D5.4

Assessment of the Full Prototype And Methodology

WP 5

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Summary

The AmI-MoSES project's objective is to realise an innovative, beyond the state of the art solution for Energy Efficiency optimisation in manufacturing companies. The solution is based, on the one hand, on a novel approach to energy consumption monitoring by introduction of so-called Ambient Intelligence parameters and, on the other hand, on a combination of so extended data set with Knowledge Management Systems. Viability of the AmI-MoSES system functionalities is to be proved in three typical manufacturing companies, within three business cases (BC) defined as a baseline for the project realisation.

This deliverable D5.4 provides results of testing, assessment and verification of the AmI-MoSES full prototype and methodology. It is the result of task T5.1 Early Prototype Integration testing in Work Package 5 – Integration and Assessment. The objective of this task is to achieve an integrated prototype of the AmI-MoSES platform, which has been tested by the SMEs in parallel to full prototype development / refinement.

This document comprises, in addition to this summary, an introductory chapter with short description of the document purpose and structure. Chapter 2 provides a presentation of the testing method applied, which expected to test the fulfilment of the end users' requirements at the level of the system full prototype, using the Test Cases described in detail in this deliverable. An iterative approach was used, which allowed to detect errors as early as possible, radically reducing the cost of fixing. In chapter 3, the AmI-MoSES Full Prototype Scope is presented, where basic functionalities could be checked and concepts proved.

The prototype provides facilities to diagnose energy efficiency related problems and solve them based on a set of previously solved problems (On-line diagnostics of energy related problems), functionalities to analyse similar solved problems in order to discover energy use patterns, so problem occurrences can be predicted and, in consequence, eliminated (Continuous improvement); functionalities to support the birth phase or installation of new manufacturing processes (Installation and ramp-up support) and characteristics that allow the monitoring of energy use and the issuing of personalised warnings / alarms to individuals or groups of employees when energy use is inefficient (Condition-based energy consumption warning).

In chapter 4, the AmI-MoSES end-users tested the fulfilment of functionalities of the full prototype through the employment of test cases which cover the use cases presented in deliverables D3.1 – Specification of Measurement Data Processing and EUP and D4.1 – Specification of the AmI-MoSES Service Platform. To conclude, chapter 5 presents a summary of conclusions and feedback to development. This feedback was structured as recommendations, which were analysed by the RTD and ICT partners for the Full Prototype refinements for the post-project developments aiming at the Commercial Exploitation of the tool.

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Abbreviations

a.m.	above mentioned
AmI	Ambient Intelligence
API	Application Programming Interface
BC	Business Case
e.g.	exempli gratia = for example
ECD	Energy Consumption Data
EES	Energy Efficiency Services
EMS	Energy Management System
etc.	et cetera
EUP	Energy Use Parameters
GUI	Graphical User Interface
i.e.	id est = that is to say
ICT	Information and Communication Technology
KM	Knowledge Management

1 Introduction

This document is the result of task T5.3 AmI-MoSES Results Assessment in Work Package 5 – Integration and Assessment. The objective of this work package is to test the early prototypes developed in Tasks T4.3 and T3.3 against the specified requirements and to test the full prototype and the methodology, i.e. assessment of the benefits for the SMEs following the application of the project's results. All deviations from the requirements detected during testing and assessment of the early prototype have been taken care of during full prototype development. All further deviations that came to view during full prototype testing and assessment will have to be corrected during the post project commercialisation phase. The testing and assessment were carried out by end-user SMEs in collaboration with RTD and ICT partners. Since the development of the full prototype was carried out in parallel to testing activities, the feedback to the development was continuously provided. This document summarises all improvements carried out during this simultaneous process and suggestions for further refinement during the post project commercialisation phase.

This document includes:

- Chapter 1 – the introduction, describes the purposes of this document, the position of this document with respect to the whole project, and provides a brief overview of the contents of the document.
- Chapter 2 – description of the method applied for testing and assessment, where the approach is elaborated from technical and business point of view.
- Chapter 3 – full prototype scope, describes the scope of the modules developed in the full prototype from the point of view of the functionalities.
- Chapter 4 – results of full prototype testing, describes the test cases for each part of the system and the testing results, as well as the level of completion of the user requirements.
- Chapter 5 – Conclusions and Feedback to Development, includes the conclusion regarding the early prototype assessment and recommendations for further Full Prototype refinements.

2 Testing Method Applied

2.1 General Approach

Qualitative and quantitative testing and assessment of AmI-MoSES results were carried out in parallel with the ICT system development as well as on the implemented demonstrators, by comparing the specified functionalities with achieved results and applying the predefined metrics. This approach assured a reliable validation of project methods and tools. Some initial metrics and target values were already defined in the project preparation phase, but they were elaborated in detail in the scope of WP1 "Requirements and Concept" and WP3/WP4 "Specification of the Measurement Data Processing and EUP/Specification of the Service Platform". These quantitative metrics include:

- Technical metrics – requirements on the tools, such as those presented in "D3.1 Specification of EUPs" and "D4.1 Specification of Service Platform"
- Business metrics – which were fully assessed based on the inputs gathered by the end-users during the application of AmI-MoSES in real work operations through the demonstrators

In order to provide **appropriate procedures for self-assessment throughout the project**, the following strategy has been applied:

The integrated full prototype was tested in collaboration of the RTD, ICT partners and end-user SMEs. The metrics related to technical aspects were assessed within the full set of requirements (i.e. Measurement data processing and EUP calculations, and Energy Efficiency Services), as described in this document, using the knowledge / information gathered in the real industrial environments. On the other hand, since the end-users could provide feedback regarding the benefits of using AmI-MoSES by means of the application of demonstrators, the metrics related to business objectives were fully assessed, in contrast to what happened at Early Prototype stage, where due to the limited scope of the technical functionalities realised in a simulated manufacturing SME environment, the business metrics were estimated only to a limited extent.

The results of these assessments are used to provide feedback to the full prototype refinements and commercialisation during the exploitation stage.

2.2 ICT System Testing Method

The approach followed in the AmI-MoSES project to develop the software tools was the combination of several state-of-the-art methods, enabled by development environments. The development followed a model-driven approach (MDA), using for some of the components the AndroMDA framework. Based on the end users' requirements, a first specification of AmI-MoSES system was made, which resulted in UML models (Class and Use Cases diagrams). Then, during the whole full prototype development, an iterative process of refining the initial models was carried out.

The testing procedure in AmI-MoSES followed the approach of developing "Test Cases" as extensions of the "Use Cases" presented in the specification documents, which are in line with the users' requirements. Test cases, which are described in detail in this deliverable, have the main purpose of verifying the fulfilment of the end users' requirements, at the level of the system full prototype. An iterative approach was used, which allows to detect errors as early as possible, radically reducing the cost of fixing.

Summarising, the main purposes of testing are:

- To verify the proper integration of all core services of the software
- To verify that all requirements have been correctly implemented
- To identify defects and ensure they are addressed prior to the deployment of the software in a production environment
- To verify the end-user-friendliness / usability

2.3 Methodology Testing Approach

The testing and assessment of the methodology was based on the inputs gathered by AmI-MoSES system end-users during the introduction of the AmI-MoSES concept within their day-to-day operations, through the execution of the demonstration activities. The validity of both RTD and Industrial Methodology as a solid and effective approach for introduction of new more intelligent energy efficiency optimisation methods and for promoting the corporate cultural change, enabling introduction of a knowledge-based system like AmI-MoSES, is to be assessed applying approaches from the two documents in the course of the AmI-MoSES system testing.

