Appendix A: The Demonstrators

Appendix A: The Demonstrators

In this appendix, all the demonstrators developed by the partners for the second deliverable DR3.2 of work-package R3 are presented. Where there are discrepancies between the Demonstrator and the Application Scenario (found in Appendix B), the demonstrator-document overrides all aspects of the application scenario.

PROMISE Demonstrator A1
CRF (EOL)

Written by:
Mario Gambera, CRF

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1 A1 CRF (EOL) – Definition of the demonstrator

1.1 A1 – The Demonstrator

Demonstrator	Describe functionality	Describe why this Demonstrator is focused in PROMISE
Passenger Car	Transport people	Lifecycle of a Passenger Car is quite long. Closing the information loop of a Product with a long life is of paramount importance. Residual value of the product at EOL is still high, both in reusability potential and in terms of environmental impact.

Table 1: The A1 PROMISE demonstrator

- This document was written using one generic Component as example.
- The Component used in the demonstrator must still be identified
- There will most likely be more than one component

1.2 A1 – Objectives (OBs) of the Demonstrator

ID	Objective (one per ID)	Describe why
O1	Identify what components worth re-use when deregistering the vehicle	Increase the percentage of reused component and increase the viability of the initiative (also introducing automation procedures) is one of the key driver for reducing OEM Deregistering costs
O1.1	Tracking relevant components info from B.o.M. / Production phase	Some information about component origin (composition, production date, design nr, etc) are necessary for the decision that will be taken at the moment of deregistration.
O1.2	Tracking relevant component info about its usage / mission	The wear-out level of a component can differ considerably depending on the mission experienced by the component itself. It is therefore necessary to define some effective “summary”, capable to synthesise mission profile. Once a suitable summary has been chosen, it is necessary to continuously update it during usage.
O1.3	Updating / resetting info about component mission in case of component substitution	If a component is replaced, summary about mission profile must be reset.
O1.4	Identify economical information about component re-use	Another fundamental aspect to be taken into account is the commercial viability of the component. This evaluation depends also on potential II hand market sale price, market acceptability capacity and so on.
O1.5	Decide whether re-use a component or not, using all the info above	See O1. This goal is achieved by using” all the information collected from O1.1 to O1.4
O2	Transfer on the component “some” relevant info about its post –deregistering life	The availability of a Tag on the component can be used to record relevant info about the treatment after separation from the vehicle. Depending on the decision taken in O1.5 it is necessary to record what reworking is necessary (if any), other info about wear out level and so on.

Table 2: Objectives (OBs) of the A1 PROMISE demonstrator

1.3 A1 – Involved actors (ACs) in the whole lifecycle of the Demonstrator

ID	Actor	External / Internal	Describe how they will be involved, their role and impact of the PROMISE technology	Importance / Relevance High, Medium, Low	BOL	MOL	EOL
AC1	The users	E	The innovation doesn't affect the user	L		X	
AC2	The Design dept	I	Design and management of info about component on the backend system	M	X		
AC3	Authorised Garage	I/E	Minimum change in the mol maintenance. Wireless comm. System automatically update on-board computer when a component is replaced.	M		X	
AC4	Authorised Garage	I/E	Use DSS. Starts the deregistration process. Collects dynamic info from the car. With the help of the DSS integrates all the static and dynamic info and decide what to reuse. Writes some info on Tag component before detachment.	H			X
AC5	Authorised dismantlers	E	Same for Authorised Garage	H			X
AC6	After Sales Department	I	Manages Cost model, Magages policy for II hand parts, manages backend systems	H	X	X	X
AC7	Re-manufacturer	I/E	Reworking operation of the II hand component. He rely on more information than on the As- is process	M			X

Table 3: Involved lifecycle actors (ACs) of the A1 PROMISE demonstrator

1.4 A1 – The demonstrator physical components (PCs)

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
PC1	TAG on relevant Component X	Uniquely identify component X, record some info about component X history.	Wireless communication with SS1. Physical, solid and stable link with component X	No. Easily available on the market. Promise Partner will provide the best solution.	Essential	FU1, FU2, FU3, FU11, FU12, FU13
PC2	Normal Production Sensor of X measurement (for ex. temperature)	Continuously measure some vehicle parameter (for ex. Outside temperature)	Link with PC4	Yes	Can be simulated with data organised in time series	FU7
PC3	Component X	Depending on X	Supports TAG	Yes	It is the "subject" of the evaluation	
PC4	ECU	Manages in real – time vehicle electronics.	Wireless link with PC1, link with PC2, hosts SS1, link with SS2	Yes	The on board diary SS1 will probably be hosted by ECU	

