DR10.2: User interface design and specification

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ABSTRACT	This document deals with the specification of graphical user interfaces of the PDKM framework, including the PDKM web portal and the PDKM back-end. The accessibility of functionality is described based on the PDKM user roles and client types.

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Abbreviations

Abbreviations used in this document:

BOM	Bill of material
DSS	Decision Support System
ECC	SAP's ERP Central Component
ERP	Enterprise Resource Planning
GUI	Graphical User Interface

HTML	Hyper Text Mark-up Language
PDKM	Product Data and Knowledge Management system
PLM	Product Lifecycle Management
WP	PROMISE Work Package

1 Introduction

In the previous task TR10.1 requirements for the PDKM framework from workpackage R9 have been identified with regard to user roles and accessibility. This deliverable deals with the specification of the graphical user interfaces for different function areas of the PDKM framework. Its main focus is the accessibility of functionality based on the roles of the users and different client types. The specification of the PDKM framework which is described in this document applies for the PDKM prototype version 2. In workpackage WP9 user requirements have been assessed and the results were documented as use-cases (see DR 9.10). In this workpackage (WP R10) user requirements from WP R9 were used as a basis and user interface requirements have been derived. The results of this work can be found in the deliverable DR10.1. Furthermore the terminology of this document is based on the terms that are introduced with the PDKM semantic object model (see deliverable DR 9.2).

2 Standard client types

This section deals with the identification of standard client types for specific function areas independent of certain user roles.

As described in the deliverable DR9.5 the PDKM system is based on the PLM system SAP ECC (back-end) and on SAP NetWeaver Portal (front-end) providing the standard user interface. While the business logic and data management is implemented in SAP ECC, the SAP NetWeaver Portal provides a single-point-of-entry to the users.

The influence of the separation of application domains on the accessibility of functions has been discussed in DR10.1. Since the PDKM functions are accessible via the front-end or back-end, clients allowing the access to these application domains are regarded as standard clients. To be more concrete, the front-end functions are accessed with a web client and back-end functions with a back-end client.

2.1 Web client

In order to access front-end functions of PDKM, a web browser is required. The current version of PDKM is compatible with Microsoft Internet Explorer 6 and Mozilla Firefox browsers. The compatibility with other or newer versions of browsers might be achieved with updates of the involved portal framework, SAP NetWeaver.

Having the browser, the user only needs to know the URL of the PDKM instance and can access it via a simple login with username and password.

2.2 Back-end client

The back-end functions of PDKM can be accessed in two ways.

A common way of access is via a web browser. Comparable to the front-end functions, the user needs to know the URL for the PDKM back-end. With appropriate access rights, users can work with the SAP Web-GUI which is a HTML based version of the SAP ECC back-end. This provides users with a comprehensive framework. This SAP Web-GUI is also incorporated into the PDKM web portal.

Another way of accessing the PDKM back-end is via the SAP ECC client, which, in contrary to the Web-GUI, must be locally installed. The client provides the same functionality as the Web-GUI with the difference that it is not HTML based but a native client application. The SAP ECC client is slightly faster than the Web-GUI.

Due to the complexity of the back-end functions, only specially trained administrative users will get granted access. Administrative in this context means not only system administration but especially also data administration.

3   User interfaces for PDKM functions

This section deals with the specification of user interfaces for the functions covered by WP R9.

3.1   User interfaces for product and product structure management

The PDKM system enables the creation and management of products and product structures. Product structures establish hierarchical relationships between components and parts of a product. Product and product structure management starts with the creation of an as-designed product which contains design information about a specific product type. This functionality is available via the administrative interfaces described in chapter 4. When the product types are created, the user is able to merge them to a product structure. This task is done by creating component-subcomponent relationships between the product types.

After a product type is created, users are able to generate a product instance (individual product). This functionality is also restricted to administrative users and is described in chapter 4.1.

In order to be able to store static values which are specific for application scenarios, additional attributes can be used. To do this, characteristics will be created and bundled in classes. These classes will be assigned to product types or product instances. The graphical user interfaces for creating characteristics and classes is described in chapter 0.

Product types, structures and instances will be visible for users on the web portal (front-end). Users can search for any product type or instance and are able to navigate through product structures. The additional attributes can also be used as search criteria. When a product type or a product instance is selected, the users are presented with all defined attributes belonging to this object.

3.2   User interfaces for configuration management

The PDKM system is able to track the history of product instances, i.e. it is traceable in which product structure a product instance has been installed before. The graphical user interface allows users to view the history of product instances and the respective periods. This functionality is accessible via the "Product instance history" button while the details of a product instance are displayed. Vice versa for a product instance which has sub-components, all installed components with the respective time period are visible. This functionality is accessible via the "Component list" button while the details of a product instance are displayed. The user is also able to enter an effective date, for which the component list of the product should be displayed. Using this option, the user can see the configuration of a product structure for any point in time in the product's life.

