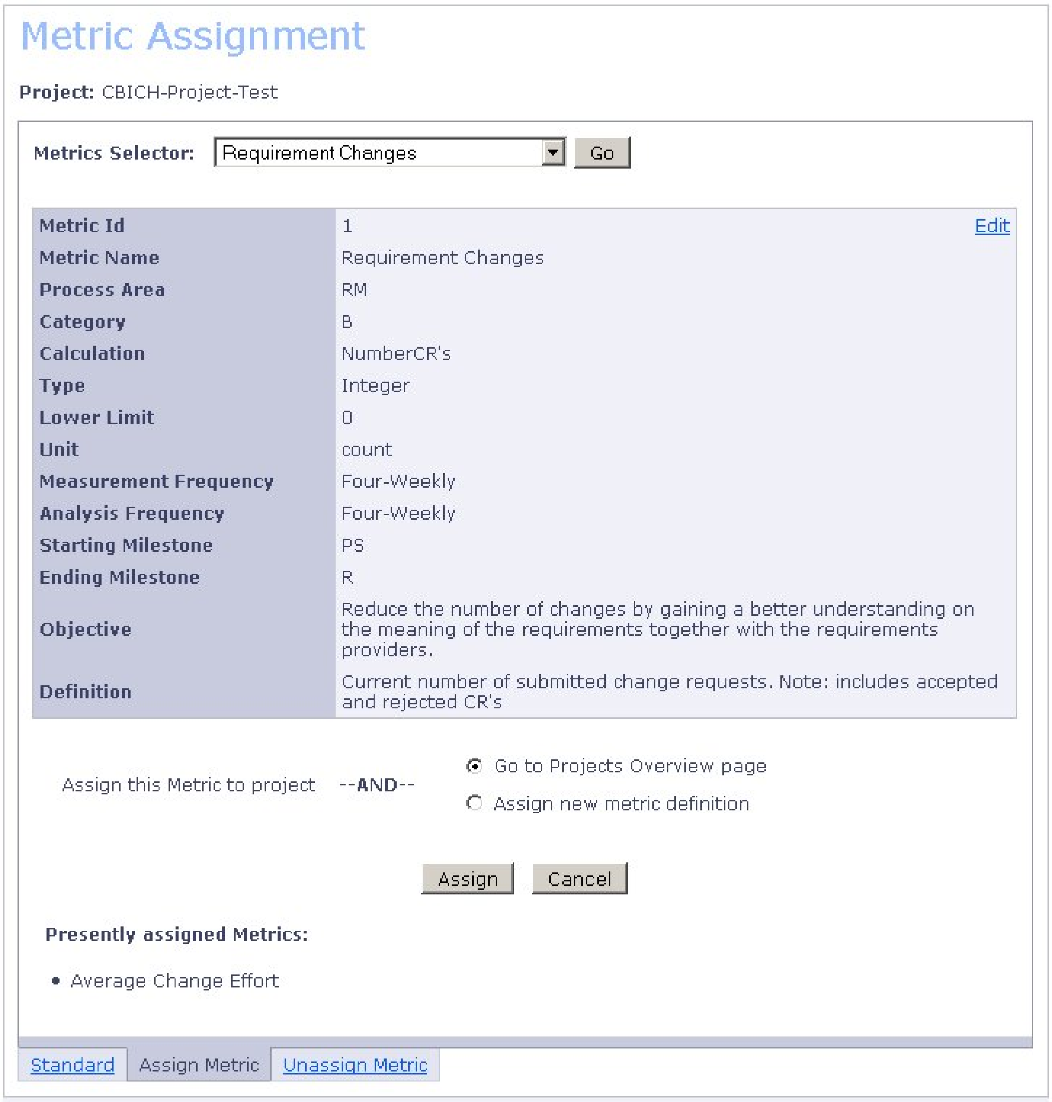
Remove Reports also ☑

Apply the above changes to project --AND--

● Go to Projects Overview page

○ Assign new metric definition

Figure 35: *Metric Assignment/Un-assignment*



Metric Assignment

Project: CBICH-Project-Test

Metrics Selector: Requirement Changes ▾

Metric Id	1 Edit
Metric Name	Requirement Changes
Process Area	RM
Category	B
Calculation	NumberCR's
Type	Integer
Lower Limit	0
Unit	count
Measurement Frequency	Four-Weekly
Analysis Frequency	Four-Weekly
Starting Milestone	PS
Ending Milestone	R
Objective	Reduce the number of changes by gaining a better understanding on the meaning of the requirements together with the requirements providers.
Definition	Current number of submitted change requests. Note: includes accepted and rejected CR's