Table 4: Physical components (PCs) of the A1 PROMISE demonstrator

1.5 A1 – The demonstrator software/support-systems (SSs)

ID	Software / support system	Describe its functionality	Describe the necessary interfaces of this software/support system to other PC IDs, SS IDs etc	Is this software / support system already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to the Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
SS1	On board Diary	Store summary about component mission. Perform some basic calculation from sensor measurements. Update component specific summaries. Reset Component specific summaries. Communicate with PC1 (r/w), PC2 (r), SS2.	Communication with PC1 when a Component is mounted or replaced, with PC2 continuously, with SS2 during the deregistration phase.	No. According to actual knowledge, on-board computer could be hosted on Vehicle ECU. SW is all to be developed	Essential	FU4, FU5, FU6, FU8, FU9, FU10, FU20
SS2	Back-end DSS	Download info from On-Board diary, get component age and mileage from On – board computer, get info from other back end systems SS3 and SS$, take decision about what reuse		No		FU14 FU15 FU16 FU17 FU18 FU19
SS3	OEM Back end IMDS	Manages info about component. Allow the identification of component characteristics from its ID number on TAG, etc.		Yes / No		
SS4	Component cost model	Manages economic info about Component.		No		

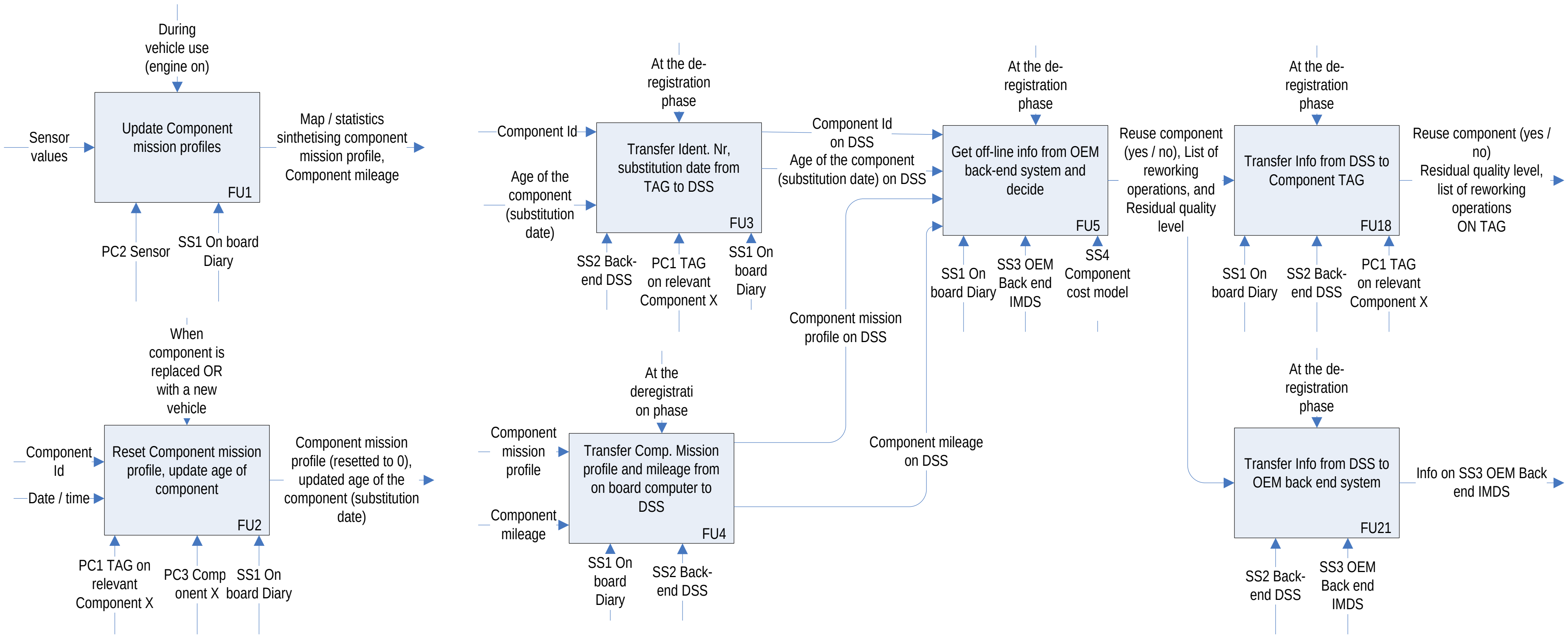
Table 5: Software / support systems (SSs) of the A1 PROMISE demonstrator