3 AmI-MoSES Full Prototype Scope

The scope of the full prototype was defined so as the complete functionalities could be checked and assessed. Table 1 below presents the modules implemented in the full prototype, with their respective functionality.

Table 1: Full prototype functionality

No.[1]	Functional Scope Description	Remarks
	ECD & AmI Monitoring Services These services will obtain ECD, AmI and Process data, filter it, adjust them to AmI-MoSES data formats and structures and finally trigger EUP calculation.	
ECD_UC1	*Configure ECD/AmI Data Transfer Tact* ECD transfer parameters are configured in the repository to correspond the needs of EUP calculation	
ECD_UC2	*ECD / AmI Monitoring* Measured ECD/AmI data is collected and transferred to AmI-MoSES platform to be used in EUP calculation	
AmI_UC1	*ECD and AmI Data Processing* Received ECD and AmI data are adapted to and stored in the Knowledge repository.	
	EUP Monitoring and Advisory Services • **EUP Monitoring** This service will provide facilities for the definition and configuration of EUP models, functionality to specify rules that define allowed thresholds for EUP model values.	
EUP-1_UC1	*EUP model formula definition* A new model formula is created, modified of deleted	
EUP-1_UC2	*EUP model definition* A new EUP is created, validated, modified of deleted	
EUP-1_UC3	*EUP prediction model configuration* An EUP prediction model configuration is created	
EUP-1_UC4	*Targeting model definition and update* An EUP targeting model is created	
EUP-2_UC1	*EUP Calculation* EUP calculation/targeting calculation is set on or set off.	
	EUP Monitoring and Advisory Services • **Advisory** This service will provide functionalities to visualise and compare historical, current and estimated EUP values in form of charts, tables and to generate customisable reports.	

[1] UC names from the Specification D3.1 and D4.1

No.[1]	Functional Scope Description	Remarks
EUP-4_UC1	*EUP data presentation and reporting* EUP data is presented, reported. The user is provided with configurable data reporting features	
EUP-4_UC2	*EUP prediction and prognosis* EUP prediction and prognosis model are generated and shown. The user is provided with configurable data reporting features	
	KM Core Services • **Problem Solving** This service will provide facilities to diagnose energy efficiency problems via case based reasoning	
KM_UC1	*CBR process triggering* This core service functionality allows an Energy Efficiency Service to use the CBR engine	
KM_UC2	*RBR process triggering* This functionality allows an Energy Efficiency Service to use the RBR engine	
KM_UC3	*Retrieve Knowledge* This functionality allows retrieval of knowledge from AmI-MoSES' own Knowledge Repository through data management services or external legacy systems through the external systems integration services.	
	MSI Core Services	
MSI_UC1	*Find Available Expert* This functionality leads to finding an expert with the appropriate expertise and availability	
MSI_UC2	*Suggest Means of Communication* This functionality leads to a suggestion regarding the most appropriate communication service to be used in a certain situation	
MSI_UC3	*Record - Track activity details* This functionality allows to record and store important details about each EE related activity	
MSI_UC6	*Notify about EE Problems* This functionality allows AmI-MoSES platform to deliver notifications about existing or possibly emerging energy efficiency problems to one or more specified users over a specified communication channel such as e-mail or SMS	
	Energy Efficiency Services (EES)	Energy Efficiency Services are to be observed as a combination of the above Core Services aimed at the solution of a particular Energy Efficiency Problem

No.[1]	Functional Scope Description	Remarks
EE_TC1	*Continuous Improvement Energy Efficiency Service* This functionality allows the analysis of solutions associated to recurrent problem types in order to discover suggestions for improvement of production units and processes aimed at the reduction of the frequency of appearance of these problems.	
EE_TC2_1	Condition Based Energy Efficiency Service: Manage alarms/warnings This service models the functionality allowing a user to manage alarms/warnings	
EE_TC2_2	*Condition Based Energy Efficiency Service: Evaluate EUP Value* This service models the functionality that allows monitoring energy consumption status by evaluating EUP values against thresholds defined in corresponding EUP targeting models under current EE context	
EE_TC3.1	*On-line Diagnostics of Energy related Problems: Analyse Energy Efficiency related Problem* This functionality enables the user to analyse an energy related problem and find a suitable solution based on solutions to previously solved problems	Alternative scenario: Installation and Ramp-up Phase (IRP). Basic functionality of the IRP service is very similar to the EE service for On-line Diagnostics of Energy related Problems. The main difference with respect to the On-line Diagnostics is that the IRP service is focused on supporting diagnosis of energy related problems in new MS installations
EE_TC3_2	*On-line Diagnostics of Energy related Problems: Support EE related Problem Diagnostics* This test case enables an external expert to support a user in diagnosing an energy related problem and find a suitable solution	

3.1 Brief description of AmI-MoSES Full Prototype

The description of the full prototype of AmI-MoSES is provided in the deliverables D3.4 and D4.4, and only very short notions are given here below to facilitate following of the tests description.

Figure 1 presents the AmI-MoSES core services, with the parts implemented in the scope of the full prototype.

