Handbook for Usage of the PROMISE decision support technology (Version 1)

Written by:
Christian Seidemann, Cognidata
Martin Schneider, Cognidata
Gerd Große, Cognidata
Helmut Neubauer, Cognidata

DELIVERABLE NO	DR8.6: Handbook for Usage of the PROMISE decision support technology (Version 1)
DISSEMINATION LEVEL	**CONFIDENTIAL**
DATE	15th May, 2007
WORK PACKAGE NO	WP R8: Methodologies for decision making for BOL, MOL, EOL
VERSION NO.	1.0
ELECTRONIC FILE CODE	DR8 6_Handbook for Usage of the PROMISE decision support technology 1.0
CONTRACT NO	507100 PROMISE A Project of the 6th Framework Programme Information Society Technologies (IST)
ABSTRACT:	This report contains the PROMISE WPR8 deliverable DR8.6: “Each new applier of the PROMISE technology should understand what part of the technology he can directly reuse, what part needs specific extensions developed by him and where the major obstacles in a successful application lay. In TR 8.6 we generate a handbook that guides new users in an instructive way.”

STATUS OF DELIVERABLE		
ACTION	**BY**	**DATE** (dd.mm.yyyy)
SUBMITTED (author(s))	Gerd Große	15.05.2007
VU (WP Leader)	Gerd Große	15.05.2007
APPROVED (QIM)	D. Kiritsis	15.05.2007

Revision History

Date (dd.mm.yyyy)	Version	Author	Comments
30.04.2007	1.0	Christian Seidemann, Martin Schneider, Gerd Große, Helmut Neubauer, Cognidata	First version of the User Handbook

Author(s)' contact information

Name	Organisation	E-mail	Tel	Fax
Christian Seidemann	Cognidata	christian.seidemann@cognidata.de	004961016559901	
Martin Schneider	Cognidata	martin.schneider@cognidata.de	004961016559901	
Gerd Große	Cognidata	gerd.grosse@cognidata.de	004961016559901	
Helmut Neubauer	Cognidata	helmut.neubauer@cognidata.de	004961016559901	

Table of Contents

Abbreviations:

BOL	Beginning Of Life
BOM	Bill Of Materials
DfX	Design for X
DHW	Domestic Hot Water
DPN	Degradation Priority Number
DSS	Decision Support System
DOW	Description Of Work
ECC	Error Correction Code
EEE	electrical and electronic equipment
EIS	Enterprise Information System
ELV	End of Life Vehicle
EOL	End Of Life
GUI	Graphical User Interface
HTML	Hyper Text Mark-up Language
HTTP	Hyper Text Transfer Protocol
JDK	Java Development Kit
JSPs	Java Server Pages
LCC	Life Cycle Cost
MOL	Middle Of Life
MTBF	Main Time Between Failures
ORM	Object-Relational Mapping
PDKM	Product Data and Knowledge Management
PEID	Product Embedded Information Device
RAM	Reliability, Availability, Maintainability
RDBMS	Relational Database Management System
SAP	Systems Analysis and Product
SQL	Structured Query Language

1 Purpose of this document

This report contains the PROMISE WP R8 Deliverable DR8.6 “Handbook for Usage of the PROMISE decision support technology (Version 1)”. Its purpose is to give new users a handbook about how to use the DSS.

Hence, this document involves two main issues: (i) the installation of the first prototype of PROMISE DSS and (ii) the description of the how to apply the different strategies. Currently, the document includes the application scenarios A1, A4 and A6. In version 2 of the document the remaining application scenarios will be added.

2 Introduction

2.1 Objectives of work package R8

According to *PROMISE Description of Work* the goal of this work package is to provide the analytical basis of the PROMISE project. This WP concentrates on predictive maintenance, diagnosis and analysis of use patterns, which rely on algorithms originating from the fields of statistics, data mining, pattern recognition and computational intelligence. Based on the PROMISE research clusters 1, 2 and 3 and the PROMISE application clusters, this work package specifies decision-making systems supported by automatic identification systems, product embedded information devices, mobile reader devices, associated software and user interfaces. In a second step, methods and algorithms for beginning of life (BOL), middle of life (MOL) and end of life (EOL) decision-making systems will be developed for the evaluation in the application clusters.

2.2 Objectives of Deliverable DR8.6

As described in PROMISE_DoW (M30-M42), the main goal of Task TR8.6 is to give each new applier of the PROMISE technology a document that makes him understand, what part of the technology he can directly reuse, what part needs specific extensions developed by him and where the major obstacles in a successful application lay. In TR 8.6 we generate a handbook that guides new users in an instructive way.

2.3 Structure of Deliverable DR8.6

The rest of this document is organized as follows:

- In Chapter 3 an introduction into the DSS is given.
- Chapter 4 gives information which technical environment is needed in order to run the DSS.
- Chapter 5 explains how to start the DSS.
- In Chapters 6-8 it is shown how the different strategies can be executed within the DSS.
- Finally, Chapter 9 summarizes the content of the document and mentions next steps.

3 Introduction to the Decision Support System

This chapter provides an overview of the architectural concepts upon which the DSS is based. It can be used in two ways: On the one hand, as a stand-alone system including its own database and GUI. On the other hand, the DSS can be integrated as part of the PDKM system.

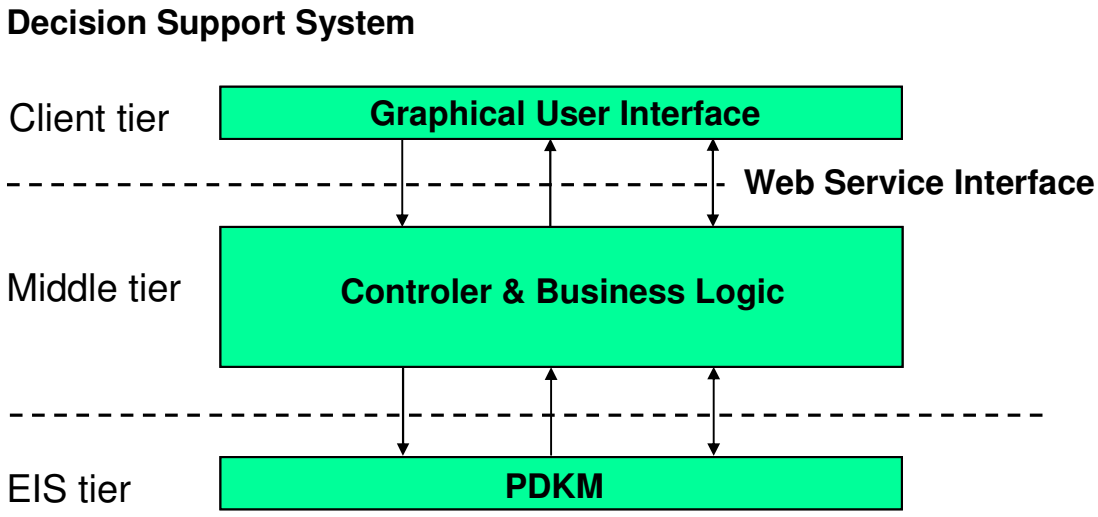


Figure 1: PROMISE DSS architecture

The PROMISE decision support system is designed as a browser-based 3-tier architecture. The EIS tier (also called the data tier or the bottom tier) maintains data pertaining to the decision support system. This tier stores data in a relational database management system (RDBMS). In the integrated solution DSS algorithms accesses data that is stored in PDKM. The middle tier implements presentation logic, controller logic and business logic to control interactions between the application's clients and the application's data. The middle tier acts as an intermediary between data in the EIS tier and the application's clients.

The middle-tier presentation logic then processes data from the application layer and presents the content to the client in form of JSPs and Servlets. The controller-action architectural pattern can be understood as a model manager. The controller itself is implemented as a web service which separates the presentation logic from the business logic.

The PDKM/DSS GUI (Client tier) development is carried out in form of iViews. iViews are web applications based on JSP that can be directly integrated into the SAP NetWeaver Portal, which provides the runtime environment for the PDKM GUI. This environment only supports JDK 1.4. Yet, the DSS includes several 3rd-party libraries and frameworks which require JDK 5.0. However, due to the separation of the presentation logic from the business logic each part can run in its own Java environment and is therefore not limited in its functionality. Furthermore, it has the advantage that only one GUI for PDKM and DSS can be developed. From the end-user's point of view it is transparent whether DSS or PDKM functionality was called.

4 Technical Information

The PDKM prototype bases on the PLM system mySAP PLM and on SAP EP. The following software versions have been used:

- SAP ECC 5.0 (including mySAP PLM)
- SAP NetWeaver 2004 with
  - SAP EP 6.0 SP 9
  - SAP WebAS 6.40
  - SAP J2EE-Engine 6.40 (realising J2EE 1.3)
- JRE 1.4.2
- MaxDB 7.5 as databases for SAP ECC and SAP NetWeaver

The PROMISE decision support system development is carried out with Java-based technologies.