1.6 A1 – Description of the functionality (FUs) of the demonstrator

ID	Functionality	Comments to functionality	Define the inputs needed to achieve this functionality and relate the input to other FU IDs (e.g. output data from FU3)	Define the outputs from this functionality	What are the controls? ID the controls by using C1, C2 etc	Technologies/Physical components/Systems/Actors involved Describe the technologies involved, or assumed technology/systems needed	Rationale Describe why this functionality is needed	Priority High, Medium, Low	Related to objective ID (Sec 1.2)
FU1	Update Component mission profiles	clock = 1 second	Sensor values	Map / statistics sinthetising component mission profile, Component mileage	During vehicle use (engine on)	PC2, SS1	Accurate knowledge of the component mission profile is essential for assessing the "worth for reusability"	High	OB1.2
FU2	Reset Component mission profile, update age of component	This operation should be fully automatic	Component Id Date / time	Component mission profile (resetted to 0), updated age of the component (substitution date)	When component is replaced OR with a new vehicle	PC1, PC3, SS1	When a component is replaced his history must be resetted	High	OB1.3
FU3	Transfer Ident. Nr, substitution date from TAG to DSS	On-board computer could be used to do this transfer	Component Id age of the component (substitution date)	Component Id age of the component (substitution date) on DSS	At the deregistration phase	PC1, SS1, SS2		High	OB1.5
FU4	Transfer Comp. Mission profile and mileage from on board computer to DSS		Component mission profile, Component mileage	Component mission profile, Component mileage on DSS	At the deregistration phase	SS1, SS2		High	OB1.5
FU5	Get off-line info from OEM back-end system and decide		Component ID, mission profile, mileage and age on DSS	Reuse component (yes / no) Residual quality level, list of reworking operations	At the deregistration phase	SS1, SS3, SS4		High	OB1.5
FU18	Transfer Info from DSS to Component TAG		Reuse component (yes / no) Residual quality level, list of reworking operations	Reuse component (yes / no) Residual quality level, list of reworking operations ON TAG	At the deregistration phase	PC1, SS1, SS2		Medium	OB2
FU21	Transfer Info from DSS to OEM back end system		Reuse component (yes / no) Residual quality level, list of reworking operations	Info on SS3	At the deregistration phase	SS2, SS3		Low	

Table 6: Functionalities (FUs) of the A1 Demonstrator

1.7 A1 – Draft illustration of demonstrator's functionalities



PROMISE Demonstrator A2
Caterpillar (EOL)

Written by:
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Updated by:
Tonya A.T. Garrett Caterpillar Inc

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2 A2 CATERPILLAR (EOL) – Definition of the demonstrator

2.1 A2 – The Demonstrator

Demonstrator	Describe functionality	Describe why this Demonstrator is focused in PROMISE
Engine of Track Type Tractor (TTT	The demonstrator aggregates all kind of field data, product specific information, and additional information and transforms it – supported by decision support system – into knowledge that can be used to take productive and effective actions. The data must be accessible by the supply chain in a PDKM system.	This demonstrator covers the closure of information loop between product operation (MOL) and product recycle, reuse, remanufacture or disposal (EOL). However, to effectively impact these focus areas the demonstrator will also have to close the loop with manufacturing and design (BOL).

Table 7: The PROMISE EOL demonstrator

2.2 A2 – Objectives (OBs) of the Demonstrator

ID	Objective (one per ID)	Describe why
OB1	Primary objective: Prove the closure of information loop between knowledge required to manage the field population as well as make the appropriate EOL decisions.	This demonstrator covers the closure of information loop knowledge-based actions at the end of life (EOL).
OB2	Demonstrator shall aggregate available engineering data, field data, and ancillary information.	All required information and data will be used to manage the field population as well as making decisions and selecting procedures for product recycle, reuse, remanufacture or disposal (EOL).
OB3	Use product embedded devices such as RFID to track components and automatically maintain related data linkages such that it can be transformed into the required knowledge.	This provides a decision making process for EOL that is based on knowledge of the entire field population.