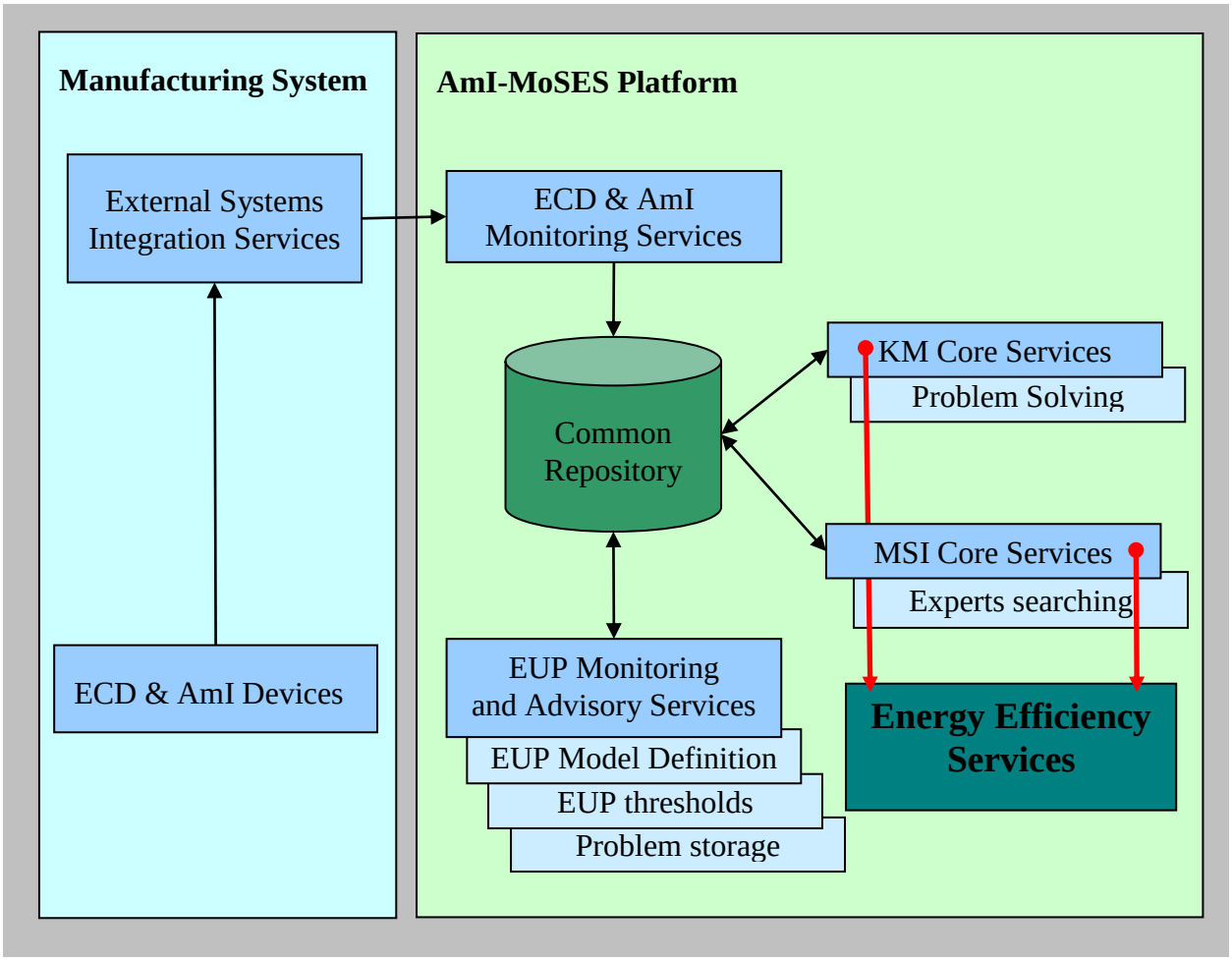

Figure 1: FP Integration Overview

3.1.1 Common Repository

The CR had already been completely implemented during early prototype development in order to facilitate those tests. During full prototype development the CR has been adapted where necessary to comply with the changes of existing and addition of new functionality.

3.1.2 Core Services

3.1.2.1 ECD & AmI Monitoring Services

These services are in charge of obtaining actual energy measurement data from the installed energy measurement devices and AmI data from installed AmI devices, respectively, via the Legacy integration services. In a first step, the received data will be filtered and adjusted to remove redundant and irrelevant data. The filtered data will then be processed and stored to the CR by fitting it to data formats and structures used within the AmI-MoSES platform.

3.1.2.2 EUP Monitoring and Advisory Services

The EUP Monitoring and Advisory Services will provide three main functionalities. Firstly, the definition and configuration of EUP models, which will basically be a combination of traditional energy consumption, AmI and Process data to get a more coherent view on current and to be expected energy usage. Secondly, the EUP Monitoring and Advisory Services will contain functionality to specify rules that define allowed boundaries for EUP model values. The service will furthermore continuously match the defined rules against the current and to be expected EUP

model values to allow for detecting abnormal uses of energy and issue warnings to the corresponding responsible staff member(s). Thirdly, the services will offer functionality to visualise and compare historical, current and estimated EUP model values in form of charts, tables, etc. and to generate customisable reports.

3.1.2.3 Knowledge Management

Problem Solving

This service will provide facilities to diagnose energy efficiency problems via case based reasoning. The problems without known cause are registered by the system and retrieved by the user. The reasoning facilities help him to diagnose the problem. Finally, the system provides a possible solution to the selected problem. Once the solution is valid, either the system proposed one or a solution provided by the user, he attaches it to the problem as a new case. When a similar problem is found by the system, it will show that solution to the user.

Problem Analysis Service

This service will provide facilities to analyse similar solved problems in order to discover energy use patterns, so problem occurrences can be predicted and, in consequence, diminished. The user retrieves the list of problems according to some criteria e.g. time span, type, severity or context. The problems have associated EUP, ECD, AmI and Process data. The user analyses the data evolution using charts. The user analyses the EUP values using statistical process control (SPC) techniques in order to find biased patterns and sends the analysis as a report to appropriate recipients so they can carry on the applicable energy efficiency actions to reduce energy consumption. Under user request, the system performs automatic retrieval, analysis of problems and delivery of the report to design.

3.1.3 Methodology

The adoption of AmI-MoSES system, or any other knowledge based system, requires a corporate cultural change – aimed at intellectual assets management – that should be promoted from the senior management, through leadership and a consistent knowledge management policy in line with the corporate vision. This cultural adaptation involves the establishment of a breeding environment where knowledge sharing and, therefore, collaboration is promoted and compensated. In this sense, the Industrial Methodology explains how extended roles should be created to support the introduction of the new approach. One of the key roles is the Chief Knowledge Officer (CKO), normally assumed by the senior management in SMEs, who is in charge of motivating the employees and who contributes most to the retention of the intellectual capital of the company – knowledge workers. The Industrial methodology focuses on how the CKO should shape the behaviour of knowledge workers for the introduction of the approach. In addition, the approach involves the follow-up of some structured steps, such as ad hoc experience, fact finding, approach formalisation, implementation and evaluation. During the initial and subsequent implementation steps, some internal and external facts should be studied, such as the return on investment (ROI) analysis of introducing the new approach, and Intellectual Property Rights (IPR) provisions that regulate the sharing of information within the extended enterprise scope in terms of information usability, accessibility, security, intellectual property and tracking. Finally, the description of the services that regulate the types of the collaborative work and the services for the knowledge management (KM) are also addressed in the methodology.

4 Assessment

4.1 Description of the Test Cases and Test Results

AmI-MoSES end-users tested the fulfilment of functionalities of the full prototype through the employment of test cases, which cover the use cases presented in D3.1 and D4.1.

4.1.1 CR Set-up module

Table 2: CR Test case 1

Test Case	Insert/delete master data records
Traceability Identifier	CR-TC1
Modules Involved	CR
Related - Use Case Name	-
Test Case Description	This test case describes the process of setting-up the CR with initial master data by inserting new records into the CR/deleting and exporting all existing records from the CR via the platform's Database Set-Up functionalities
Actors	AmI-MoSES administrator
Performance Goals	Efficient user-friendly data insertion process that (partly) hides the complexity of the database structure
Preconditions	-
Post conditions	Inserted data stored in the CR/Deleted data removed from CR
Scenario	*Begins when AmI-MoSES administrator selects the "Database Set-Up" menu item from the AmI-MoSES menu* *The administrator selects one of the three item menus "Insert Data", "Clean Database" or "Export Database"* *Ends when the uploaded data was stored in the CR/the data was deleted/exported from the CR*
Alternative Scenario	-
Special Requirements	-
Test Results	Inserted data was stored in the CR - functionality confirmed. Data was exported / deleted from the CR - functionality confirmed.