Assign this Metric to project --AND--

● Go to Projects Overview page

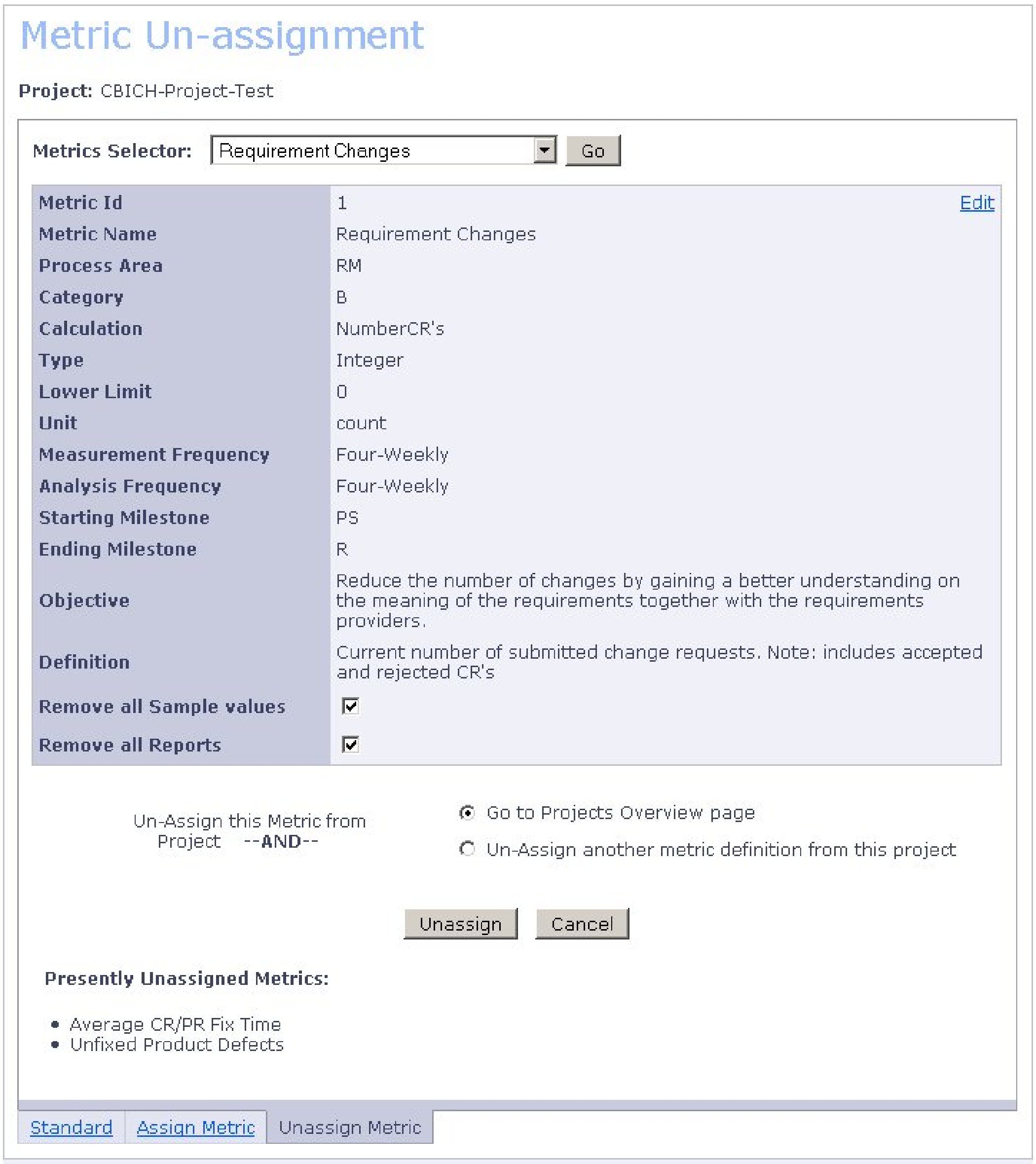
○ Assign new metric definition

Presently assigned Metrics:

- Average Change Effort

Figure 36: *Metric Assignment*

The Standard tab in this webpage is the default tab, which allows to do the Metric Assignment and Un-assignment at the same time but lacks the display of Metric Attributes. Assign Metric tab, allows browsing through the Metric attributes when some Metric is selected from the Metric selector drop down box. Metric selector drops down box shows only those Metrics, which have not been assigned to the project. With this tab, it is not possible to do the Un-assignment as well, and this can be achieved in the Un-assign Metric tab.



Metric Un-assignment

Project: CBICH-Project-Test

Metrics Selector: Requirement Changes

Metric Id	1
Metric Name	Requirement Changes
Process Area	RM
Category	B
Calculation	NumberCR's
Type	Integer
Lower Limit	0
Unit	count
Measurement Frequency	Four-Weekly
Analysis Frequency	Four-Weekly
Starting Milestone	PS
Ending Milestone	R
Objective	Reduce the number of changes by gaining a better understanding on the meaning of the requirements together with the requirements providers.
Definition	Current number of submitted change requests. Note: includes accepted and rejected CR's
Remove all Sample values	☑
Remove all Reports	☑

Un-Assign this Metric from Project --AND--

● Go to Projects Overview page

○ Un-Assign another metric definition from this project

Presently Unassigned Metrics:

- Average CR/PR Fix Time
- Unfixed Product Defects

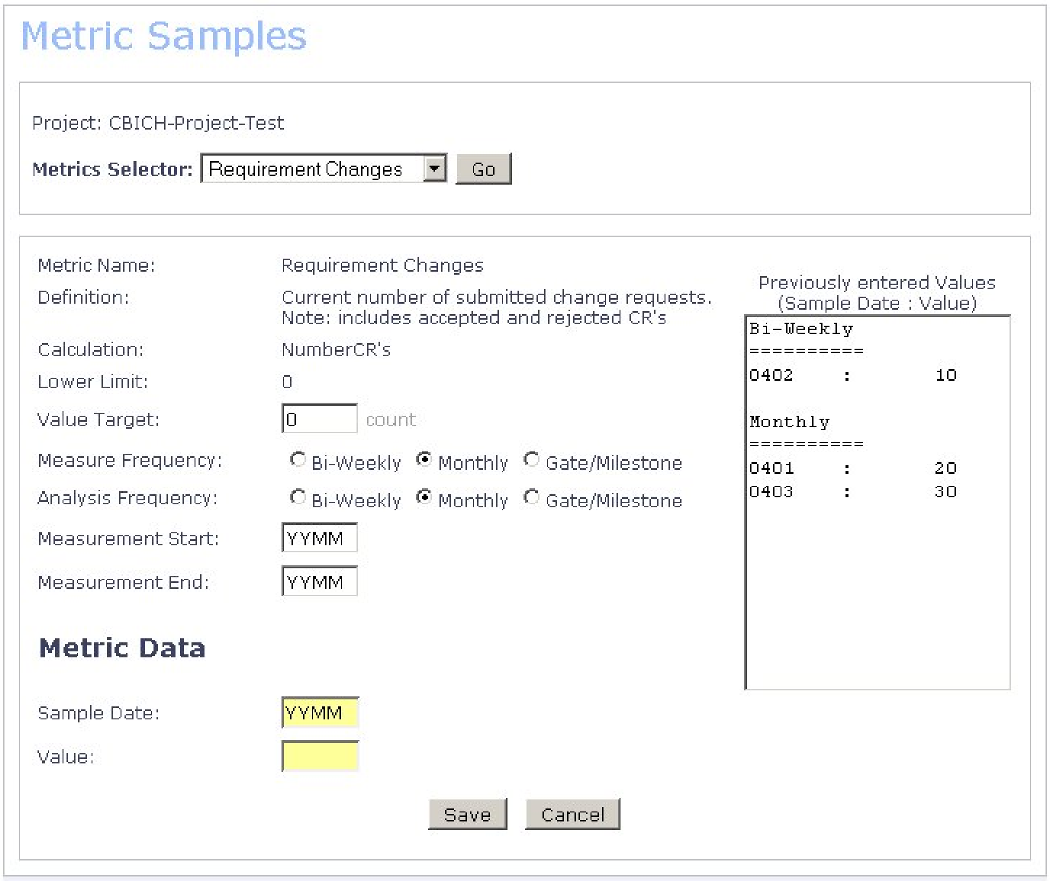
Figure 37: *Metric Unassignment*

Metric Un-assignment operation is very much similar to the Assign Metric tab, but in Metrics Un-assignment user is given with the option of removing the Metric values and reports associated with that Metric as well. These two options can also be seen in Figure 35 and Figure 37.

Assigning and Un-assigning Metrics requires that user is having the role of Project Metrics Administrator or Quality Assurance Officer.

Project Metrics

Once the Metrics assignment is done, user can start entering the measurement values for the project with assigned Metric. Figure 38 shows the screenshot for the Project Metrics webpage.



Metric Samples

Project: CBICH-Project-Test

Metrics Selector: Requirement Changes ▾

Metric Name: Requirement Changes

Definition: Current number of submitted change requests. Note: includes accepted and rejected CR's

Calculation: NumberCR's

Lower Limit: 0

Value Target: 0 count

Measure Frequency: ○ Bi-Weekly ● Monthly ○ Gate/Milestone

Analysis Frequency: ○ Bi-Weekly ● Monthly ○ Gate/Milestone

Measurement Start: YYMM

Measurement End: YYMM

Previously entered Values
(Sample Date : Value)

```
Bi-Weekly
==========
0402    :       10

Monthly
==========
0401    :       20
0403    :       30
```

Metric Data

Sample Date: YYMM

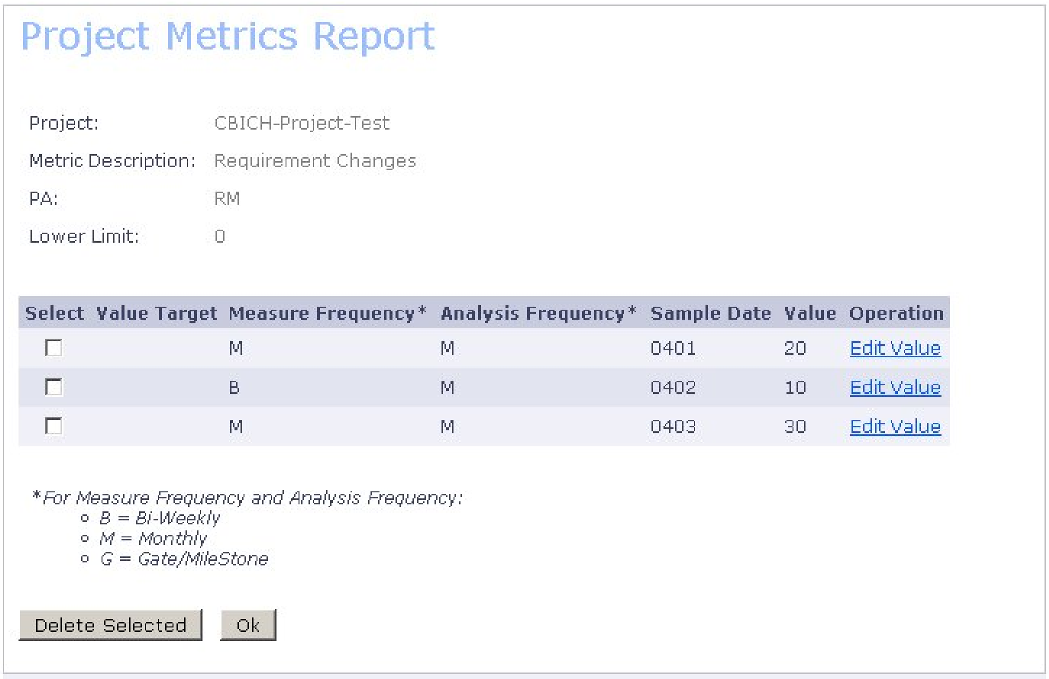
Value:

Figure 38: *Metric Measurement Values*

Users having role of Project Metrics Administrator or Quality Assurance Officer are only allowed to view this webpage. Rest all users (users assigned to this project) can just browse the measurement values for carrying out the reports.