Table 8: Objectives (OBs) of the A2 PROMISE demonstrator

2.3 A2 – Involved actors (ACs) in the whole lifecycle of the Demonstrator

ID	Actor	External / Internal	Describe how they will be involved, their role and impact of the PROMISE technology	Importance / Relevance High, Medium, Low	BOL	MOL	EOL
AC1	Product Design	Internal	Optimize designs and support Dfx	H			X
AC2	Manufacturing	Internal	Optimize manufacturing processes and forecasting build	M			
AC3	Logistics	Internal/External	Forecasting and tracking	H			
AC4	Remanufacturing	Internal	Decision making and process optimization	H			X

Table 9: Involved lifecycle actors (ACs) of the A2 PROMISE demonstrator

2.4 A2 – The demonstrator physical components (PCs)

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
OS1	Engine of TTT product	Vehicle motion and power	RFID will be attached on the on the engine.This RFID will provide information of the component during PLM Information from the RFID could be tracked and updated during each maintenance period or other major envent (renting, selling products,…) . Data could be store periodically by using RFID reader. Critical PLM information could provide user of major information on failure mode and maintenance reporting (repair, replace component) for EOL actions	The engine already exists on CAT TTL. No sensor is providing feedback information during PLM for EOL RFID has to be hire and need to be placed on the engine and data transfer system, data management system should be develop for PLM EOL application. Data reader system should be physically implement at dealers for data transfer and updated	Develop component data information PLM fro EOL acion, reduce risk of productt failure, increase user safety working conditions,	FU 1 Data storage FU 2 Data reader, FU 3Data udtae FU 4 EOL actions

Table 10: Physical components (PCs) of the A2 PROMISE demonstrator

2.5 A2 – The demonstrator software/support-systems (SSs)

ID	Software / support system	Describe its functionality	Describe the necessary interfaces of this software/support system to other PC IDs, SS IDs etc	Is this software / support system already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to the Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
SS1	Data storage on RFID (ID, manufactured location,….	store manufacturing, logistics data	software reader (wireless system)	Software is not available. It should be hire to be used	Capture data from engine during PLM for EOL action	FU1
SS2	Data management ssytem	Update data on on RFID for any major issue occur on engine during PLM	Update information on RFID by using software and RFID reader	Software will be used to store information on RFID for SS3 Software is not available. It should be developed to be used	Update component data information during PLM for EOL product	FU2
SS3	Data management system	Transform information into decision for EOL	Provide BOL and PLM major event for EOL decision (reuse, reman, recycle	Software should transform information into action for EOL treatment Software is not available. It should be developped	Transform information into knowledge for EOL product	FU3