4.1.2 ECD & AmI Monitoring Services

Table 3: ECD Test case 1

Test Case	Configure ECD/AmI Data Transfer Tact
Traceability Identifier	ECD-TC1
Modules Involved	ECD & AmI Monitoring
Related - Use Case Name	ECD_UC1
Test Case Description	ECD transfer parameters are configured in the repository to correspond the needs of EUP calculation
Actors	System administrator, Plant expert AmI-MoSES system
Preconditions	The general setup is in the Knowledge Repository (production units, production processes, products, organizational structure, ECD devices, AmI devices and user rights). The hardware for ECD/AmI data monitoring is installed.

	User knows the ECD data requirements for EUP calculation: the precision of data, measurement intervals, pre-processing requirements.
Post conditions	The ECD/AmI transfer tact configuration is stored in Knowledge Repository
Scenario	*User gets a filtered list of defined ECD/AmI devices from the repository.* *User selects the desired ECD/AmI device and configures parameter transfer interval or turns transfer of data on/off* *User saves the configuration to Knowledge Repository.*
Alternative Scenario	-
Special Requirements	-
Requirements Covered	r_M_fun_01.01, r_M_fun_01.02, r_M_fun_01.03,r_M_fun_01.04, r_R_fun_01.01, r_R_fun_01.02, r_R_fun_01.03, r_R_fun_01.04, r_V_fun_01
Test Results	Transfer parameters configuration is saved into the Knowledge Repository. Functionality confirmed.

Table 4: ECD Test case 2

Test Case	ECD/AmI Monitoring
Traceability Identifier	ECD-TC2
Modules Involved	ECD & AmI Monitoring
Related - Use Case Name	ECD_UC2
Test Case Description	Measured ECD/AmI data is collected and transferred to AmI-MoSES platform to be used in EUP calculation
Actors	AmI-MoSES system ECD/AmI hardware, data collector, data concentrator
Preconditions	The hardware for ECD/AmI monitoring is installed. The ECD/AmI monitoring is configured
Post conditions	ECD/AmI data has been sent to AmI-MoSES platform
Scenario	*The ECD /AmI data is collected by the data collector and buffered in its internal memory* *If needed the ECD/AmI data is transmitted from data collectors to data concentrator and stored there* *Upon request the ECD/AmI data is transferred to the AmI-MoSES platform and stored in Knowledge Repository*
Alternative Scenario	-
Special Requirements	-
Requirements Covered	r_M_fun_01.02, r_V_fun_01, r_R_fun_01.02
Test Results	ECD and AmI data is collected and sent to AmI-MoSES platform. Functionality confirmed.

Table 5: ECD Test case 3

Test Case	ECD and AmI Data Processing
Traceability Identifier	ECD_TC3
Modules Involved	ECD & AmI Monitoring
Related - Use Case Name	AmI_UC1

Test Case Description	This test case describes the handling of incoming ECD and AmI data in the AmI-MoSES platform
Actors	AmI-MoSES platform services ECD device AmI device Data Collector/concentrator
Preconditions	ECD measuring devices, AmI devices and data collectors/concentrators have been defined and entered in the common repository
Post conditions	Received ECD and AmI data are adapted to and stored in the Knowledge Repository. Received AmI data has been added to the context of current MS situation and ECD structure for EUP calculation is stored
Scenario	*ECD and AmI data is sent to the AmI-MoSES platform through a common interface* *ECD and AmI Data Processing service receives measured data* *ECD and AmI Data Processing service filters received data and adapts it to the Knowledge repository data format* *ECD and AmI Data Processing service combines measured AmI data with existing context data to build a coherent context of current MS situation, and prepares/structures ECD for EUP calculation* *ECD and AmI Data Processing service stores the enhanced context data and ECD structure in the Knowledge Repository through* *Data Management services*
Alternative Scenario	-
Special Requirements	-
Requirements Covered	r_M_fun_01.01, r_M_fun_01.02, r_M_fun_01.03,r_M_fun_01.04, r_R_fun_01.01, r_R_fun_01.02, r_R_fun_01.03, r_R_fun_01.04, r_V_fun_01
Test Results	ECD and AmI data are filtered, adapted, contextualized within the Manufacturing System (MS) environment and stored in the Knowledge Repository. Functionality Confirmed

4.1.3 EUP Monitoring and Advisory Services

Table 6: EUP Test case

Test Case	Model Formula Definition
Traceability Identifier	EUP-TC1
Modules Involved	EUP Monitoring and Advisory Services
Related - Use Case Name	EUP-1_UC1
Test Case Description	A new model formula is created, modified of deleted
Actors	System administrator and plant expert Production unit or process step that requires monitoring AmI-MoSES System AMI and ECD measurement devices and the middleware
Preconditions	The energy consumption model to be defined, formulas and parameters are known. AmI-MoSES repository includes the information needed in the EUP definition: - the production unit/ process step of interest - the ECD and AmI measurement options related to the production unit/process - product / process and production parameters required in the EUP model.
Post conditions	A new formula model is created, updated or deleted. The repository is updated accordingly.
Scenario	***New formula:***

	User gives a name and a short description for the new formula. User enters the model formula as a mathematical expression that contains model parameter names. User gives some info and guidance about the model formula. User accepts the model formula. AmI-MoSES system checks the formula and reports errors to the user. *User can give a description for each parameter. A unit of measurement can be specified for each parameter and the result of the formula. User saves the EUP formula model. Created-timestamp is stored to the repository.* ***Formula update:*** *User searches an existing model formula and opens it. The user can modify the description, edit the model formula and change the parameters.* *The edited formula can be saved as a new formula or it can replace the original formula.* *The modification timestamp is stored to the repository.* ***Model deletion:*** *User can search an existing formula model and delete it. If the model is in active use or part or some other EUP, it cannot be deleted and user gets a warning. The deletion timestamp is stored to the repository.*
Alternative Scenario	-
Special Requirements	-
Requirements Covered	r_M_fun_02, r_R_fun_02, r_V_fun_02
Test Results	A new formula model is created / updated and stored in the Knowledge Repository. Functionality confirmed.

Table 7: EUP Test case

Test Case	EUP model definition
Traceability Identifier	EUP-TC2
Modules Involved	EUP Monitoring and Advisory Services
Related - Use Case Name	EUP-1_UC2
Test Case Description	A new EUP is created, validated, modified of deleted
Actors	System administrator and plant expert AmI-MoSES System
Preconditions	The energy consumption model to be defined, formulas, required measurements, measurement frequencies and other parameters are known and available in the system. AmI-MoSES repository includes the information needed in the EUP definition, such as, the production unit/ process step of interest, the ECD and AmI measurement options related to the production unit/process, and the product/process, production parameters required in the EUP model and the related EUP formulas and formula parameters for EUPs, prediction and targeting models
Post conditions	A new model is defined. The repository is updated accordingly.
Scenario	*User gives a name and a short description for the model. User selects the production unit and the process step the EUP is related to and saves the data.* *User selects a formula for the model.* *The formula is shown to the user. The user also gets information and guidance related to the formula. A list of the required formula parameters is shown to the user. For each parameter, the user can get guidance and info. User chooses the parameter values or links them to variables to be used in EUP calculation.* *When the EUP is defined, the user stores it to the repository. The EUP can be*

	linked to a production unit and a process step. The status of the new model in the repository is "Inactive". The creation timestamp is stored to the repository. *Model can be validated. After the model is saved, the user can select test values from parameter values for the EUP and calculate the EUP with the values.*
Alternative Scenario	-
Special Requirements	-
Requirements Covered	r_M_fun_02.01, r_M_fun_02.02, r_R_fun_02.02, r_R_fun_02.01 r_V_fun_02
Test Results	EUPs are defined and stored in the Knowledge Repository. Functionality confirmed.