Project Metrics Report

In this webpage any user (assigned to the selected project) can view the stored Metric measurement values. Project Metrics Administrator and Quality Assurance officer will have the option of editing the values. For editing the values, user will be taken to the Project Metrics webpage, where the form will be filled with the selected Sample date values. Figure 39 shows the screenshot for Project Metrics Report.



Project Metrics Report

Project:	CBICH-Project-Test
Metric Description:	Requirement Changes
PA:	RM
Lower Limit:	0

Select	Value Target	Measure Frequency*	Analysis Frequency*	Sample Date	Value	Operation
□		M	M	0401	20	Edit Value
□		B	M	0402	10	Edit Value
□		M	M	0403	30	Edit Value

*For Measure Frequency and Analysis Frequency:

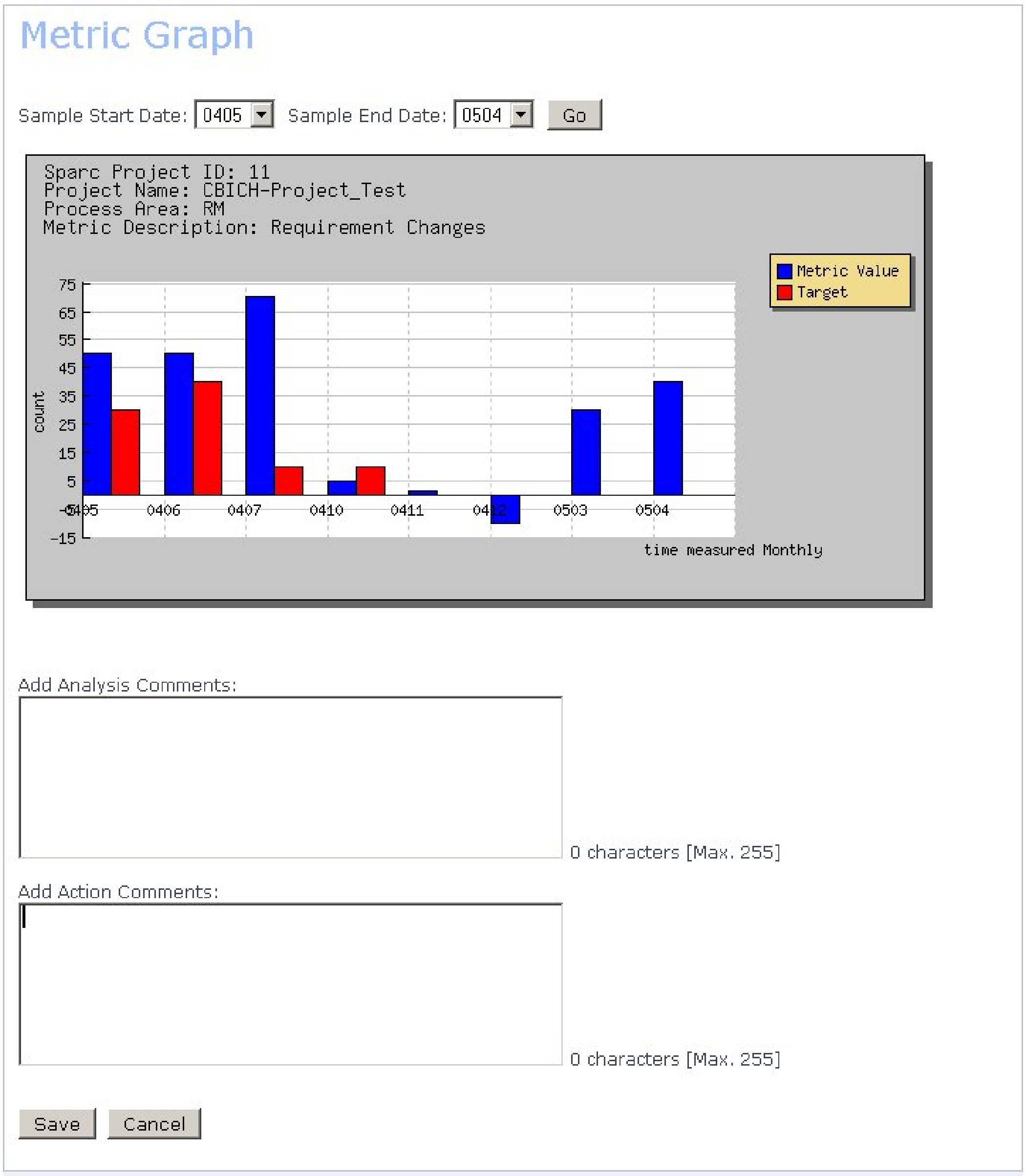
- B = Bi-Weekly
- M = Monthly
- G = Gate/MileStone