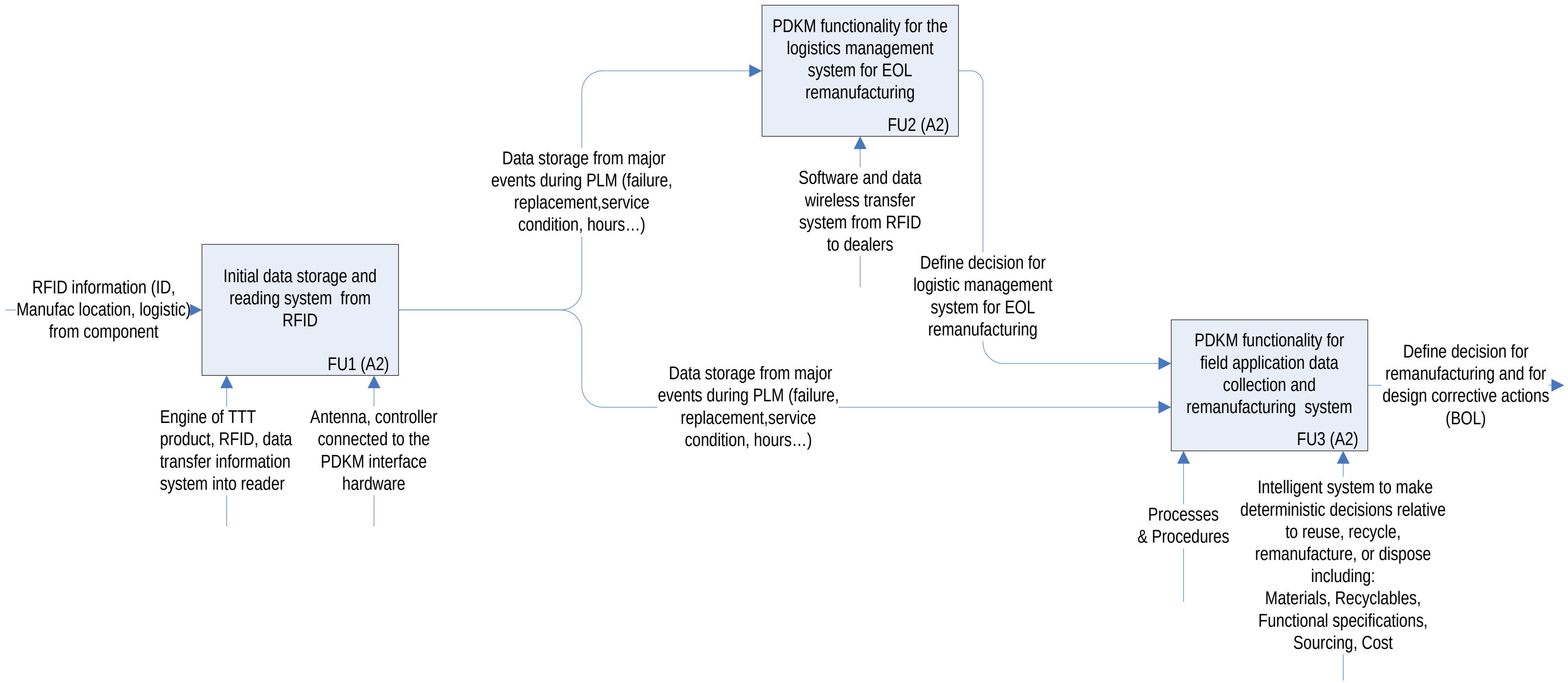
Table 11: Software / support systems (SSs) of the A2 PROMISE demonstrator

2.6 A2 – Description of the functionality (FUs) of the demonstrator

ID	Functionality	Comments to the functionalities	Define the inputs needed to achieve this functionality and relate the input to other FU IDs (e.g. output data from FU3)	Define the outputs from this functionality	What are the controls? ID the controls by using C1, C2 etc	Technologies/Physical components/Systems/Actors involved Describe the technologies involved, or assumed technology/systems needed	Rationale Describe why this functionality is needed	Priority High, Medium, Low	Related to objective ID (Sec 1.2)
FU1	Initial data storage and reading system from RFID	Flexible and user configurable Intuitive user interface that is automated where possible.	RFID information (ID, Manufac location, logistic) from component	Data storage from major events during PLM (failure, replacement,service condition, hours…)		Engine of TTT product, RFID, data transfer information system into reader Antenna, controller connected to the PDKM interface hardware	This function provides the data needed for EOL remanufacturing Reliable in harsh environments	H	OB3
FU2	PDKM functionality for the logistics management system for EOL remanufacturing	Flexible and user configurable Intuitive user interface that is automated where possible.	Information output from F1	Define decision for logistic management system for EOL remanufacturing		Software and data wireless transfer system from RFID to dealers	This function provides for a logistic system that can forecast need based on field population and remanufacturing	H	OB2, OB3
FU3	PDKM functionality for field application data collection and remanufacturing system	Flexible and user configurable Intuitive user interface that is automated where possible.	Information output from F1, F2	Define decision for remanufacturing and for design corrective actions (BOL)		Intelligent system to make deterministic decisions relative to reuse, recycle, remanufacture, or dispose including: • Materials • Recyclables • Functional specifications • Sourcing • Cost Processes & Procedures	System the is capable of reading the RFID information and then making the required connections to the information in the PDKM system Provides the linkage between BOL, MOL, and EOL for intelligent management of the EOL functions	H	OB1, OB2

Table 12: Functionalities (FUs) of the A2 Demonstrator

2.7 A2 – Draft illustration of the demonstrator's functionalities



PROMISE Demonstrator A3
BIBA / INDYON (EOL)

Written by:
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3 A3 BIBA/INDYON (EOL) – Definition of the demonstrator