3.3   User interfaces for field data functions

The PDKM system is able to deal with field data both in form of single values and in form of documents. Since field data in form of single values is usually transmitted via the PROMISE Middleware to the PDKM, there is no graphical user interface required in the web portal, where single values of field data can be entered manually. However, the user interface provides the option to upload files containing field data.

In order to make PDKM capable of receiving different field data types, some configuration work has to be done. Some of these tasks are performed by an administrative user in the back-end. The respective user interfaces are described in chapter 4.4. These administrative user interfaces offer also functionality to enter single values of field data.

Other pre-work before receiving field data via the PROMISE Middleware can be done in the web portal. The external IDs for the objects producing the field data have to be mapped to objects in the PDKM. Once the configuration work in the back-end is done, this task can be accomplished by any user in the web portal. Afterwards, respective subscription requests to the PROMISE Middleware (compare deliverable DR6.5 "Interface definition and design of enterprise

communication infrastructure") have to be triggered. This can also be done by any user in the web portal.

As soon as field data is received and stored in the PDKM system, users can navigate through product instances and see all types of field data for a product instance. Furthermore, users are able to select one ore more field data types and visualise them in a graph. The visualisation covers the respective time period and the field data values. The visualisation period can be entered manually and in order to ease the examination the graphs can be moved horizontally or vertically. Additional functionality to deal with field data in form of single values is provided by the back-end, see chapter 4.4.

For functionality with respect to field data in form of documents please refer to section 4.4.

3.4 User interfaces for event management

The PDKM system is able to capture information about usage of product instances in form of events, which can also be seen as field data in a broader sense. Two types of events, Incidents and Maintenance Actions, can be attached to a product instance. The web portal offers functionality to browse through product instances and view the corresponding event objects. When an event object is selected, detailed information will be presented to the user.

3.5 User interfaces for document management

The PDKM system enables attaching documents to a product type or product instance. This task can be performed by an administrative user in the appropriate back-end user interfaces, see section 4.4. These documents can be accessed via the web portal. The documents that are attached to one of the mentioned objects are shown in the detailed information section.

3.6 User interfaces for knowledge management

The PDKM system is capable of managing knowledge that is either generated by the DSS system or entered directly into the PDKM. For that, different PDKM functionalities described in the preceding sections can be utilised. In many cases, it is expected that knowledge can be stored in documents. This kind of knowledge is managed by using the document management functionality of the PDKM. Another possibility of managing knowledge is to represent them with mechanisms that are used to model field data. This can easily be done if knowledge can be interpreted as a value with a time stamp. Last but not least, events can be used to represent knowledge, which offers more complexity then the field data option.

Besides that, the PDKM including the DSS graphical user interfaces contains mechanisms to invoke different DSS algorithms. The users are able to specify parameters for DSS algorithms and will be presented with the results. These graphical user interfaces are described in chapter 5.

3.7 User interfaces for access control

The PDKM functionality that is offered in the front-end can be accessed via internet by using a web browser. The users are authenticated by a login name and password. The user management for the front-end is done by an administrative user, who is able to access appropriate functionality in the back-end.

4 Description of administrative user interfaces

Most of the SAP functionality, which covers a complete PLM system, can be accessed via Web-GUI. However, this chapter introduces only the most important transactions (SAP ECC back-end functionalities) that are relevant in the context of PDKM. Information about the complete set of functionality can be found in the SAP ECC on-line help [1].

A brief overview of the SAP back-end user interfaces is given, which are provided to administrate object data via SAP Web-GUI. In particular, the GUI functions to create, to organize, and to classify objects of PLM, e.g. Equipments representing product instances and Materials representing product types. Document Management is described. Furthermore, the GUI functions for declaring Measuring Points representing sensors, Measurement Documents representing sensor values, and the visualization of measurement values are discussed.

For ease of description and link to presented GUIs, the terminology used in SAP ECC will be used. Some of it has already been introduced in this introduction to the chapter. The corresponding PDKM term is usually only given at the first occurrence of an SAP term. A summarizing overview of the SAP terms and their corresponding PDKM terms can be found in table 1 of DR9.3 "Specification of System Functions".

4.1 Materials and Bills of Material

The term Material describes all types of material, not only raw material, but also semi-finished goods and finished articles. Compared to the object-oriented programming, the Equipments represent the objects or instances, whereas the Materials describe the classes[1]. Further, an Equipment (see chapter 4.2) can be "instantiated" based on a certain Material with the help of the Serial Number. In this case, the ID of the Material combined with the Serial Number identify a single Equipment, representing a facility in the real world. Materials are introduced to the PLM system to model for example spare parts used during maintenance processes.