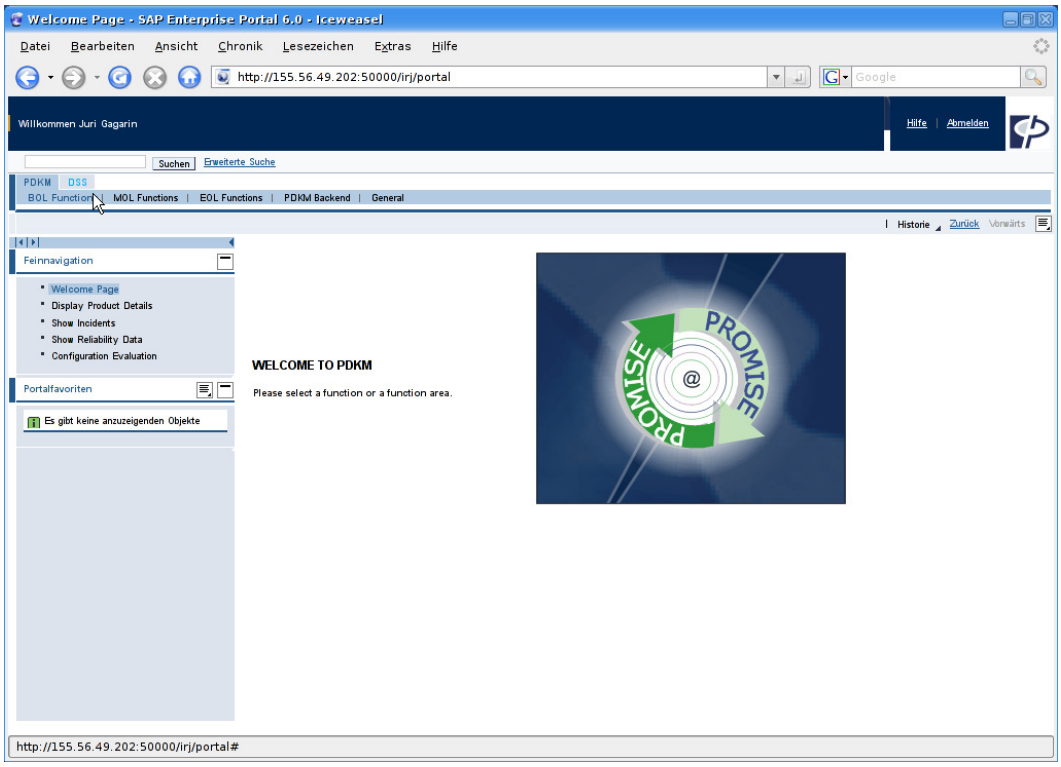
The development environment consists of the following components:

- Sun Java 2 Platform Standard Edition 5.0 Development Kit (JDK 5.0)
- Apache Tomcat 4.1.31 Servlet/JSP Container
- Eclipse 3.1.2 + WTP plug-in + Hibernate Tools plug-in
- Hibernate 3.1.2
- Commons-Math: The Jakarta Mathematics Library, Version 1.1
- MaxDB 7.5 (temporary database)

Using only platform independent components PROMISE DSS can be installed on multiple OS platforms.

5 Starting the DSS

After starting the DSS the system carries out a user login procedure and continues with the main screen:

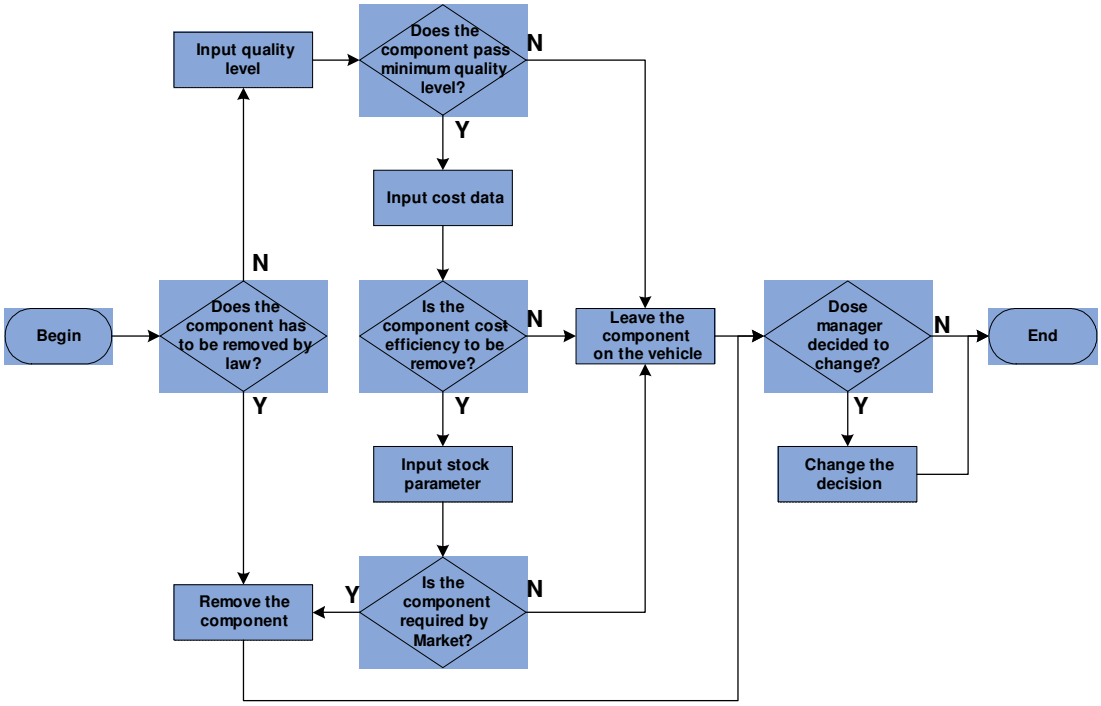


From here the user can start or administer the different decision support strategies.

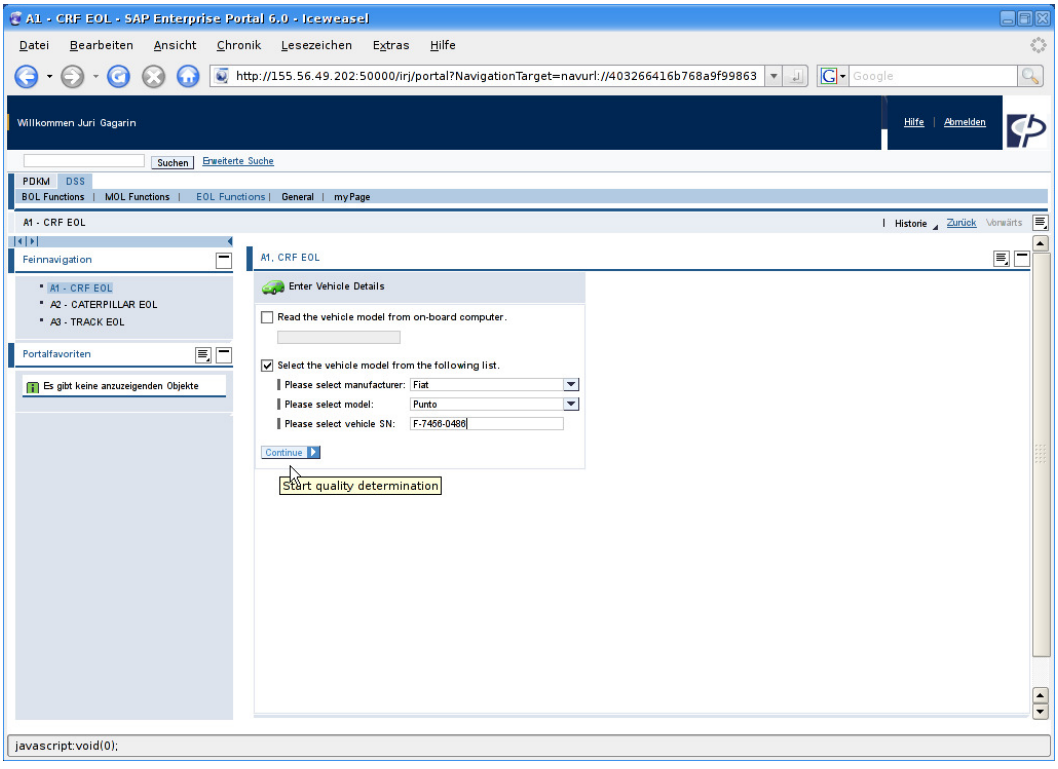
6 Strategies for End of Life

6.1 Example A1: Decision support for disassembly

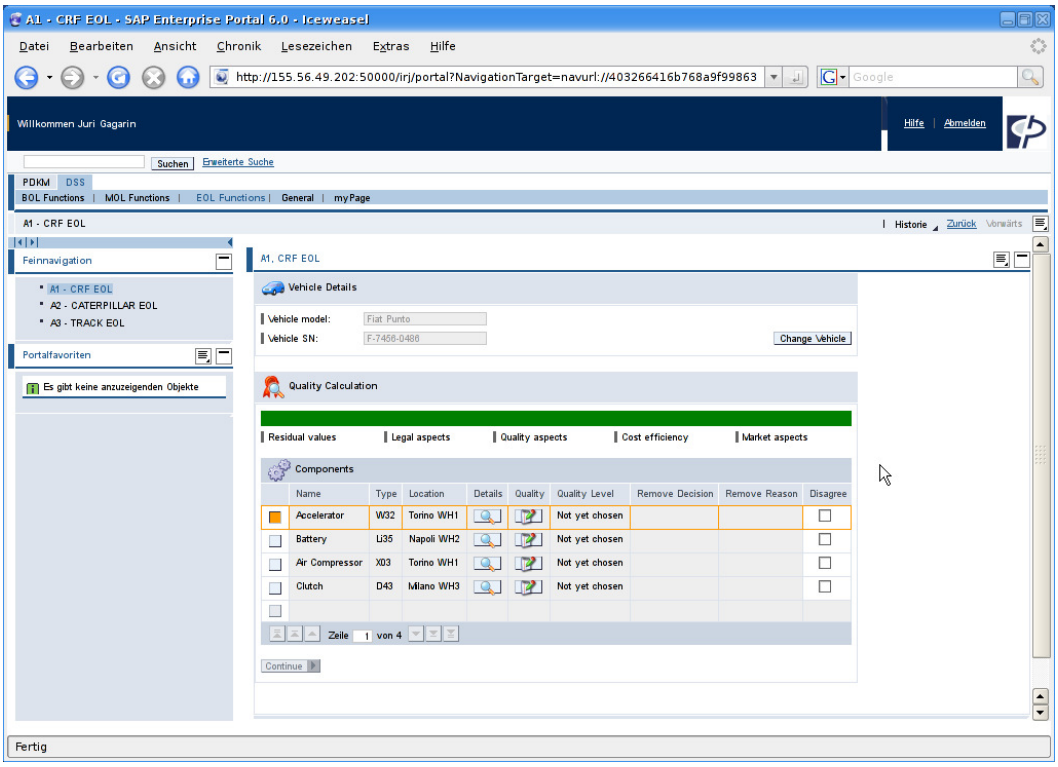
The ELV (End of Life Vehicle) directive (EU/2000/53) forces car manufacturer to increase their efforts in reuse, recycling and recovery of materials from ELVs. The DSS has therefore implemented a strategy that guides motor mechanics through the process of decommissioning ELVs. In the next figure the decision process is depicted.