Figure 39: *Project Metrics Report*

Graph Based Reports

Reporting is one of the important features of PRECISE and this can be achieved from this webpage. Here any user can generate reports based on the Metric measurement values stored. By default the Graph report is generated from the starting Sample date to the available ending Sample date.

But, user is always given an option to modify the range by selecting some other starting and ending Sample dates. Figure 40 shows the screenshot of a sample Graph Report.



Metric Graph

Sample Start Date: 0405 Sample End Date: 0504

Sparc Project ID: 11
Project Name: CBICH-Project_Test
Process Area: RM
Metric Description: Requirement Changes

Add Analysis Comments:

0 characters [Max. 255]

Add Action Comments:

0 characters [Max. 255]

Figure 40: *Graph Based Metric Report*

4. Testing and Verification

Testing is a process, which reveals errors in the program. It is the major quality measure employed during software development. During testing, the program is executed with a set of conditions known as test cases and the output is evaluated to determine whether the program is performing as expected.

For PRECISE also testing was done based on different user role levels and on individual webpage's as they are completed and become ready for production environment. After the development of whole application, testing was done based on some test cases are generated as input conditions that fully execute all functional requirements for the program. This kind of testing helps in find errors in the following categories:

- Incorrect or Missing functions
- Interface errors
- Errors in data structure or external data access
- Performance errors
- Initialization and termination errors

In this testing only the output is checked for correctness and the logical flow of the data is not checked. Finally an in house testing of the entire system is done, before it's completely moved to production environment. The aim of this kind of testing is to satisfy the requirements and specifications.

5. Conclusion and Outlook

The PRECISE system was successfully developed and a public release has been made and being used by the Innovation Center community. This web application has fulfilled all the requirements given for the development of the application. PRECISE is successfully; able to differentiate between various different user roles and dynamically sets the webpage's and menus. While developing PRECISE following points were kept in mind, so that the application code would be easier to understand for later purposes.

- Easy structure of the code for better understanding
- All Classes, Functions, Queries and Global variable defines in one page with nice comments and easy references

Although this application satisfies all the given requirements, but still there are further improvements that can be made for the future updates or releases. There could be a page for User Preferences and Advanced Search included. Using User Preferences, user can set the default look and feel for his ease and using Advanced Search, user shall be able to search with multiple fields in PRECISE database. Apart from this a script can be written which does a regular checks and keep tracks of the measurement values and if required an auto mails to the project users in case of any correction or required update for values.

6. References

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16. **Zend PHP Tutorials:** http://www.zend.com/zend/tut/

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Appendix – Sample values for the Data Model

EBIP_USER:

User_Id	Email	Password	First_Name	...
10010	analyst@philips.com	precise	Precise	...
10011	admin@philips.com	precise	WebStudent	...
10012	metrics_admin@philips.com	precise	Metrics	...
10013	metrics_analyst@philips.com	precise	Metrics	...

EBIP_PERM:

Perm_Id	Perm_Cluster_Id	Perm_Name	Perm_Descr	...
10183	10180	ProjectMetricsAnalyst	read-only per project	...
10184	10180	ProjectMetricsAdministrator	read & write per project	...
10185	10180	ProcessAnalyst	read-only over all projects	...
10186	10180	Administrator	read & write over all projects	...