All Materials associated with a certain Equipment are listed in the Bill of Material. A maintenance Bill of Material (BOM) is a complete, formally structured list of the components making up an Equipment together with their quantity. The components can be stock or non-stock spares or assemblies (groups of spare parts), which in turn can be described using maintenance BOMs. Maintenance BOMs are primarily used for the following purposes:

- Structure description: Using maintenance BOMs one can specify exactly where maintenance tasks are to be performed on a technical object.

- Assignment of spare parts: A maintenance BOM is used in plant maintenance to assign spares for a technical object.

Materials can be created with the help of the transaction MM01 (SAP Menu → Logistics → Plant Maintenance → Management of Technical Objects → Material → Create). They are combined to a Bill of Material for a certain Equipment in transaction IB01 (SAP Menu → Logistics → Plant Maintenance → Management of Technical Objects → Bill of Material → Equipment BOM → Create) or to an assembly or sub-BOM in transaction CS01 (… → Bill of Material → Material BOM → Create).

4.2 Technical Objects

Equipments represent one kind of Technical Objects for the Product Lifecycle Management. To manage information about specific objects or components of facilities, the PLM system of SAP allows classifying Equipments. The creation of Equipments is executed as described in the following.

- The transaction IE01 (Create Equipment) is located in the following directory: SAP menu Logistics → Plant Maintenance → Management of Technical Objects → Equipment → Create (General).
- After selecting the Equipment Category or a Reference Equipment/Material, the Equipment is created by pressing "Enter".

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[1] This is only for illustration and should not be mixed with the Classification of Technical Objects with the help of Characteristics and Classes in section 4.3.

- The next window (Figure 1) shows the master record of the Equipment. All information can be saved to the system after completing the required input fields.
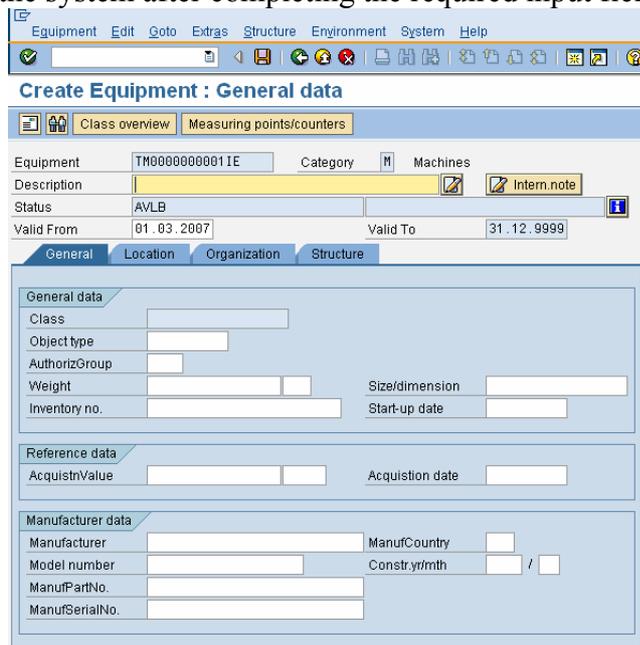

Figure 1: Create an Equipment

Functional Locations represent the second kind of technical objects relevant for PLM applications. With the help of Functional Locations information about buildings, departments and areas of an enterprise can be managed. There are three ways to create a Functional Location in mySAP PLM: (a) creating a new Functional Location without any information or (b) creating a new Functional Location by using data from another Functional Location or (c) by using data from a reference location. In the context of the PROMISE project Functional Locations play a minor role. For detailed information please visit the SAP Help [1].

All technical objects, i.e. both Equipments and Functional Locations, can be organized in hierarchies in order to reflect their relationships in the real world. The master record of each Technical Object offers an interface to control the hierarchy of its sub-objects. The interface can be activated using the "Structure"- tab. Every table entry in the mask corresponds to a sub-equipment. To manipulate the hierarchy of Technical Objects, GUI functions for installing an Equipment to and dismantling an Equipment from a Functional Locations are supported. To add a new sub-object, e.g., install a new Equipment, a new row is to be added to the structure table. Furthermore, the ID of the Equipment that shall be installed has to be specified. In order to create a deeper hierarchy, the master record of any equipment in the hierarchy can be opened so that that's sub-equipments can be altered.