Table 8: EUP Test case

Test Case	EUP prediction model configuration
Traceability Identifier	EUP-TC3
Modules Involved	EUP Monitoring and Advisory Services
Related - Use Case Name	**EUP-1_UC3**
Test Case Description	An EUP prediction model configuration is created
Actors	System administrator and plant expert AmI-MoSES System
Preconditions	Information of existing prediction models and their properties are available. ECD and AmI measurement data needed in the prediction calculation is available.
Post conditions	A prediction model configuration is created and stored into the repository.
Scenario	*User gives a name and a short description for the new prediction model configuration. The user gets a list of available prediction models. The user associates the prediction model to an existing EUP model. The user selects a prediction model to be configured. The model, its parameters and info about the model and parameters are shown to the user.* *User gives values for the model parameters.* *The prediction model can be validated and updated.*
Alternative Scenario	-
Special Requirements	-
Requirements Covered	r_M_fun_03.01, r_R_fun_03.01, r_V_fun_02
Test Results	A prediction model can be configured and associated to an existing EUP model. Functionality confirmed.

Table 9: EUP Test case

Test Case	Targeting model definition and update
Traceability Identifier	EUP-TC4
Modules Involved	EUP Monitoring and Advisory Services
Related - Use Case Name	EUP-1_UC4
Test Case Description	An EUP targeting model is created
Actors	System administrator and plant expert

	AmI-MoSES System
Preconditions	The EUP model is stored in the repository. ECD and AmI measurement data that is required in the targeting model calculation is available. AmI-MoSES repository includes the information needed in the EUP targeting model definition: - the ECD and AmI measurement options related to the production - unit/process and that can be used in the targeting model - product / process and production parameters that can be used in the targeting model. The user has logged into the system.
Post conditions	A targeting model is created and stored into the repository.
Scenario	*User gives a name and a description for the targeting model.* *The user selects a formula for the targeting model.* *The user associates the targeting model to an existing EUP model.* *The formula, its parameters and info about the formula and parameters are shown to the user. User selects values to the formula parameters.* *The user can specify the semantics of the targeting model.* *The targeting model can represent an upper or lower threshold value for a warning condition.* *The targeting model can be validated and updated.* *User saves the targeting model parameters to the repository.* *After that user can validate the targeting model with EUP reference data values.*
Alternative Scenario	-
Special Requirements	-
Requirements Covered	r_M_fun_03.02, r_R_fun_03.02, r_V_fun_02
Test Results	A targeting model is defined and associated to an existing EUP model. The targeting model can be validated and updated. Functionality confirmed.

Table 10: EUP Test case

Test Case	EUP Calculation
Traceability Identifier	EUP-TC5
Modules Involved	EUP Monitoring and Advisory Services
Related - Use Case Name	EUP-2_UC1
Test Case Description	EUP calculation/targeting calculation is set on or set off.
Actors	System administrator and plant expert EUP calculation module AmI-MoSES System
Preconditions	EUP model/targeting model have been defined and stored in the repository The ECD and AmI measuring devices that are required in the EUP calculation have been installed, ECD and AmI data processing module is in use. ECD and AmI measurement data is available AmI-MoSES repository includes the real data needed in the EUP and target model calculation The EUP parameter values are linked to the calculation program parameters.

Post conditions	Based on user demand the EUP values are stored with timestamps.
Scenario	*The user can see which EUP models are active or inactive. The user selects one of them to be activated or deactivated.* ***Activation:*** *The user selects the EUP model to be activated. The user defines a calendar schedule for the calculation of the EUP (for example, 9–17, every workday). The user selects a sampling frequency for the EUP.* *The calculation module starts to perform the EUP calculations at the defined schedule. EUP is marked as active in the repository. EUP values are stored to the repository with timestamps.* ***Deactivation:*** *User sets off the EUP calculation. EUP calculation stops. No more data is stored to repository, the EUP status is inactive.*
Alternative Scenario	-
Special Requirements	-
Requirements Covered	r_M_fun_03, r_R_fun_03, r_V_fun_02
Test Results	EUP calculation can be activated or deactivated. Functionality confirmed.

Table 11: EUP Test case

Test Case	EUP data presentation and reporting
Traceability Identifier	EUP-TC6
Modules Involved	EUP Monitoring and Advisory Services
Related - Use Case Name	EUP-4_UC1
Test Case Description	EUP data is presented, reported
Actors	EUP /targeting calculation System administrator and plant expert have defined EUP and targeting modes for a plant object. EUP(s) has been defined to a plant object A plant object (device) needs to be monitored. AmI-MoSES System and related Legacy systems
Preconditions	EUP calculation has been used or is going on, data is stored to repository. An EUP model and /or targeting model related to the object of interest has been defined and stored in the repository. Measurement and AmI devices are active. The user has logged into the system.
Post conditions	EUP related data is presented to the user
Scenario	*User selects an EUP from a list (filtered)* *User selects the report type: table; line diagram, scatter plot, or some other possible report.* *The report is shown.* *User can adjust parameters from the report like time period, showing actual or targeting values etc.* *User can select objects of interest from the report like EUP parameters and see the measurement values and other relevant data.* *User can print/save the report.*
Alternative Scenario	-
Special Requirements	-

Requirements Covered	r_M_fun_04, r_R_fun_04, r_V_fun_02,
Test Results	The user is provided with configurable data reporting features. Functionality confirmed.

Table 12: EUP Test case

Test Case	EUP prediction and prognosis
Traceability Identifier	EUP-TC7
Modules Involved	EUP Monitoring and Advisory Services
Related - Use Case Name	EUP-4_UC2
Test Case Description	EUP prediction and prognosis model are generated and shown
Actors	EUP /calculation System administrator and plant expert have defined EUP and targeting models for a plant object. EUP(s) has been defined to a plant object A plant object (device) needs to be monitored. AmI-MoSES System and related Legacy systems
Preconditions	EUP and monitor data exists in the repository. An EUP model and targeting model related to the object of interest has been defined and stored in the repository. Measurement and AmI devices are active. The user has logged into the system.
Post conditions	EUP prognosis and prediction data is presented, reported
Scenario	*User select an EUP from a list (filtered)* *User selects the EUP* *User gets al listing of related prediction models to the selected EUP.* *Predict/prognosis models are shown.* *The report is shown.* *User can adjust parameters from the report like time period, showing actual or targeting values.* *User can select objects of interest from the report like EUP parameters and see the measurement values and other relevant data.* *User can print/save/send the reports.*
Alternative Scenario	-
Special Requirements	-
Requirements Covered	r_M_fun_04, r_R_fun_04, r_V_fun_02,
Test Results	Prognosis and prediction capabilities are provided to the user. Functionality confirmed.