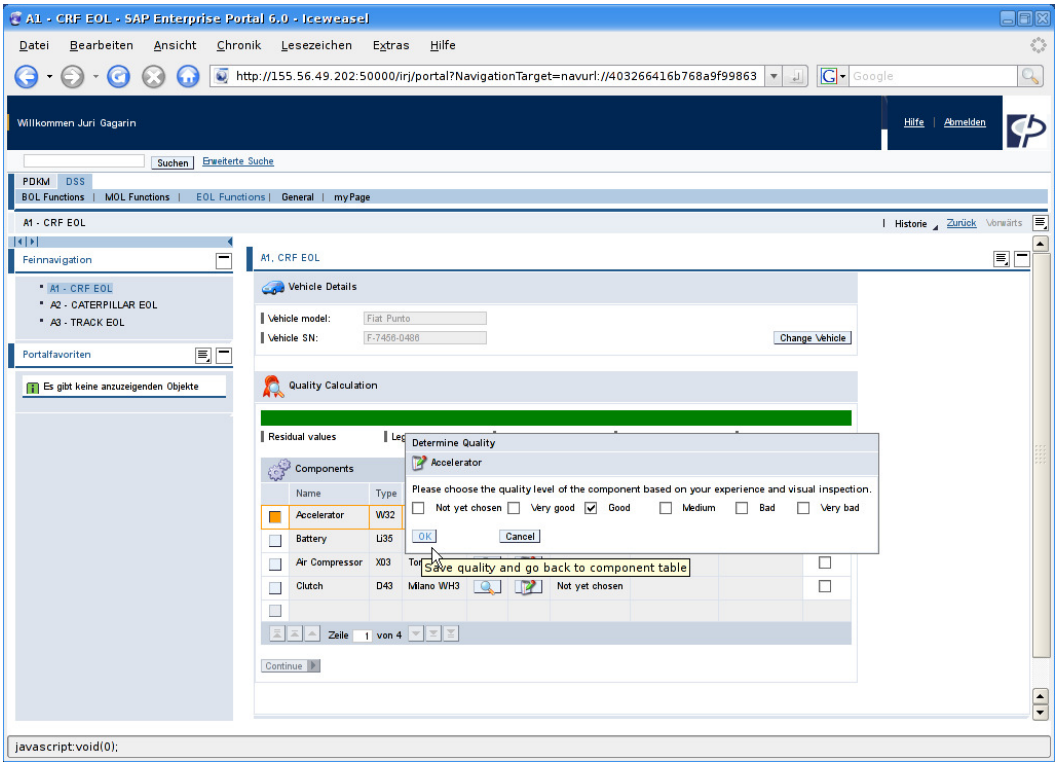
The DSS supports this process. By pressing the respective button for the decommissioning strategy “A1 CRF EOL” the process starts. At first the present car has to be identified, either by downloading information from the car or by typing the serial number manually.



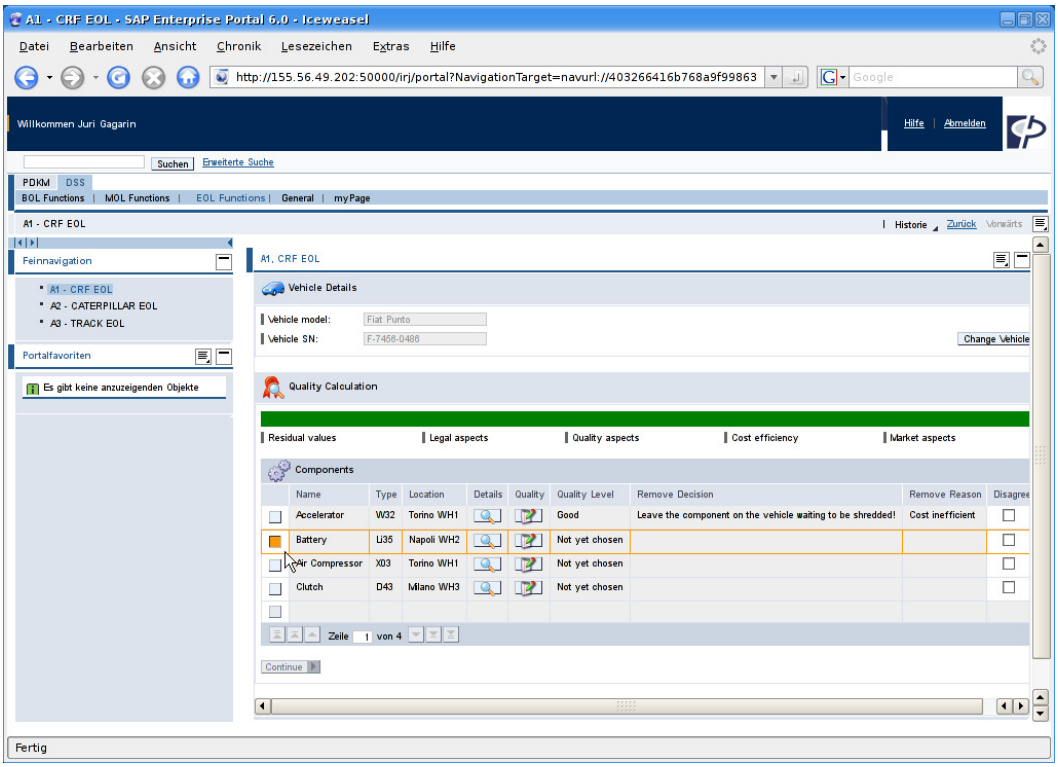
Afterwards the system displays the list of components which either have to be removed or to be shredded.



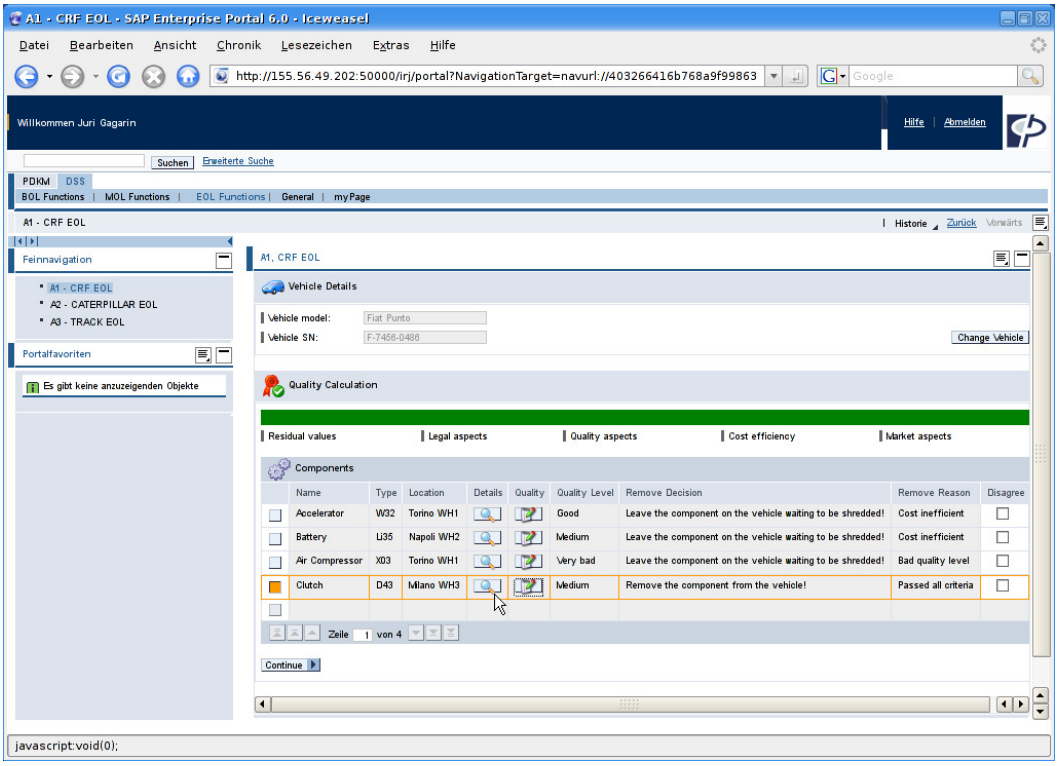
The mechanic has to go over each of these components and has to meet the correct decision. In each line a number of functions can be executed. By typing “Details” important information out of the back office is presented, by typing “Quality” the mechanic can enter its own estimation of the state of the component. In the next figure this can be seen.



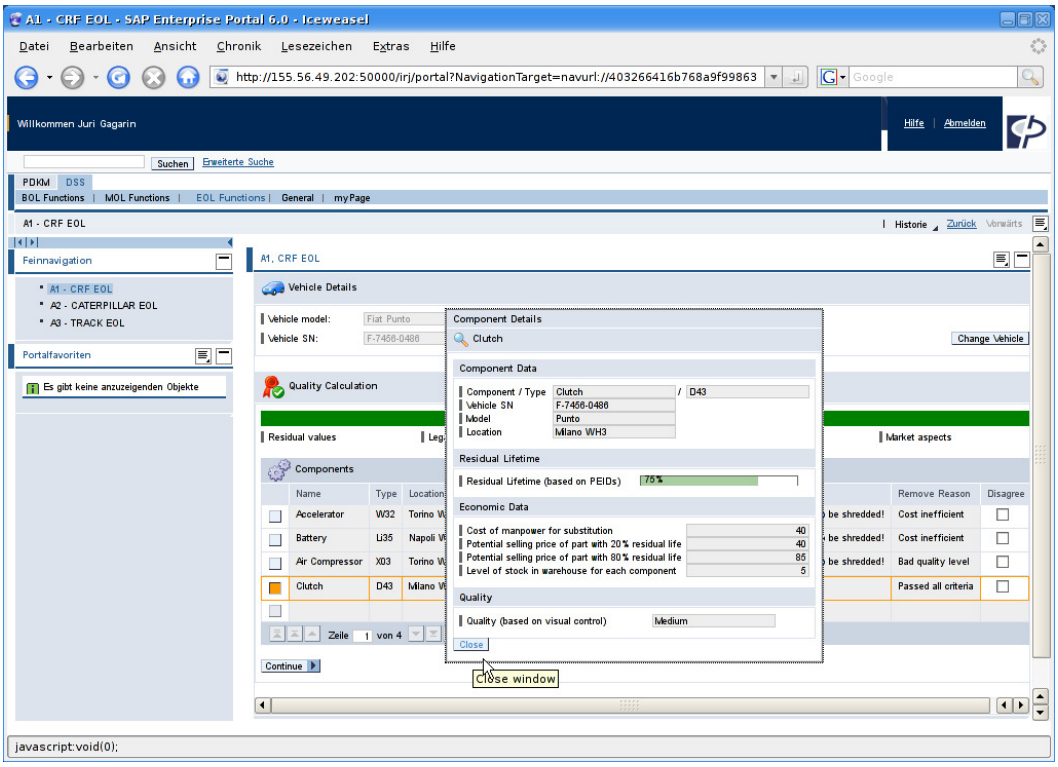
Depending on the actual own assessment of the component the mechanic chooses one of the 5 options. Closing the window with “ok” leads back to the overview list which displays the chosen option under “Quality Level”.