EBIP_USERPERM:

User_Id	Perm_Id
10010	10184
10011	10189
10012	10183
10013	10185

EBIP_TEAM:

Team_Id	Team_Default_Perm_Id	Name	Team_Descr	...
10180	10180	Precise	PRoject database for Evaluation, Controlling, Inventory, Structure & Elaboration	...

EBIP_TEAMUSER

Team_Id	User_Id
10180	10010
10180	10011
10180	10012
10180	10013

PR_PROJECT

Project_Number	SPaRC_Project_Name	Active	Project_Phase	Project_Process_Type_Id	...
1000	CBICH-Test-Project-1	1	Design & Implementation	2	...
1001	CBICH-Test-Project-2	1	Verification & Validation	1	...
1002	CBICH-Test-Project-3	0	Specification & Planning	1	...

PR_PROJECT_USER

Project_Number	User_Id	Role
1000	10012	agent
1000	10202	analyst
1000	10014	manager
1000	10020	qao
1000	10110	agent
1000	10130	qao

PR_KPI_REPORT

Project_Number	KPI_Number	KPI_Report_Sequence_Number	Report_Start_Id	Report_End_Id	...
1000	1	505	410	503	...
1000	21	510	505	505	...
1001	22	518	502	518	...

PR_PROCESS_TYPE

Project_Process_Type_Id	Milestone_Or_Gate_Id	MG_Sequence_Number	Project_Process_Type_Name	...
1	PS	1	OSRP	...
1	SV	18	OSRP	...
1	PC	24	OSRP	...
2	S	6	BCaM	...
2	A	13	BCaM	...
2	V	24	BCaM	...

PR_TRACKING

Project_Number	Project_Process_Type_Id	Milestone_Or_Gate_Id	Tracking_Type	Initial_Plan_Value	Last_Baseline_Value	Achieved_Value	Forecast_Value
1000	1	PS	Schedule	501	510	510	520
1000	1	SV	Schedule	501	510	515	520
1000	2	PC	Schedule	413	413	413	413
1001	2	S	Schedule	328	328	335	340
1001	2	A	Schedule	301	301	301	301

PR_TRACKING_HISTORY

Tracking_Sequence_Number	Project_Number	Milestone_Or_Gate_Id	Initial_Plan_Value	Last_Baseline_Value	Achieved_Value	Forecast_Value	...
41	1000	SV	408	410	406	410	...
42	1000	PS	408	408	NULL	410	...
43	1000	PS	408	408	NULL	408	...

PR_KPI_DEFINITION

KPI_NUMBER	KPI_DESCRIPTION	PA	Calculation	Measure_Freq	Upper_Limit	Lower_Limit	Target	Type	...
1	Requirement Changes	RM	NumberCR's	Monthly	*NULL*	0	*NULL*	integer	...
21	Product Defects	PPQA	NumberProblemReports	Monthly	*NULL*	0	*NULL*	integer	...
22	Change Effort Ratio	RM	actualEffortAcceptedCR's / actualEffortProject x 100	Monthly	100	0	*NULL*	float	...

PR_KPI_PROJECT

Project_Number	KPI_NUMBER	Measure_Frequency	Upper_Limit	Lower_Limit	Target	KPI_Start_Id	KPI_End_Id	...
1000	1	Monthly	*NULL*	0	*NULL*	401	512	...
1000	21	Monthly	*NULL*	0	*NULL*	505	512	...
1001	22	Bi-Weekly	100	0	*NULL*	501	544	...

PR_KPI_VALUE

Project_Number	KPI_Number	KPI_Value_Sequence_Number	KPI_Value	Upper_Limit	Lower_Limit	Target	Measure_Frequency	Analysis_Frequency
1000	1	501	5	NULL	0	NULL	Monthly	Monthly
1000	1	502	9	NULL	0	NULL	Monthly	Monthly
1000	1	503	15	NULL	0	NULL	Monthly	Monthly
1000	21	505	163	NULL	0	NULL	Monthly	Bi-Weekly
1001	22	501	1.3	100	0	NULL	Bi-Weekly	Bi-Weekly