An overview of the hierarchy of all Technical Objects can be retrieved using transaction IH03. As alternative to the Windows Explorer-like list-based view of the object hierarchy, it is also possible to display graphically the portion of the hierarchy with a specific Equipment or Functional Location as the root. The two visualization alternatives are shown in Figure 2a) and b), respectively.
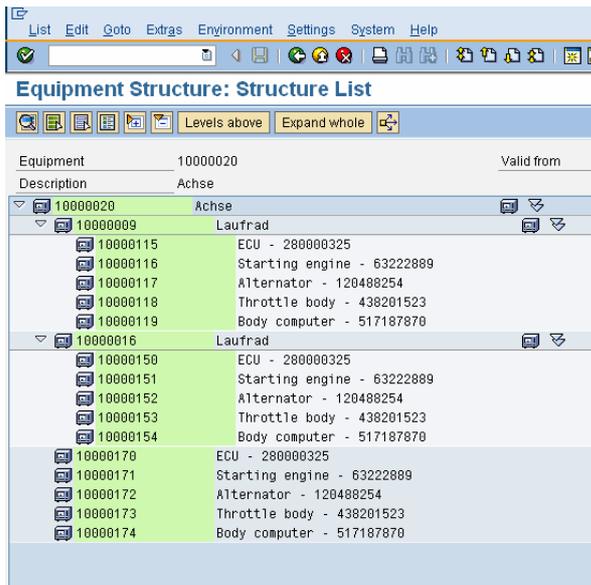
a) List-based display   b) Graph-based display
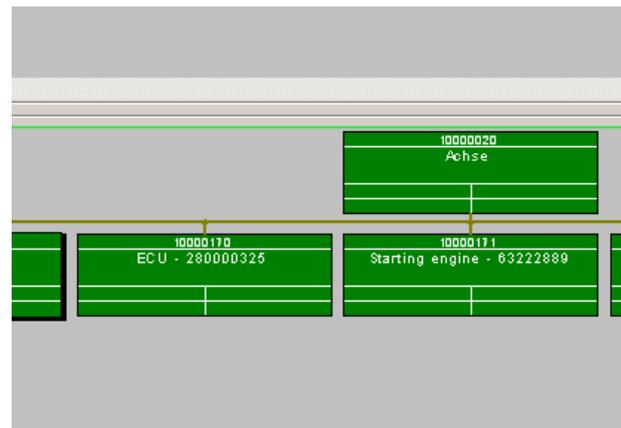
Figure 2: Equipment Structure

4.3   Classification of Technical Objects

With the help of Classification, the set of possible properties of Equipments can be extended. It is possible to specify a classification of Technical Objects entered in the PLM system. The classification is defined by Characteristics of the Technical Objects, which are organised in Classes. A Characteristic is inserted into <please specify> with transaction CT04, which can be found under SAP Menu → Cross-Application Components → Classification System → Master Data → Characteristics. As shown in Figure 3, the transaction allows specifying the name, description, and the data type of the Characteristic.

Several Characteristics can be combined to build a Class. For example, the Characteristics *mileage* and *fuel consumption* can be used to define the Class *automobile*. This Class can be used to store more detailed information for the Equipment *MyCar* than the general Equipment information. Classes can be structured by using hierarchies, i.e. properties of more general classes can be inherited to sub-classes. Multilevel inheritance is allowed. Moreover, multiple super-classes can be assigned to a sub-class, whereas the sub-class inherits all characteristics of its super-classes. A Class is defined with the help of the transaction CL02 under SAP Menu → Cross-Application Components → Classification System → Master Data → Classes.
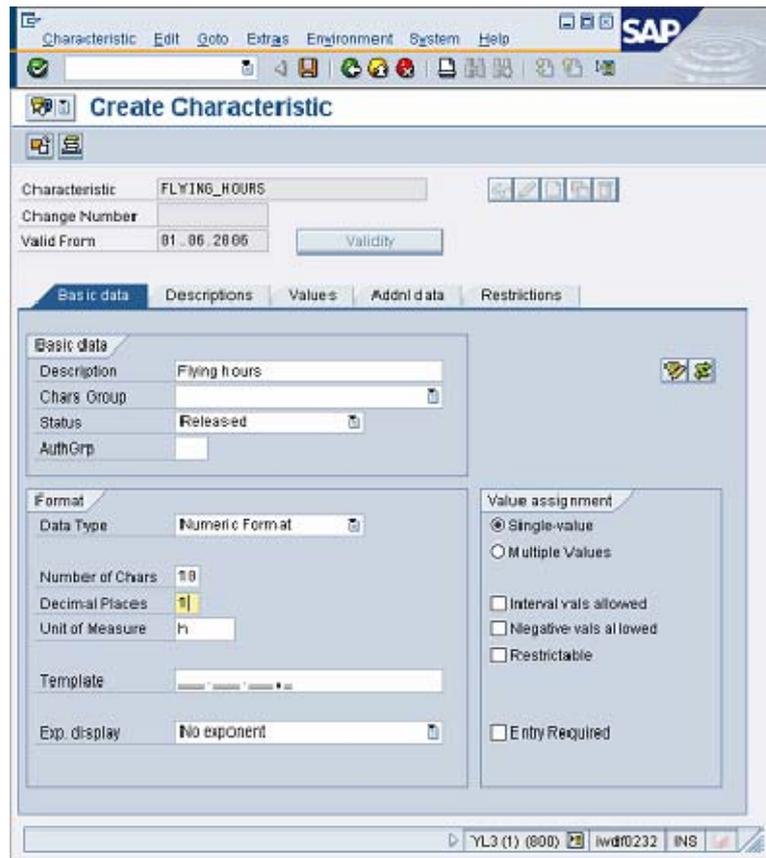
Figure 3: Create a Characteristic