4.1.4 KM Core Services

Table 13: KM Test case

Test Case	CBR process triggering
Traceability Identifier	KM-TC1
Modules Involved	KM Core Services

Related - Use Case Name	KM_UC1
Test Case Description	This test case models the functionality that allows an Energy Efficiency Service to use the CBR engine
Actors	AmI-MoSES EE Service(s)
Preconditions	Associated "entities" should contain data in the common repository
Post conditions	The CS provides to the EES a list of similar entities of the specified type
Scenario	*Energy Efficiency Service (EES) starts a CBR process for some defined "entity". The type of entity to be analysed depends on the high-level service (EES) that uses this CS.* *User defines, through an EES, criteria and their weightings, which are applied in similarity calculation.* *The CBR service provides a list of entities that are similar to the analysed entity. List is ordered by similarity.*
Alternative Scenario	-
Special Requirements	-
Requirements Covered	r_M_fun_06.02, r_R_fun_06.02, r_V_fun_04.01, r_V_fun_04.02
Test Results	Given an unsolved analysed problem, the Online Diagnostic EES retrieves a list of problems with similar characteristics. These problems' solutions (causes and actions) can be inferred to the analysed problem. Functionality confirmed

Table 14: KM Test case

Test Case	RBR process triggering
Traceability Identifier	KM-TC2
Modules Involved	KM Core Services
Related - Use Case Name	KM_UC2
Test Case Description	This test case models the functionality that allows an Energy Efficiency Service to use the RBR engine
Actors	AmI-MoSES EE Service(s)
Preconditions	Associated "entities" should contain data in the common repository User-defined rules (i.e. thresholds for the EUPs, context rules) have been specified
Post conditions	The CS provides Rule Based Reasoning to the ESS
Scenario	*Energy Efficiency Service (EES) starts a RBR process for some defined "entity". The type of entity to be analysed depends on the high-level service (EES) that uses this CS* *RBR service evaluates rules. Triggering of the evaluation depends on the implementation of the high level service that uses the RBR service* *Energy Efficiency Service (EES) performs actions that have been specified when a rule is true (e.g. stores a problem, notifies a user). These actions depend on the implementation of the high-level service (EES).*
Alternative Scenario	-
Special Requirements	-
Requirements Covered	r_V_fun_04.02, r_R_fun_03.01
Test Results	Condition Based Warning EES makes use of this functionality when comparing the EUP values with respect to a threshold. If overridden, the EES stores a prob-

	lem and notifies the user through AmI-MoSES Notification Service (MSI-TC4). Functionality confirmed

Table 15: KM Test case

Test Case	Retrieve Knowledge
Traceability Identifier	KM-TC3
Modules Involved	KM Core Services
Related - Use Case Name	KM_UC3
Test Case Description	This test case models the functionality that allows retrieval of knowledge from AmI-MoSES' own Knowledge Repository through data management services or external legacy systems through the external systems integration services.
Actors	Maintenance manager / AmI-MoSES System
Preconditions	Necessary interfaces should be implemented with existing legacy systems
Post conditions	On-time contextualized information is presented to the user when an energy efficiency problem is detected or when the user asks for assistance in solving a problem related to energy efficiency optimization.
Scenario	*The user requests knowledge e.g. documents for assisting him in solving a problem* *The system looks for information within its own database resources* *If the information is available within the common repository, the system retrieves and shows the information to the user* *If the information is not directly available on the Common Repository, the system interfaces existing legacy systems and tries to retrieve information* *that do not conflict with Extended Enterprise Intellectual Property Rules*
Alternative Scenario	-
Special Requirements	-
Requirements Covered	r_M_fun_06.03, r_V_fun_06.03, r_V_fun_06.02, r_R_fun_04.02
Test Results	In Continuous Improvement EES, the functionality is used to retrieve suggestions for improvement of production units, product parts and processes related to solved problems of the same type. In Online Diagnostics EES, this functionality is used to attach information (photos, schemas, graphical illustration) to a problem definition / description. Functionality confirmed

4.1.5 MSI Core Services

Table 16: MSI Test case

Test Case	Find Available Expert
Traceability Identifier	MSI-TC1
Modules Involved	MSI Core Services
Related - Use Case Name	MSI_UC1
Test Case Description	This test case leads to finding an expert with the appropriate expertise and availability
Actors	All AmI-MoSES platform users, specifically Maintenance Managers, Energy Managers.
Preconditions	Experts with respective expertise have been defined and entered in the common

	repository
Post conditions	The user has found an appropriate and available expert or the platform informs him that no available expert matching the given criteria could be found
Scenario	*Define search criteria like needed expertise, expertise level, time frame, etc.* *Search appropriate experts* *The platform provides a list of found experts, which match the criteria*
Alternative Scenario	-
Special Requirements	-
Requirements Covered	r_R_fun_06.03
Test Results	AmI-MoSES system provides a list of suitable experts who support the user in solving the Energy Efficiency related problems. Functionality confirmed

Table 17: MSI Test case

Test Case	Suggest Means of Communication
Traceability Identifier	MSI-TC2
Modules Involved	MSI Core Services
Related - Use Case Name	MSI-UC2
Test Case Description	This test case leads to a suggestion regarding the most appropriate communication service to be used in a certain situation
Actors	All AmI-MoSES platform users, specifically Maintenance Managers, Energy Managers, etc.
Preconditions	Information describing the available and preferred communication means of participating actors have been defined and entered into the common repository
Post conditions	An appropriate communication service that can be used by the users has been found
Scenario	*Analyse the user's and expert's available and preferred means of communication* *The platform tries to match the available and preferred communication means* *The platform suggests a way of contacting an expert if a match could be found. Otherwise a default communication means is suggested*
Alternative Scenario	-
Special Requirements	-
Requirements Covered	r_R_fun_06.03
Test Results	AmI-MoSES system provides a way of contacting suitable experts who may support the user in solving the Energy Efficiency related problems. Functionality confirmed

Table 18: MSI Test case

Test Case	Record - Track activity details
Traceability Identifier	MSI-TC3
Modules Involved	MSI Core Services
Related - Use Case Name	(MSI_UC3)
Test Case Description	This test case allows to record and store important details about each EE related

	activity
Actors	All AmI-MoSES platform services
Preconditions	Tracking for an activity has been activated
Post conditions	Activity details have been stored in Knowledge Repository
Scenario	*Gather activity details (user performing activity, activity performed, involved objects)* *Store activity details in Knowledge Repository*
Alternative Scenario	-
Special Requirements	-
Requirements Covered	r_R_fun_06.03
Test Results	AmI-MoSES system tracks the users' activity within the platform. Functionality Confirmed

Table 19: MSI Test case

Test Case	Notify about EE Problems
Traceability Identifier	MSI-TC4
Modules Involved	MSI Core Services
Related - Use Case Name	MSI-UC6
Test Case Description	This test case allows AmI-MoSES platform to deliver notifications about existing or possibly emerging energy efficiency problems to one or more specified users over a specified communication channel such as e-mail or SMS
Actors	AmI-MoSES Notification Service
Preconditions	Users and their contact information have been defined in Knowledge Repository Communication channels have been installed
Post conditions	Notifications have been sent.
Scenario	*Notification Service receives a request for sending notifications to a set of users using a given communication channel.*
Alternative Scenario	-
Special Requirements	-
Requirements Covered	r_R_fun_05, r_V_fun_05.05
Test Results	Notification services are used within the Energy Efficiency Services. Functionality confirmed