The process ends when all components are processed.



In case the mechanic wants to see the underlying information on which the decision was based, s/he can press the respective “Details” button.

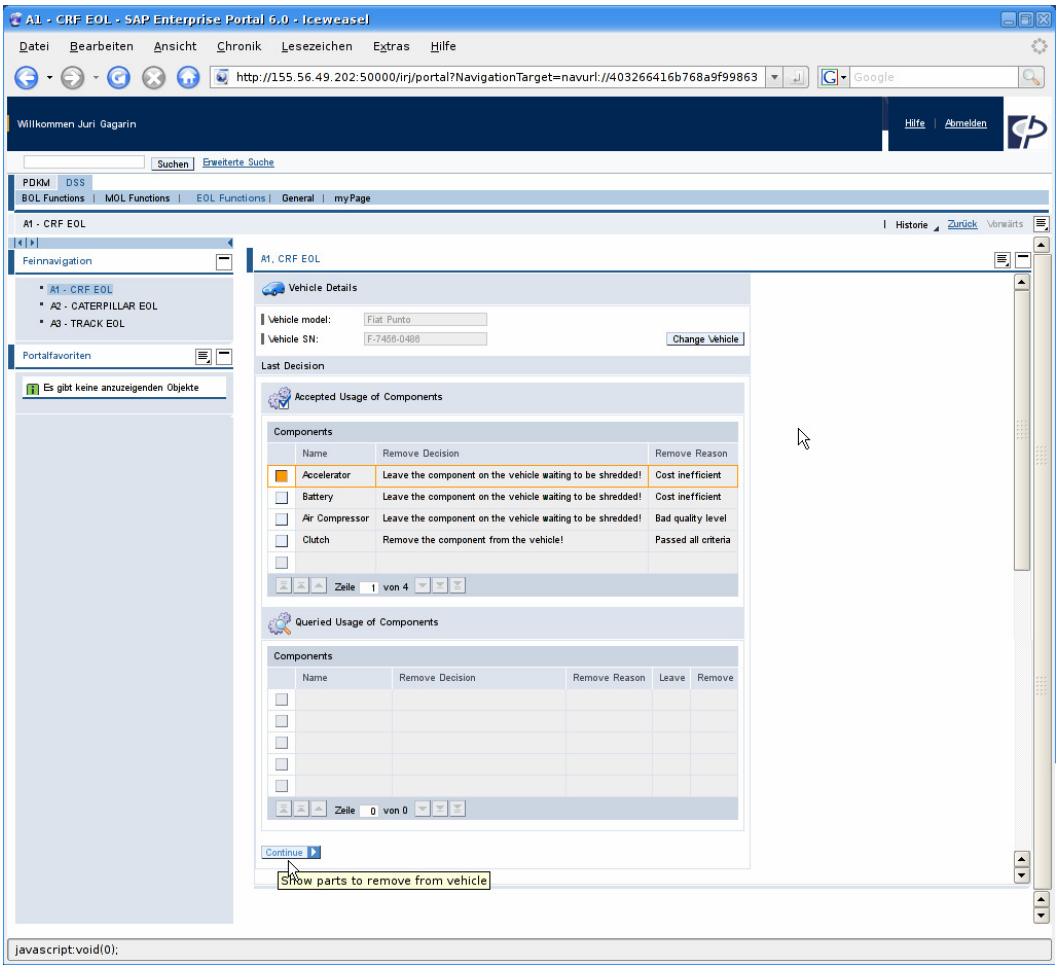


In the “Components Details” screen the computed residual lifetime is given. This value is computed as the average lifetime of such components, taking also care of previous repairs or received sensor data. However, nobody took a look on the physical component.

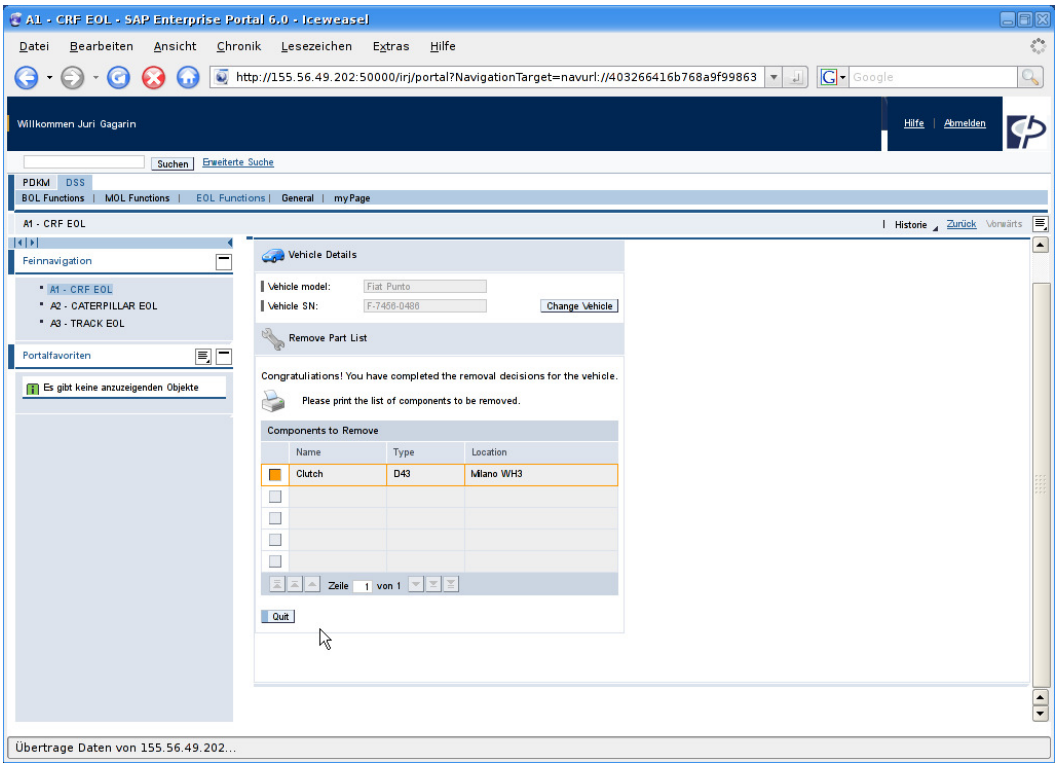
In addition there is financial information about the possible second hand prices and the labour hours for substituting the component. Finally, the number of pieces in the inventory is given. Altogether the mechanic can now decide whether it makes sense to remove the component from the car.

Having finished the analysis the mechanic can review the decisions. If s/he wants to overrule the decision the “Disagree” button has to be clicked.

The next two screens display the list of decisions.



At the end the mechanic might want to print the list of parts which have to be removed, in order to walk to the car.



7 Strategies for Middle of Life

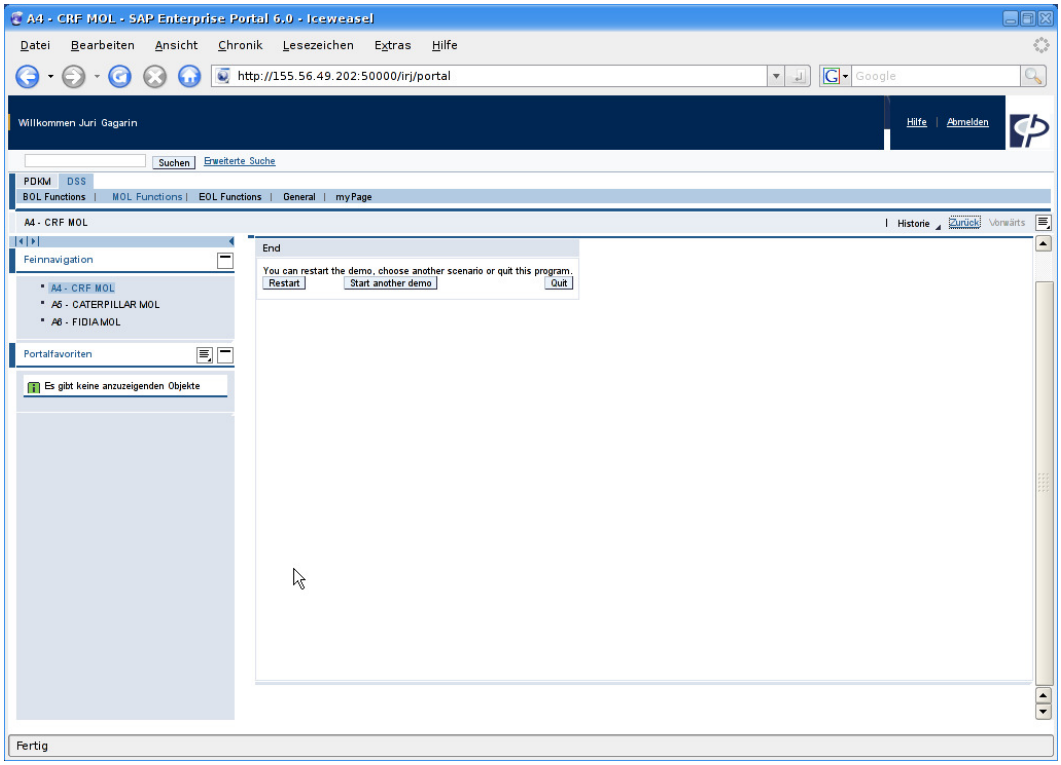
7.1 Example A4: Maintenance of a fleet of trucks

In this example the DSS is used to support the maintenance of a fleet of trucks, optimising the maintenance plan and increasing the overall availability of the trucks. This will improve the knowledge about the customer habits and the mission profile of the vehicle and finally enable to:

- Reduce the number of vehicle stops for maintenance
- Minimize the overall lifecycle costs of the components
- Avoid component breakdowns
- Take into account vehicle availability while planning maintenance interventions
- Take into account maintenance crew availability for performing maintenance

The idea behind predictive maintenance is the identification of slow degradation trends in the performance of specific systems in order to identify with reasonable warning the need of an intervention. This allows the optimisation of maintenance intervention with the implementation of a customised maintenance policy and contributes to make explicit the residual life of the component in order to better manage the total Life Cycle Cost (LCC).