4.4 Document Management

The SAP Document Management comprises a range of functions for managing documents that may be stored both in the SAP System and in external systems (for example CAD or CAM tools). In addition to managing documents, it also coordinates document processing. It is possible to automate the entire life cycle of a document: from document creation to document storage, from access to update.

Using the transaction CV01N (SAP Menu → Logistics → Central Functions → Document Management System → Document → Create), a document info record that stores all of the data required to process and manage a document and attached files, the so-called Originals, can be created as shown in Figure 4.
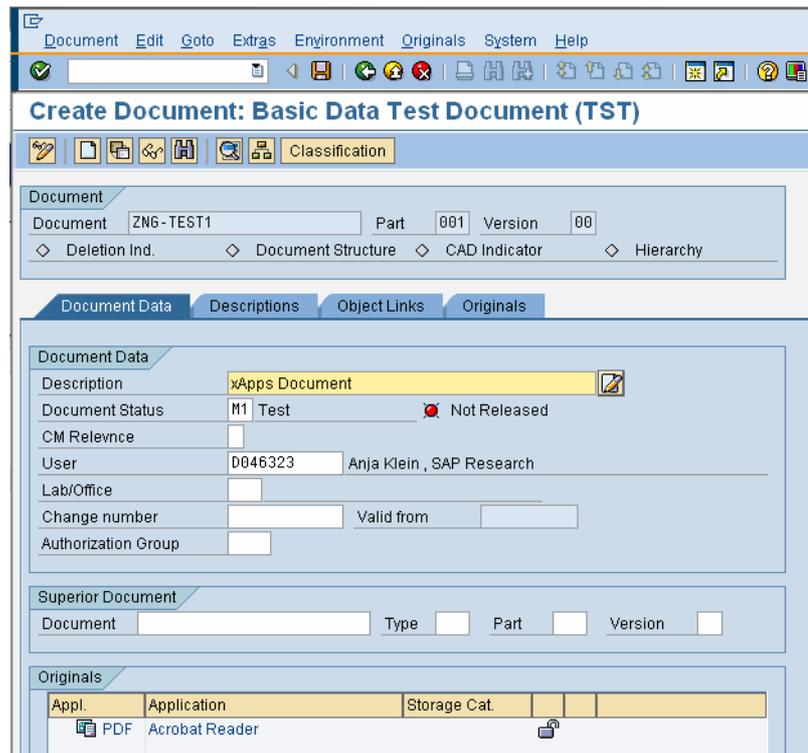
Figure 4: Create a Document Record

By clicking on the ⬜ -button, new Originals can be loaded to the document. In the tab "Object Links", references to certain Materials and Equipments can be managed. To work with documents inserted to the PLM, there are transactions to change (CV02N), display (CV03N) and find documents (CV04N).

4.5 Field Data Management

Measuring Points

Measuring Points represent sensors collecting data in the real world. Every Technical Object can own one or more Measuring Points, which can be assigned using transaction IK01 (SAP Menu → Logistics → Plant Maintenance → Management of Technical Objects → Environment → Measuring Points → Create) or in the master record of the Technical Object (IL02 resp. IE02). The following information is part of the master record of a Measuring Point (compare Figure 5):

- MeasPoint: This field contains the ID of the Measuring Point. It is created by the system, unique in the whole system, and needed to create Measurement Documents.
- Char. Name: the reference to an existing Characteristic. It is possible to pick a Characteristic from the list of all defined Characteristics.
- (freely chosen) Description of measuring point
- Counter: This field defines whether the Measuring Point is used as a counter. In this case the most recent value must be higher than the second recent value.
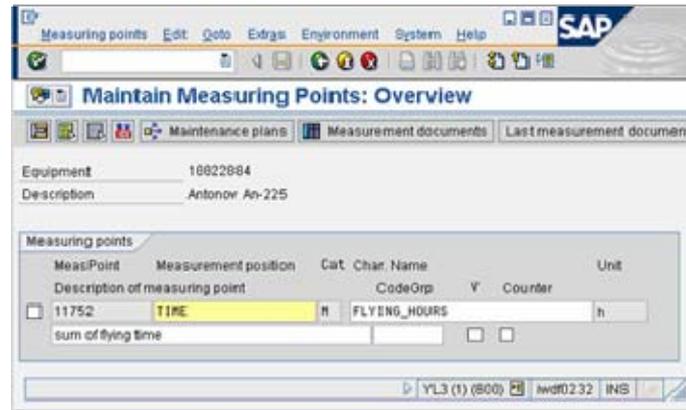
Figure 5: Maintaining Measuring Points

Measurement Documents

Measurement Documents are needed to record data captured for Measuring Points. For each value in a stream of measurement data, a Measurement Document is required. A Measurement Document can be created using transaction IK11, to be found under SAP Menu → Logistics → Plant Maintenance → Management of Technical Objects → Equipment → Measurement Documents → Create.