4.1.6 Energy Efficiency Services

Table 20: EE Test case 1

Test Case	Continuous Improvement Energy Efficiency Service
Traceability Identifier	EE_TC1
Modules Involved	Energy Efficiency Services
Test Case Description	This test case models the functionality that allows the analysis of solutions associated to recurrent problem types in order to discover suggestions for improvement of production units and processes aimed at the reduction of the frequency of appearance of these problems.
Actors	Plant expert / AmI-MoSES System / Design team

Preconditions	Problems with attached solutions are stored in the CR
Post conditions	The application of these suggestions is expected to reduce the frequency of such problem type occurrence
Scenario	*1 - The plant expert wants to analyse problems of a certain type (solved problems) in order to improve production units and processes based on the analysed problems' solutions. The plant expert sets the configuration parameters for the automation:* • *Threshold for the number of recurrent problems of a certain type. When the frequency of a certain problem type is reached, the automatic analysis is triggered* • *Recipients' list for the report delivery* *2 - The system automatically notifies responsible people of the occurrence of a certain problem type a number of times greater than the specified threshold. This notification is called an incidence* *3 - The plant expert retrieves a list of the incidences* *4- The system analyses the problem solutions and provides suggestions for the improvement of production units and processes* *5 - The plant expert analyses the system proposed solution and its application, which may reduce the future problem occurrences of that type* ***Feedback to design*** *6 - The plant expert sends the analysis as a report to appropriate recipients so they can carry on the applicable energy efficient actions to reduce future energy problems occurrence on a particular element of the manufacturing system*
Test Results	The steps of the scenario were carried out. Functionality confirmed

Table 21: EE-3 Test case 2-1

Test Case	Condition Based Energy Efficiency Service: Manage alarms/warnings
Traceability Identifier	EE_TC2_1
Modules Involved	Energy Efficiency Services
Test Case Description	This test case models the functionality allowing a user to manage alarms/warnings
Actors	Maintenance Manager/Energy Manager
Preconditions	Measurement values are defined and the data is being communicated to the system EUPs are defined and stored in the system Communication ways for sending notifications are set up
Post conditions	The alarm/warning is saved. If active, the incoming measurement data or calculated EUP values are compared to threshold values in saved alarms. Depending on the active attribute of the alarm/warning, the alarm is monitoring the selected measurement values or EUP.
Scenario	*Select EUP targeting model that alarm is intended to monitor* *Choose the user to be informed when the alarm/warning is issued* *Choose the way notification is to be issued* *Save the newly entered alarm*
Test Results	AmI-MoSES user is able to create, modify, delete and confirm alarms / warnings. Functionality confirmed

Table 22: EE-3 Test case 2-2

Test Case	Condition Based Energy Efficiency Service: Evaluate EUP Value
Traceability Identifier	EE_TC2_2
Modules Involved	Energy Efficiency Services
Test Case Description	This test case models the functionality that allows monitoring energy consumption status by evaluating EUP values against thresholds defined in corresponding EUP targeting models under current EE context
Actors	AmI-MoSES service
Preconditions	EUP targeting model defined Alarm/Warning was created and is active EUP values are calculated
Post conditions	Problem description stored in Knowledge Repository Notifications about EE problem sent to defined users
Scenario	*Retrieve all EUP targeting values for the calculated EUP value* *Evaluate EUP value against thresholds in targeting model. If threshold is breached:* *- Create an EE problem description and store it in Knowledge Repository* *-Retrieve all alarms/warnings that are related to the targeting model* *-For each alarm/warning issue notifications to users defined in alarm/warning*
Test Results	AmI-MoSES system evaluates EUP values against thresholds. Once the threshold is overridden, AmI-MoSES users are notified. Functionality confirmed

Table 23: EE-3 Test case 3-1

Test Case	On-line Diagnostics of Energy related Problems: Analyse Energy Efficiency related Problem
Traceability Identifier	EE_TC3_1
Modules Involved	Energy Efficiency Services
Test Case Description	This test case enables the user to analyse an energy related problem and find a suitable solution based on solutions to previously solved problems
Actors	Production Manager (end user) Maintenance Manager (end user) Energy Manager (end user)
Preconditions	An energy related problem has been detected by the CBECW (EE_TC2) service and stored in the Knowledge Repository Responsible staff has been notified about the problem The Knowledge Repository contains a case base of already solved energy related problems
Post conditions	The user has found a suitable solution and the current EE related problem has been marked as solved with appropriate cause(s) and action(s). If the user has not found a suitable solution, he issues a request for help from external expert.
Scenario	*User views a list of currently unsolved EE related problems* *User selects an unsolved EE related problem for analysis* *User views the EE related problem description and edits the description if necessary*

	User starts the analysis using CBR (KM_TC1) *User is presented a list of already solved EE related problems that are similar to the current one* *User can compare the current EE related problem to each of the similar ones* *If an already solved EE related problem is determined to be similar enough the user can mark the current EE related problem as solved with Cause(s) and Action(s) selected from the already solved EE related problem* *If the user cannot find a suitable solution to the current EE related* *problem he can request help in finding the analysing the problem by using the functionality provided by the Human Resource Discovery Service (MSI_TC1)*
Alternative scenario	Installation and Ramp-up Phase (IRP). Basic functionality of the IRP service is very similar to the EE service for On-line Diagnostics of Energy related Problems, i.e. it will also support the user in analysing energy efficiency problems and finding possible solutions to those problems – if needed with help by an external expert. The main difference with respect to the On-line Diagnostics is that the IRP service is focused on supporting diagnosis of energy related problems in new MS installations
Test Results	AmI-MoSES user is able to solve EE related problems with the CBR facilities or with the help of experts who belong to the Extended Enterprise. Functionality confirmed

4.2 Assessment of Technical requirements

Test cases can be traced back to the use cases developed in D3.1 and D4.1. In turn, these use cases can also be traced back to the user requirements identified in the Business Cases. In order to test the compliance of the early prototype with the business cases requirements, and based on the test results, Table 24 was created. It shows the tests cases performed and the summary of the fulfilment degree with respect to the business cases end user requirements.

Table 24: Functionality tested.

No.	**Function - component**	**Relevance (0 to 3) and fulfilment of results (0 not fulfilled - 3 excellently fulfilled)**		
		BC1	**BC2**	**BC3**
	CR Set-up module			
CR-TC1	Insert / edit database records	2/3	2/3	2/3
CR-TC2	Insert relationships between database items	2/3	2/3	2/3
	ECD & AmI Monitoring Services			
ECD-TC1	Configure ECD/AmI Data Transfer Tact	3/3	3/3	3/3
ECD- TC 2	ECD/AmI Monitoring	2/3	2/3	2/3
ECD- TC 3	ECD and AmI Data Processing	2/3	2/3	2/3
	EUP Monitoring and Advisory Services			
EUP-TC1	Model Formula Definition	3/3	3/3	3/3
EUP-TC2	EUP model definition	2/3	2/3	2/3
EUP-TC3	EUP prediction model configuration	3/3	3/3	3/3
EUP-TC4	Targeting model definition and update	2/3	2/3	2/3
EUP-TC5	EUP Calculation	2/3	2/3	2/3