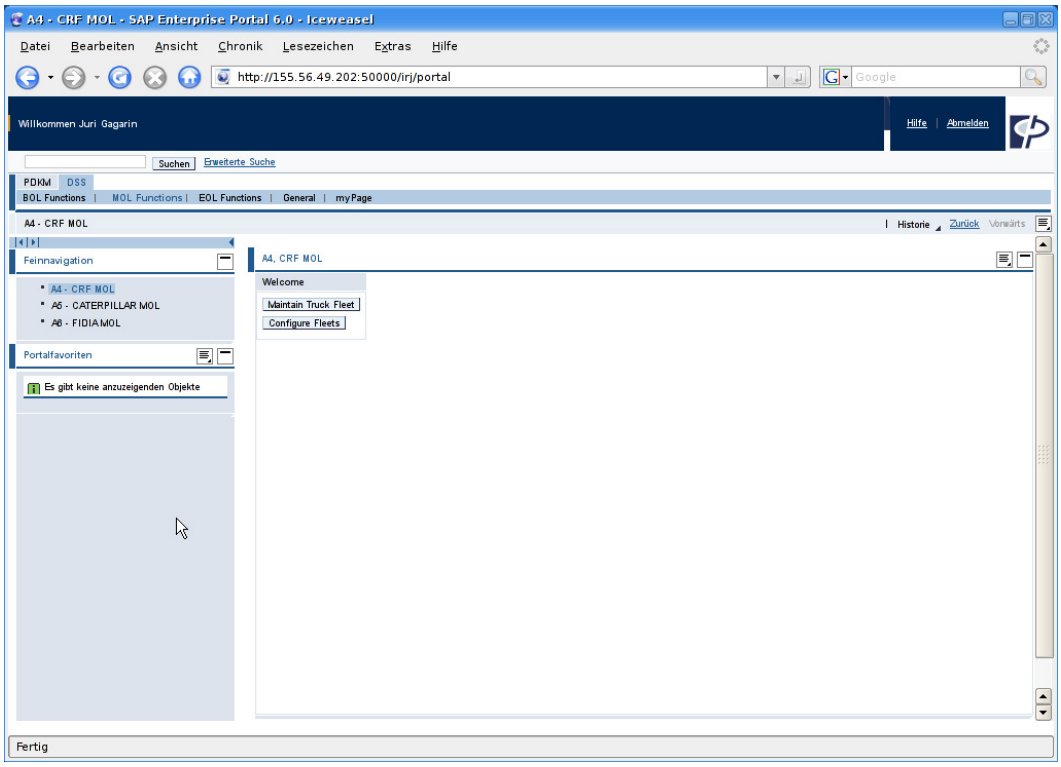
In the DSS the user navigates to the A4 use case:



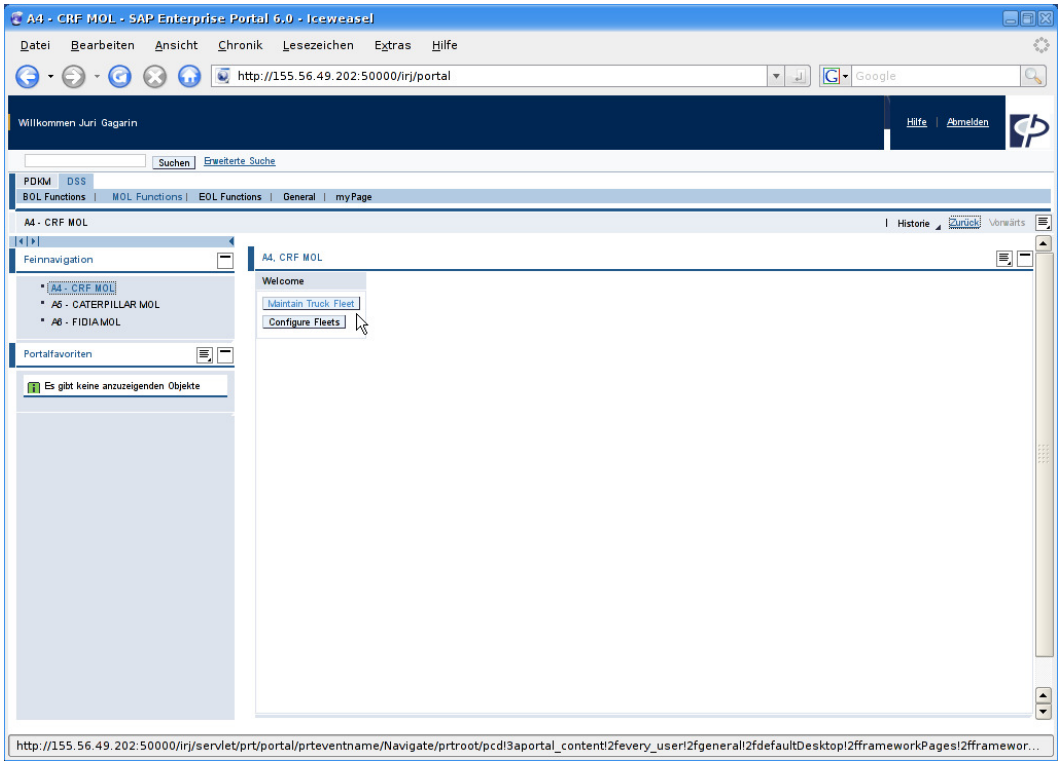
Then the user has two options:

- Getting support for decision making or

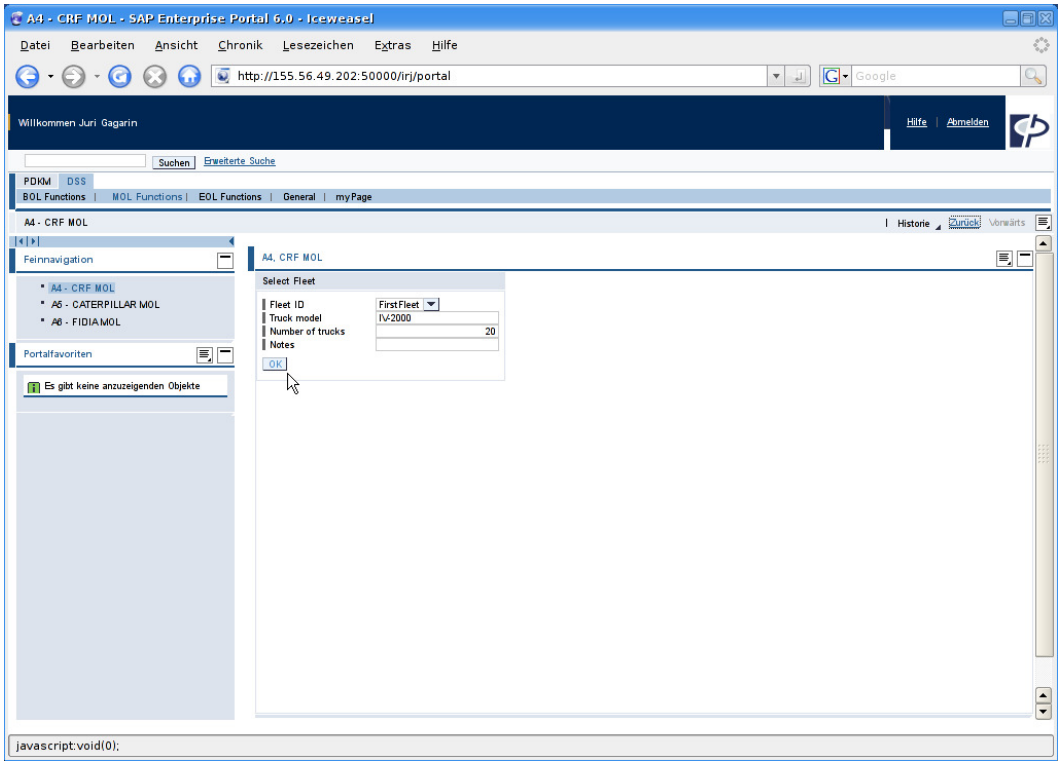
- Configuring the DSS.



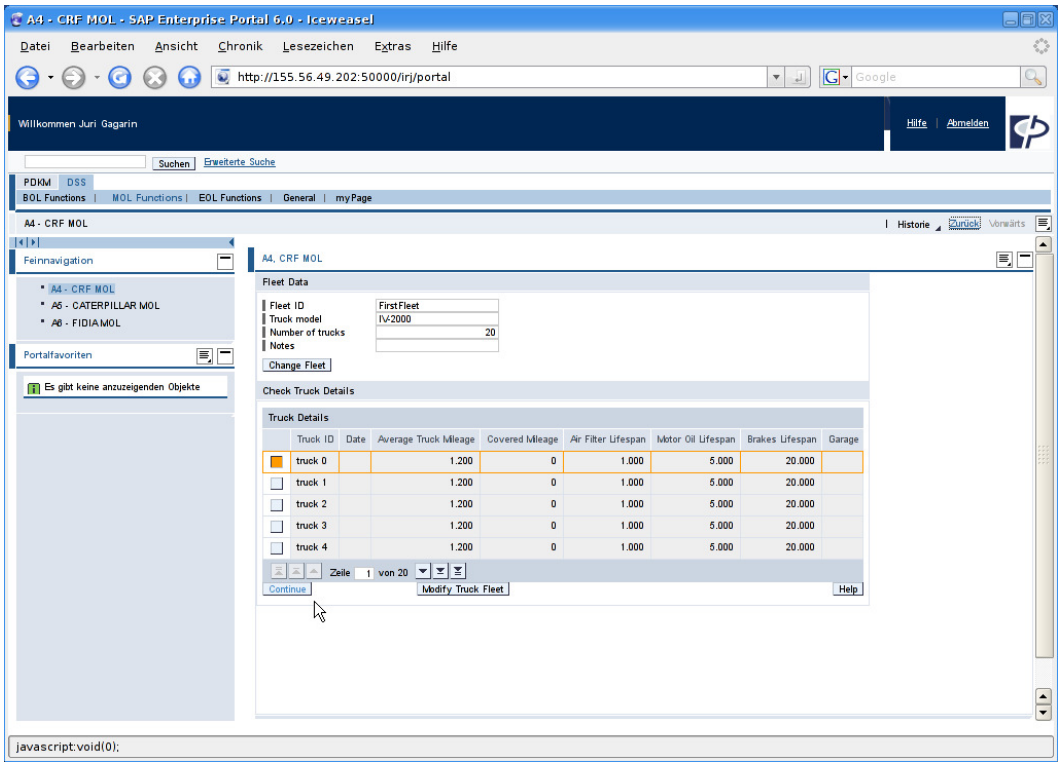
If the user selects the option “Maintain Truck Fleet” the system will support the decision process.