Before the measurement value can be inserted, the ID of the Measuring Point has to be filled in. One single measurement value of the stream of measurement data can be specified. Furthermore, the responsible person, who inserted the measurement data, and a comment for the measurement can be included in the Measurement Document. The unit of the measurement value and other restrictions are applied as declared in the master record of the corresponding Measuring Point.

Measuring Points as well as Measurement Documents can be grouped to represent records of values from different sensors that belong semantically together e.g. because they are measured at the same point in time.

Visualization of measurement data

After selecting a Measuring Point, it is possible to display the complete list of Measurement Documents [Measurement documents] or to view only the last Measurement Document [Last measurement document...] entered in the PLM system.

Figure 6: List of Measurement Documents

In the first case, the available Measurement Documents are listed in a table as shown in Figure 6. Every line of the table represents a Measurement Document. Measurement Documents of interest may further be selected by clicking the buttons in the left column of the table. The selected measurement values can also be displayed as diagram ![diagram icon] as shown in Figure 7.
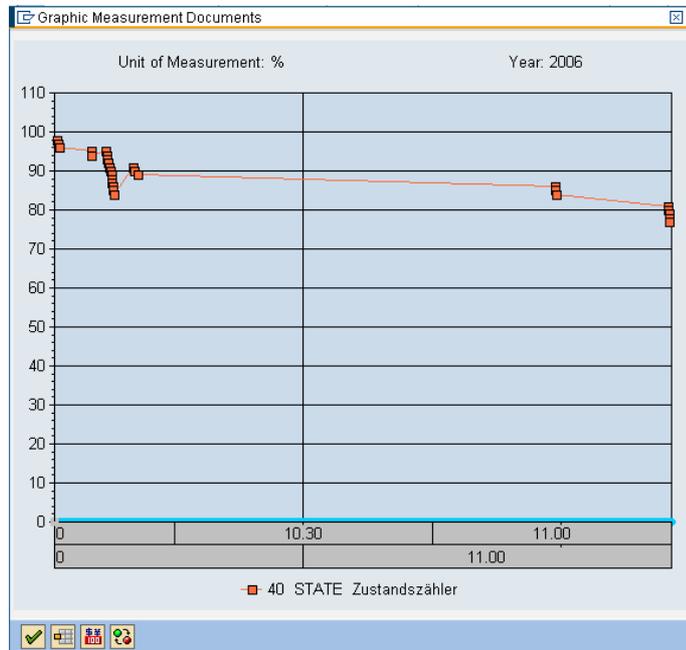

Figure 7: Measurement Graph

4.6 Notifications

Notification objects are used to store information about equipments which can occur in form of events. An event in the lifecycle of products could be e.g. a maintenance action or an incident. Notifications can be created by using the transaction IW21. They can store the title of the event, the type of the event and a text describing the event. Furthermore activities can be assigned to notifications which can be chosen out of an activity catalogue. The activity catalogue will defined for a notification type in the customization.

5 DSS User Interfaces

The current version of the Decision Support System covers three representative application scenarios. The integration of PDKM and DSS on the GUI level is demonstrated with the help of the exemplary scenarios A1, A3 and A6. The user interfaces for the other application scenarios will be discussed in DR10.6c.

5.1 User interfaces for A1 (Optimized Vehicle Recycling)

The EOL scenario A1 demonstrates the application of the Decision Support System to optimize the recycling process of a car.
First, the respective car is identified either via RFID reader or by manually inserting the vehicle model and S/N. The respective vehicle information is extracted from the PDKM. The components of the vehicle to be taken into consideration during the recycling process are listed in a table as shown in Figure 8. For each component the system provides detailed information like residual lifetime or economic data. To allow an optimal DSS result the service technician has to evaluate

the quality of each component in a visual inspection. After determining the component's quality, the system provides a recommended recycling action together with the decision reason. The component can either be removed from the car for further utilization or it is recommended to be left on the car to be scraped.