EUP-TC6	EUP data presentation and reporting	3/3	3/3	3/3
EUP-TC7	EUP prediction and prognosis	3/3	3/3	3/3
	KM Core Services			
KM_TC1	CBR process triggering	3/3	3/3	3/3
KM_TC2	RBR process triggering	3/3	3/3	3/3
KM_TC3	Retrieve Knowledge	3/3	3/3	3/3
	MSI Core Services			
MSI_TC1	Find Available Expert	2/3	2/3	3/3
MSI_TC2	Suggest Means of Communication	3/3	3/3	3/3
MSI_TC3	Record – Track activity details	2/3	2/3	3/3
MSI_TC4	Notify about EE Problems	3/3	3/3	3/3
	Energy Efficiency Services			
EE_TC1	Continuous improvement Energy Efficiency Service	3/3	3/3	3/3
EE_TC2_1	Condition Based Energy Efficiency Service. Manage alarms/warnings	3/3	3/3	3/3
EE_TC2_2	Condition Based Energy Efficiency Service: Evaluate EUP Value	2/3	2/3	3/3
EE_TC3_1	On-line Diagnostics of Energy related Problems: Analyse Energy Efficiency related Problem	3/3	3/3	3/3

4.3 Assessment of Business Requirements

The development and integration of the Full Prototype functionalities enabled a complete testing and assessment of the system with respect to the Business Requirements. Based on the Full Prototype functionalities testing, the business objectives introduced in the Description of Work and refined in the Business Cases description can be assessed as fully achieved.

MBAS and RIFOX business objectives of reduction of energy waste of their systems and the reduction of time necessary to provide appropriate knowledge on customer site are satisfied with the introduction of Energy Efficiency Services (EES, such as the On-line Diagnostics for Energy related Problems Service) on the one hand tracking EUPs and creating warnings in case energy use of their systems overrides some predefined limits and, on the other hand, supporting a user in finding a suitable solution based on solutions to previously solved problems. In case there is no solution available within the Knowledge Repository, the EES enable an external expert to support a user in promptly diagnosing the problem and finding a suitable solution. The EES make use of the MSI core services (e.g. Find available Experts within the Extended Enterprise) and Knowledge Management Services (e.g. RBR process triggering, CBR process triggering and Retrieve Knowledge), supported by the Industrial Methodology (specially, the MSI and KM related parts).

VICINAY business objectives of increasing energy efficiency within the chain production process, reducing energy costs of the plant, fulfilling the commitments to become an environmentally friendly enterprise and improving business processes by the integration of an online energy use monitoring system are ensured by the introduction of the On-line Diagnostics Energy Efficiency Service along with the Continuous Improvement Energy Efficiency Service. The latter service allows the analysis of solutions associated to previous recurrent problem types in order to discover suggestions for improvement of VICINAY production units and processes aimed at reducing the frequency of appearance of these problems. The reduction of the number of some

type of recurrent problems is expected to reduce the energy consumption of the plant, improving the image as seen by clients, suppliers and society.

Shortly summarised, the compliance with the business related requirements can be evaluated as positive at the level of AmI-MoSES Full Prototype, taking into account the software configurability and scalability, and its potential applicability to other industrial sectors where knowledge needs to be efficiently and promptly managed so as to improve the energy efficiency of products and processes.

4.4 Assessment of Methodology

The AmI-MoSES Industrial and RTD Methodology, which was agreed and elaborated by the consortium RTDs and Industrial Partners, were adopted as the reference guideline for the introduction of the software tools in end-users' day-to-day operations.

The senior managers from AmI-MoSES consortium industrial companies understood that the adoption of a knowledge-based system like AmI-MoSES requires their initial commitment to communicating the new knowledge management policy to the entire enterprise. This new policy, which must be aligned with a new corporate vision, involves the creation of an innovative environment that allows a cultural adaptation focused on knowledge sharing and collaboration, not only within the limits of the organization, but also within the Extended Enterprise (manufacturing system vendors and end-users). So as to ease and leverage this adaptation, senior managers commonly agreed that a structured, systematic approach must be applied. For a detailed description of this approach see deliverable D2.3 – AmI-MoSES Industrial Methodology. In short, the initiative must include investing in knowledge worker loyalty.

The validity of the Industrial Methodology as a solid and effective approach for promoting the corporate cultural change was assessed and favourably evaluated keeping in mind that the initiative represents an initial additional overhead for the knowledge experts, who will invest time in feeding the knowledge-based systems with their expertise. The senior managers from the consortium companies commonly agreed that so as to turn their organizations into knowledge-based interrelated entities, the establishment of the above mentioned appropriate environment is compulsory. The senior managers stated that the adoption of the KM systematic and motivation / rewards mechanisms presented in the Industrial Methodology can enable a smooth and quick cultural transition for leveraging the adoption of a knowledge-based system such as AmI-MoSES. The industrial AmI-MoSES methodology with annexed User Manual is very promising in terms of enabling users of the d AmI-MoSES system to efficiently solve Energy Efficiency problems and their reoccurrence, through strengthening the users' decision-making skills, allowing relatively inexperienced workers to make the same quality decisions as the expert.

The AmI-MoSES RTD Methodology can be also assessed favourably as it provides enough additional reading material for advanced system users or those intending to introduce more intelligent systems for Energy Efficiency optimisation.

5 Conclusions and Feedback to Development

As stated before, the end-users provided feedback as result of the tests carried out. This feedback was structured as recommendations, which were analysed by the RTD and ICT partners (see Table 25) for the Full Prototype refinements for the post-project developments aiming at the Commercial Exploitation of the tool.

Table 25: End-users feedback

Recommendation	Response
CR Set up module	
It may be necessary to create in the user interface a utility for password recovery.	The issue will be developed during the commercialisation stage of the AmI-MoSES product.
Confirmation to delete data when you press the button *Clean Database* in Database Set-up.	This issue will be tackled during the post project exploitation phase and adapted to end-users' specific requirements.
ECD & AmI Monitoring Services	
It may be necessary to create new database elements to fulfil the changing data requirements of each enterprise.	The necessary updates in the Database set-up facility will be studied and developed during the commercialisation of the product.
The targeting model should be included in the of EUPs tab within "EUP Monitoring" menu, in order to allow setting the lower and upper threshold of EUPs. Splitting the "EUP Monitoring" functionality into too many tabs may render the functionality difficult to understand / use.	The issue will be adapted in the commercialisation of the product after studying its viability.
KM Core Services	
CBR: At the time of checking weights for the calculation of similarity, replace the screen "Define Weightings for Similarity Calculation" by a predefined template for each type of problems. This template could be adjusted by knowledge experts instead of allowing less experienced users to set the values.	The issue will be developed in the commercialisation of the product after studying its viability.
MSI-Core Services	
Add a link to HR discovery in the On-line diagnostics user interface. This way, if no cause and attached solution is found for a problem, the end-user will be able to invoke the HR discovery core service.	The issue will be developed in the commercialisation of the product after studying its viability.
Within the HR discovery screen, the user is not able to retrieve a list of experts with different expertise.	The issue will be developed in the commercialisation of the product after studying its viability.
Energy Efficiency Services	
Continuous Improvement EES: In the threshold configuration screen "Edit Analysis", the time unit for the number of events should be explicitly shown.	This issue was adjusted in the Full Prototype version of AmI-MoSES.