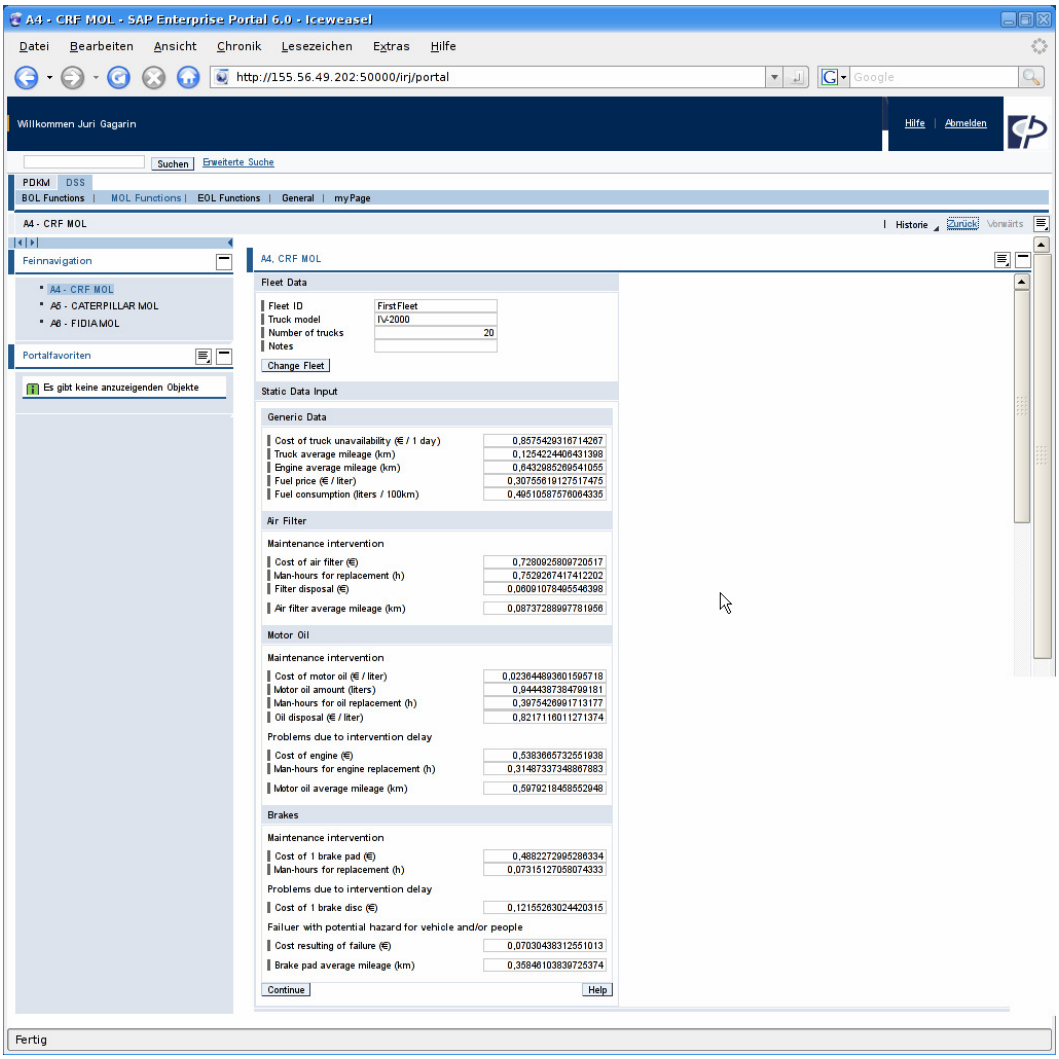
At first the use has to identify the tuck fleet s/he wants to analyze.



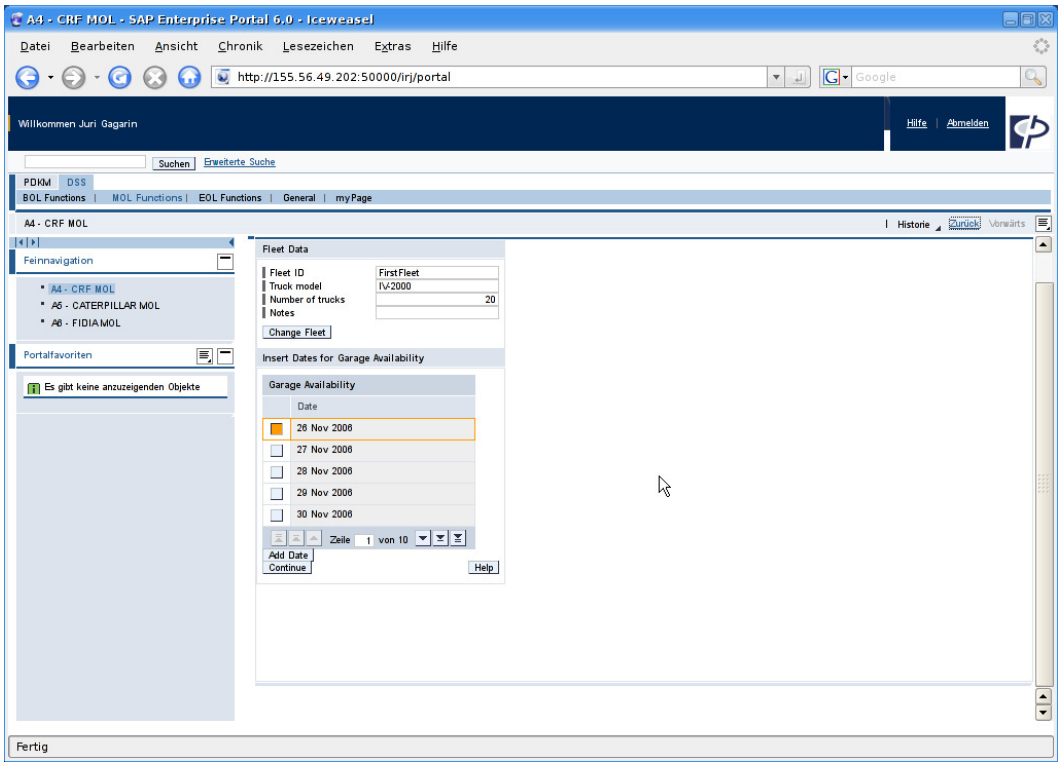
The system will display the list o all trucks in the fleet with corresponding important attributes.



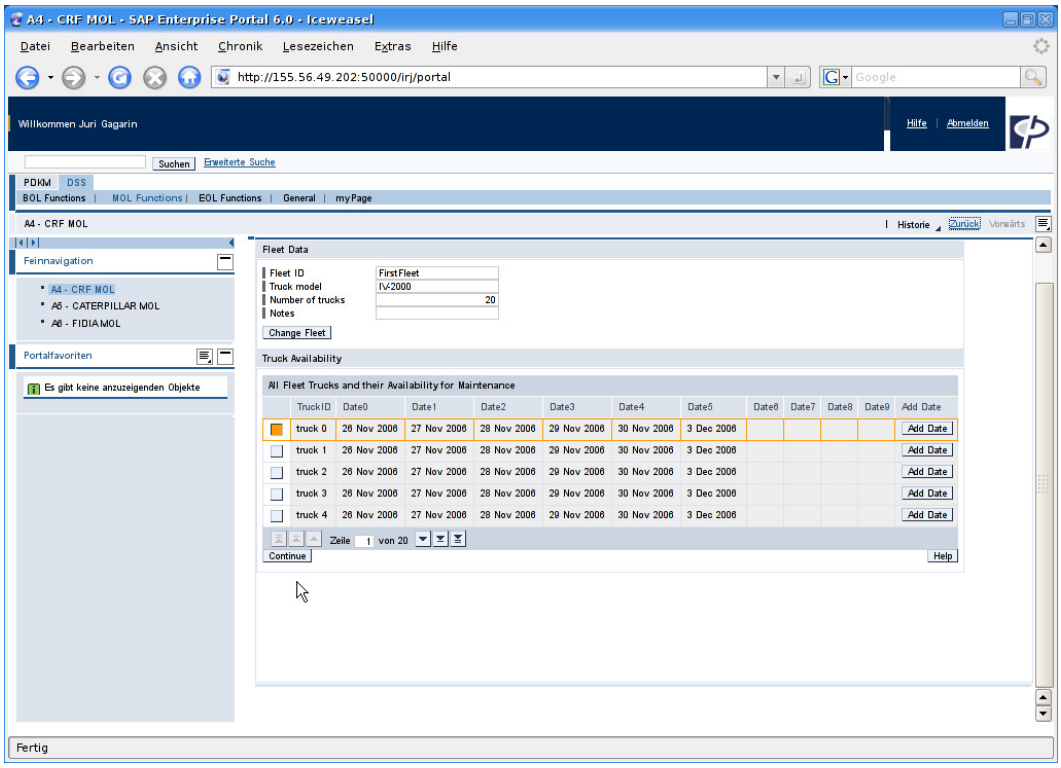
The system allows the user to see the underlying truck fleet parameter for the decisions.