Figure 8: Component table with recommendations

At this step, the service technician may disagree with the suggested action. He is allowed to change the recycling action (Figure 9).
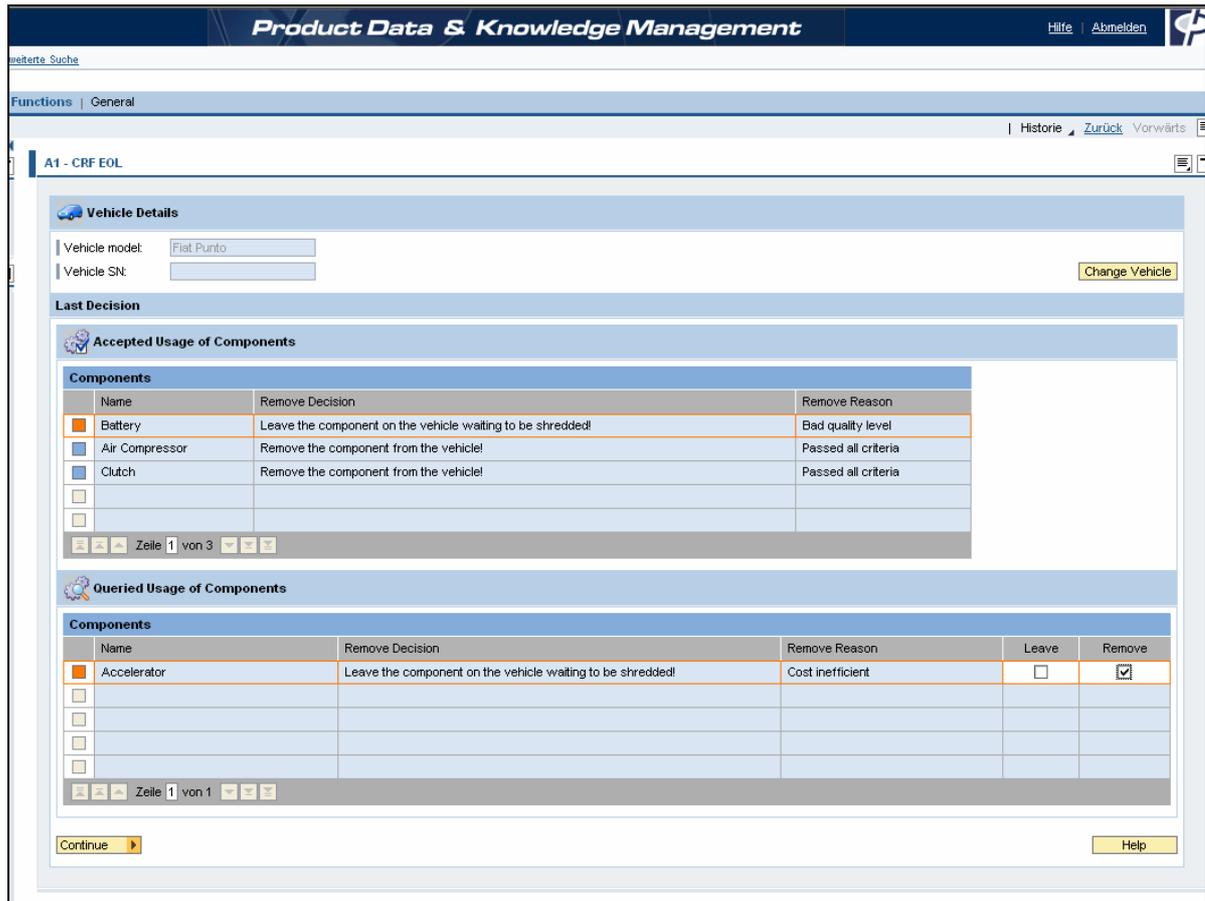
Figure 9: Interaction of service technician to change recycling action

The results of the decision support are shown in the last screen. All components that have to be removed from the car, before it is scraped, are shown in the list ready for printing.

5.2 User interfaces for A3 (Plastic Recycling)

The scenario A3 comprises the problem of plastic recycling. The Decision Support System was implemented for the use case "Incoming Goods". First, the user has to select an incoming container from the drop down list. Information about its location is automatically shown (Figure 10).
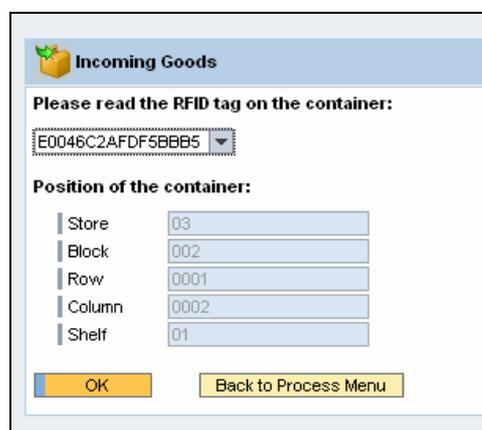

Figure 10: Location information for selected container

The Decision Support System automatically determines the next process step. For example, mixed content of the container has to be sorted. With the user's confirmation the next process step is stored in the database and the container information is updated.