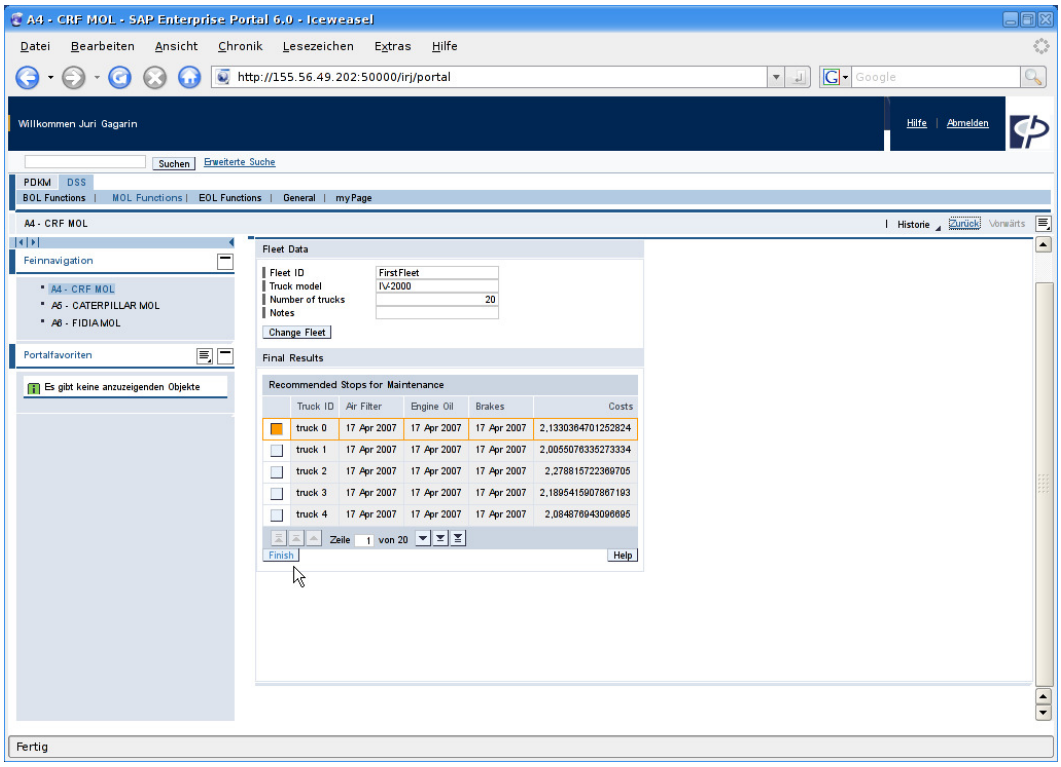
With an interface to the garage schedule the system is able to optimize the maintenance schedule.



The user can get an overview over the truck availability and possible maintenance days.



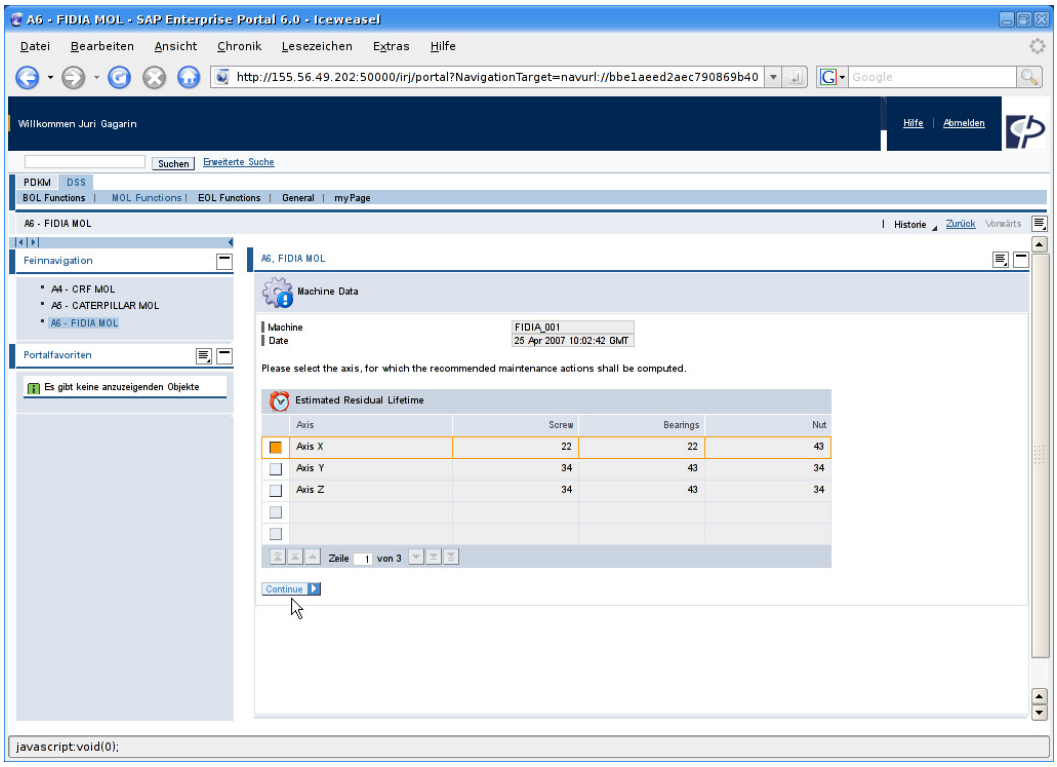
Finally the system can compute the cost of maintenance for a given choice for the day.



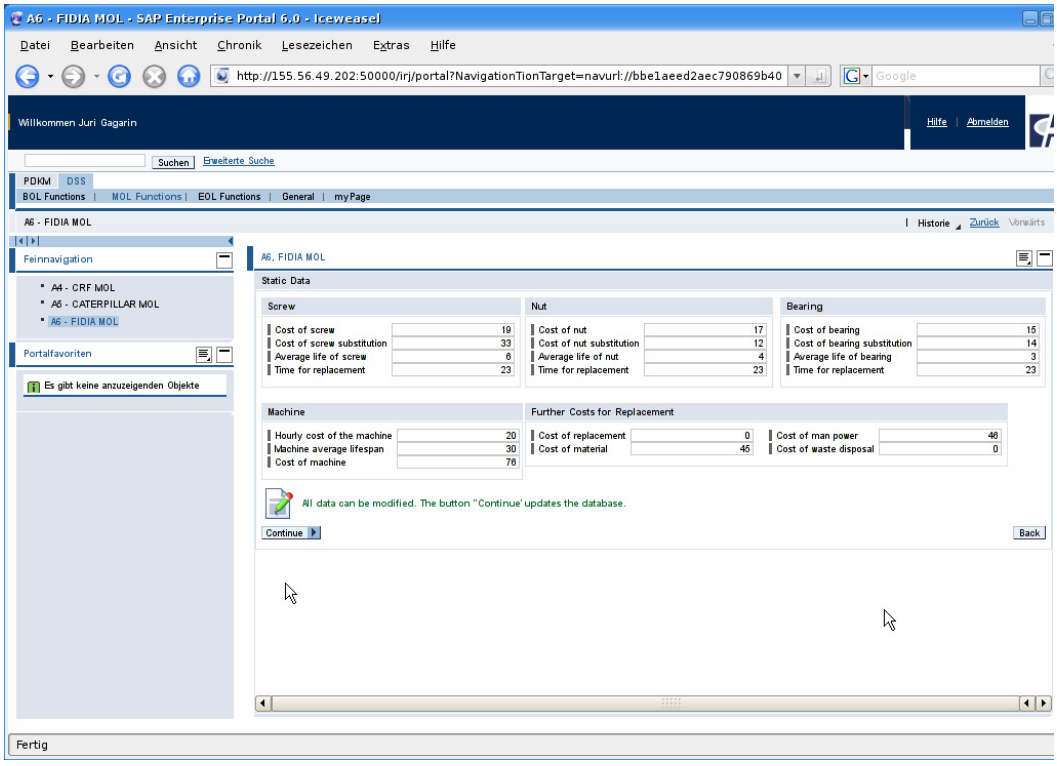
7.2 Example A6: Predictive Maintenance of machine tools

Periodic diagnostic tests on the milling machine provide indicators on the “health state” of its mechanical components. The A6 DSS is made of two components: the aging module that provides the residual life of the mechanical monitored components and the maintenance cost management module that provides a list of suggested interventions that can be performed on the machine tool when the residual life of these mechanical components of the axes is under a certain fixed threshold. Residual lifespan of each axis is provided by the DSS aging module running on each CNC on board the milling machine. The DSS maintenance cost management module is centralized on the central server at FIDIA service.

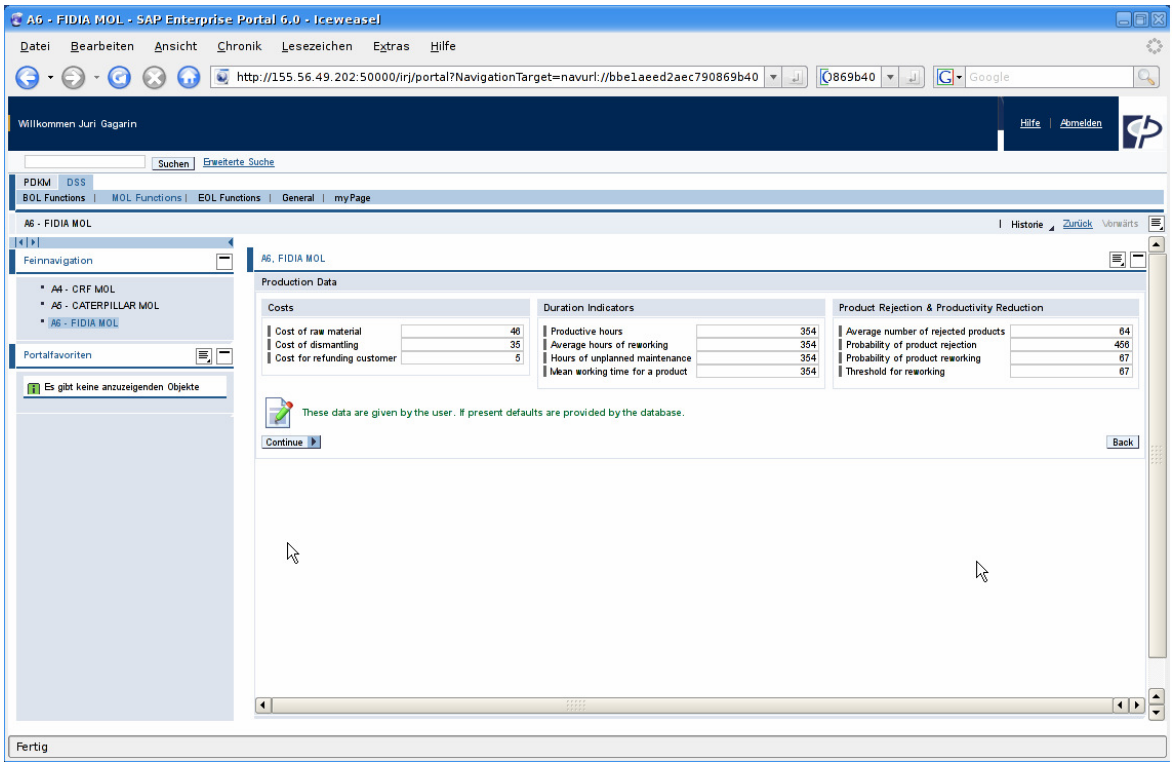
The application starts by showing the three axes with their main attributes.



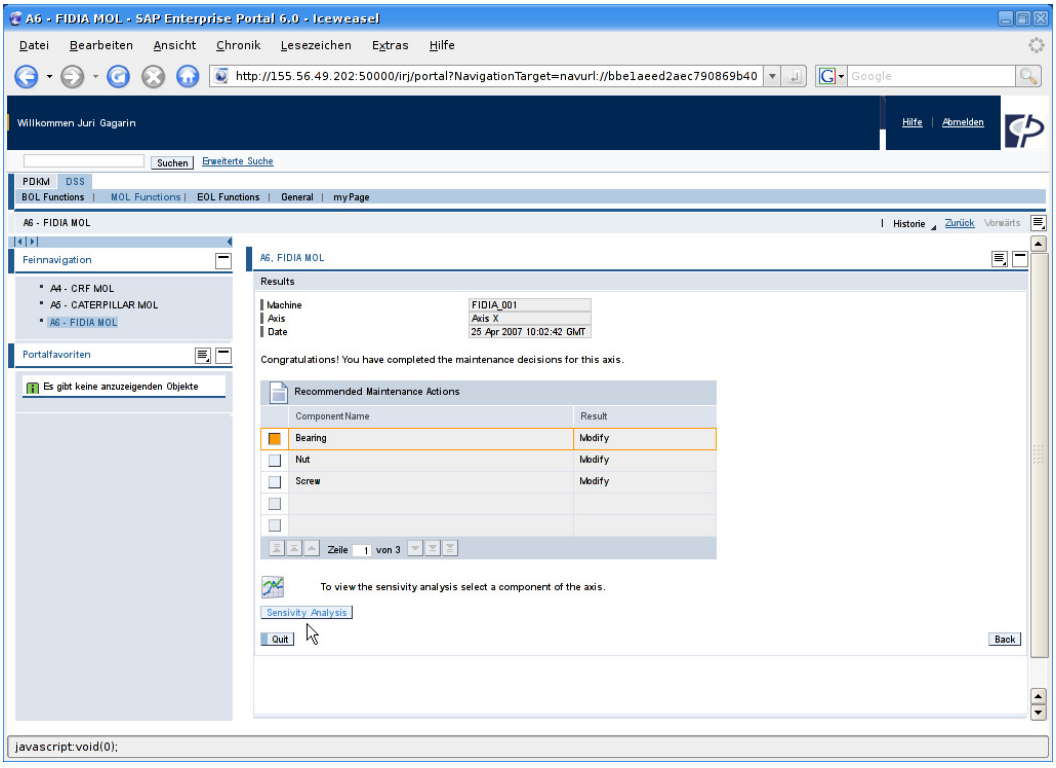
This kind of analysis needs a substantial amount of static data about screws, nuts and bearings.



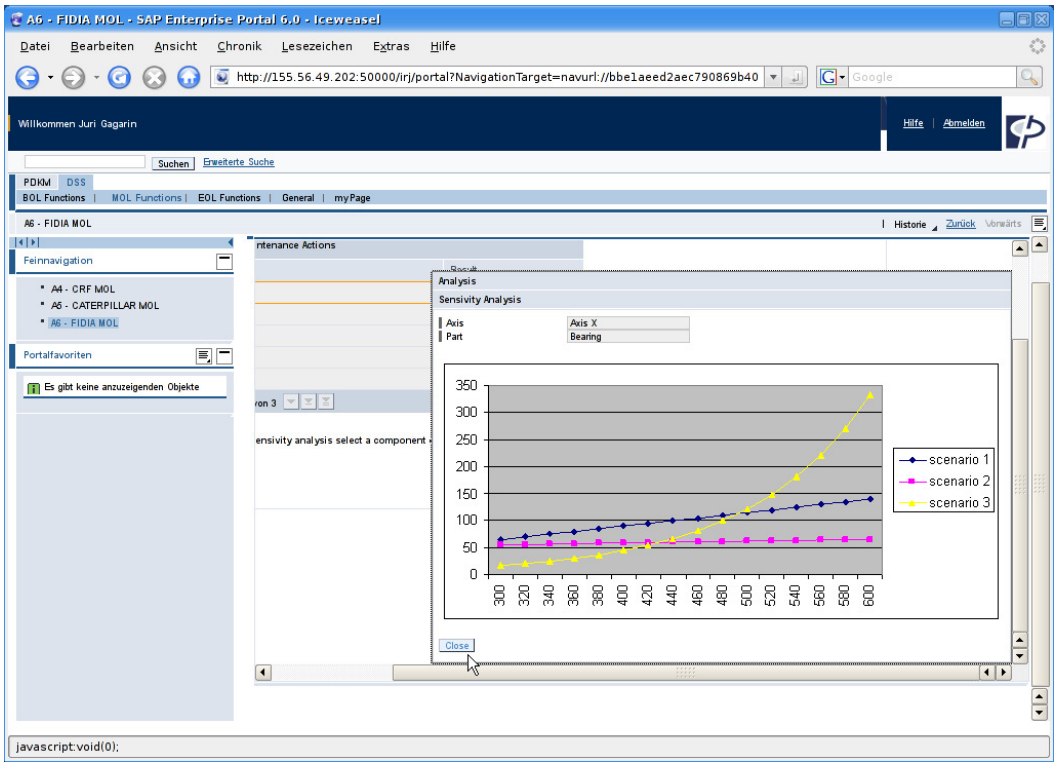
The same counts for static data about material and labour costs and all kinds of costs generated by failures.



Based on the static data and the sensor data the system computes then which of the three decisions, replace, modify or continue, are the best choice from a financial point of view.



In case the analyst wants to see the cost curves, s/he can press on the button “Security Analysis”.



8 Strategies or Begin of Life

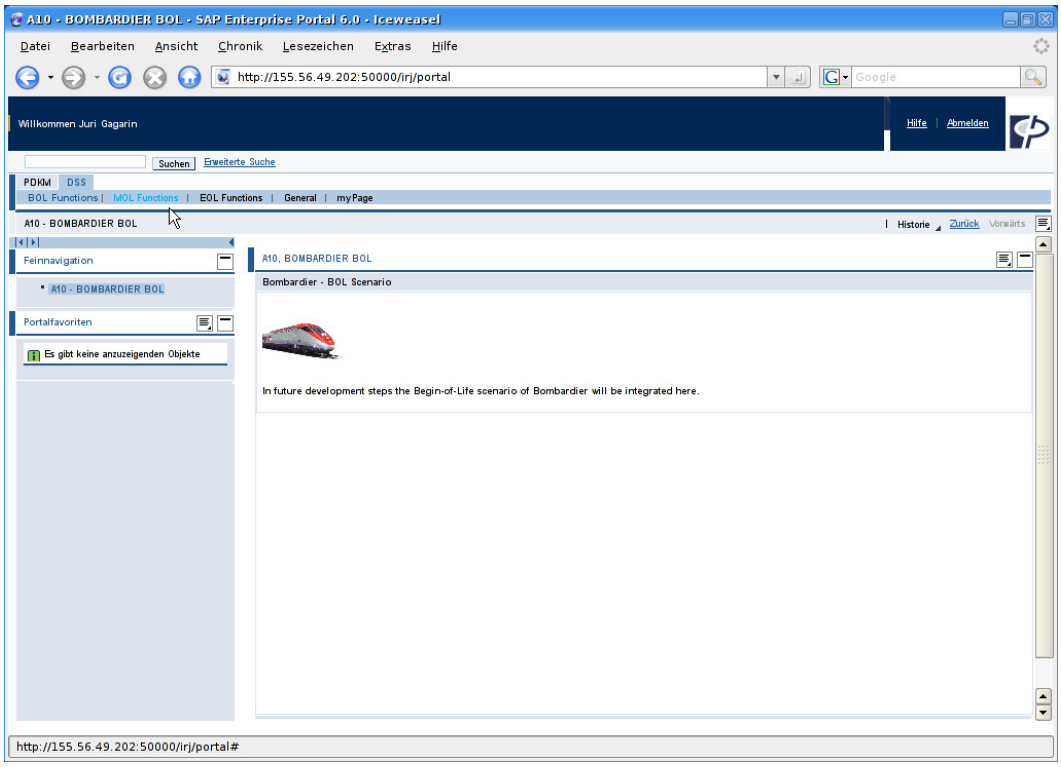
8.1 Example A10: Decision Support for Design for X

The main objective of the decision strategy of the DfX demonstrator is to provide decision methods and algorithms that allow transforming product lifecycle data into DfX knowledge where "X" stands for:

- RAM/LCC (reliability, availability, maintainability / life cycle cost);
- Safety;
- Environment.

The DfX decision strategy implemented in the first prototype of A10 DSS is composed of two main steps: (i) information generation, and (ii) knowledge generation. The purpose of the information generation step is to determine how well is the component/subsystem/system performing with respect to the design aspect considered and the purpose of the knowledge generation step is to determine the main causes behind the level of performance achieved with respect to the design aspect considered in order to aid designers in improving the next generation of locomotives from the point of view of the design aspect considered.

The application starts by pressing the A10 button.



9 Conclusion

The present document contains the first version of a handbook for the DSS. It includes a survey of the DSS, technical information and the application of the decision support strategies. Currently, three different decision support strategies are treated.

In Version 2, the remaining strategies will be added.