5.3   User interfaces for A6 (Machine Maintenance)

The A6 scenario is an MOL axis maintenance application. After selecting a machine, the residual lifetime of the machine's axis components are shown in a table. Here, the user selects the axis, for which the maintenance actions shall be calculated.

In addition to the residual lifetime, detailed static information like costs and replacement time as well as production data about maintenance duration and productivity reduction are retrieved from the database as shown in Figure 11. These data may be modified by the user.

Figure 11: Static data retrieved from PDKM

Based on the given data, the DSS computes recommended maintenance actions for every part of the chosen axis. The results are shown in the screen in Figure 12. In future versions, the sensitivity analysis will be included.
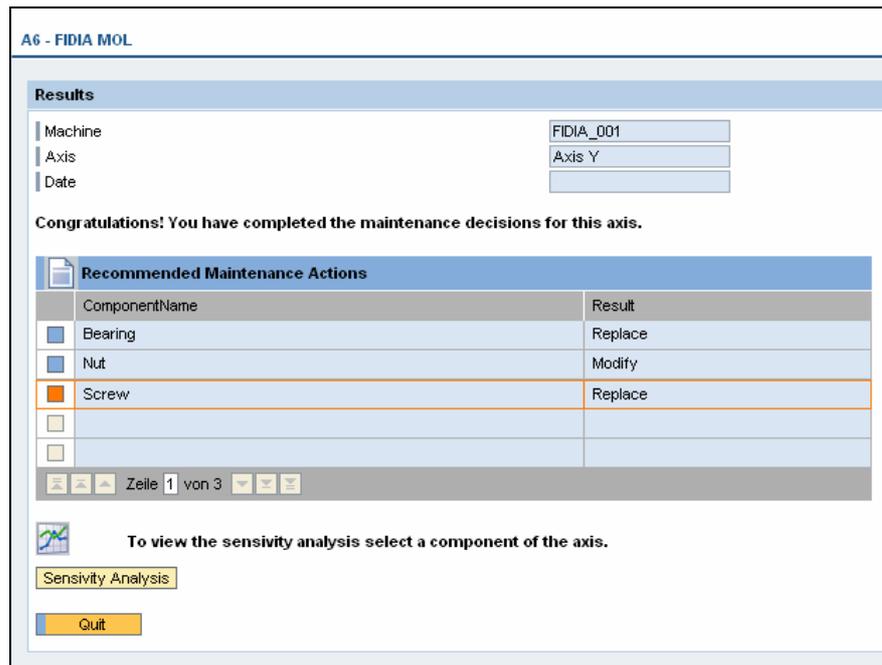
Figure 12: DSS results for A6 – Recommended maintenance actions

6 Description of user roles

In the scope of the PDKM, there are different user roles which can be defined for each application scenario. Each user belongs to one application scenario domain so that only data of the respective application scenario can be accessed.

A user within an application scenario receives a login name and password for the PDKM web portal. Therefore he/she can access to PDKM functionality and apply them to available objects in the current system. Search mechanisms also deliver all available objects in the current system. This could lead to the situation that in the scope of the PROMISE project (where it is planned that only one central PDKM system will be installed and only one mandate maintained) users can see objects where the user is not a member of the corresponding scenario. In a real-life scenario this situation can be avoided easily by installing more systems or maintaining more mandates within a system. Similar concerns that result from security related issues are investigated in workpackage WP R13. Furthermore users only have the possibility of invoking DSS graphical user interfaces for their own application scenarios.

For each application scenario key-users will be defined who have special access rights. Key-users perform tasks in order to customise the PDKM. They additionally receive a login name and password for PDKM back-end graphical user interfaces. Their access to back-end functionalities is restricted to the transactions (SAP ECC back-end functionalities) which are required for their role in the application scenario.

For the whole project there are global administration users. They have access to all function areas in both front-end and back-end domains. Global administrators are responsible for setting up and maintaining the PDKM.

7 Conclusion

The deliverable gives an overview about the graphical user interfaces currently supported by the PDKM system. According the architecture of the PDKM, we can differentiate between the GUIs for PKDM functions, for DSS-functions, and for the administration of PLM objects at the

backend. While the GUIs for PDKM and DSS functions have been implemented as Webclients, the GUI for administration of PLM objects is available as a backend-client of the mySap PLM system, which the PDKM is built upon. The GUIs allow the user to solve a rich set of PLM tasks, such as product/product structure management, configuration management, field data capture and management, and application-specific decision making. The GUIs for PDKM and DSS functions have been integrated into a single web-based user interface, offering a uniform and convenient point of entry for all PDKM users.

References

1. On-line help for SAP ECC 5.0 (as of 01.03.2007):
   http://help.sap.com/saphelp_erp2004/helpdata/en/e1/8e51341a06084de10000009b38f83b/frameset.htm