3.1 A3 – The Demonstrator

Demonstrator	Describe functionality	Describe why this Demonstrator is focused in PROMISE
EOL information management for tracking and tracing of products for recycling	**Material flow** Figure 3 (see section 5) describes the application field for the RFID technology in the life cycle of car bumpers with an attached or embedded tag (or PEID) from the producer side: After use and dismantling the single bumper or bumper fraction goes to the collection point (e.g. an open container) by passing a reader gate. This reader gets all data from the single bumper tag. The milling starts when a sufficient amount of bumpers is available. Before milling, a manual or automated sorting system sorts the bumpers for recycling from the container fractions. After milling and filling the material goes via a truck to another recycling facility. There the material is put into a warehouse. On customer demand this facility produces new plastic granulate, which is basis for new plastic products. **Information flow** The external information flow in the recycling industry is normally text based via paper documents, fax and e-mails in combination with verbal agreements. The text based information is combined with additional information. Agreements will be not recorded. The internal information is also text based but instead of using fax and e-mail the information handling is supported by an internal ERP system, WMS (Warehouse Management System) or PPS (Production Planning and Control System). There is no data collection in place regarding PLM relevant data.	The objective of this demonstrator is to develop an application which supports the tracking and tracing of products estimated for recycling by using the PROMISE PEID technology and PDKM system in combination with the using of indoor and outdoor navigation systems. The application scenario including specifications for the required equipment, the sensors, the smart tags, the receivers i.e. all the communication infrastructure will be provided by INDYON and BIBA by taking into account results of a national funded research project (OPAK).

Table 13: The A3 PROMISE demonstrator

3.2 A3 – Objectives (OBs) of the Demonstrator

ID	Objective (one per ID)	Describe why
OB1	Develop an application which increases the recycling rate.	Less waste, legislative pressure, financial aspects, independency from raw materials.
OB2	Tracking and tracing of relevant product data together with the materials during all recycling processes and supply of these data for recycling process.	During the processes where the materials are being milled, etc. it is important to keep the right data to the materials, even when there is a mixture of different batches. The parameters of the recycling processes depend on these data.
OB3	Tracking and tracing of relevant product data together with the materials during all recycling processes and supply of these data for product design.	During the processes where the materials are being milled, etc. it is important to keep the right data to the materials, even when there is a mixture of different batches. The design of new products depends on these data.
OB4	Support of decision making systems with relevant data.	Control systems adapted to the processes depending on the incoming data from the materials.

Table 14: Objectives (OBs) of the A3 PROMISE demonstrator

3.3 A3 – Involved actors (ACs) in the whole lifecycle of the Demonstrator

ID	Actor	External / Internal	Describe how they will be involved, their role and impact of the PROMISE technology	Importance / Relevance High, Medium, Low	BOL	MOL	EOL
AC1	Customer selling used parts	External	Supplier of relevant product data	H		X	X
AC2	Logistic operator	Internal	Moving of the materials; Data exchange for process support.	H	X		X
AC3	Machinery workers recycler	Internal	Production of high quality recycling products	H	X		
AC4	Customer which uses recycled plastics	External	He gets precise data about his product	H	X		
AC5	Automotive design department	External	Feedback from recycled product quality and data	H	X		

Table 15: Involved lifecycle actors (ACs) of the A3 PROMISE demonstrator

3.4 A3 – The demonstrator physical components (PCs)

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
PC1	RFID tag 868 MHz (optional, only if PC9 is not in use)	ID #/pallet #	PC3	Yes	RFID tagged to the packing material for item identification	FU1 / FU2
PC2	RFID transponder 125 kHz	Storage of geographic position	PC4	Planned for OPAK	RFID embedded into the warehouse floor for position identification	FU1 / FU2
PC3	UHF RFID reader system	Reading of PC1	PC1, PC6, PC7, PC8, SS4	Yes	See PC1	FU1 / FU2
PC4	125 kHz RFID reader system	Reading of PC2	PC2, (PC5), PC6, PC7, PC8, SS4, SS5	Planned for OPAK	See PC2	FU1 / FU2
PC5	Ultrasonic sensor (optional, not necessary if PC3 is in use)	storing position identification (x-, y-position)	PC4	Planned for OPAK	See PC2	FU1 / FU2
PC6	Ultrasonic sensor	Storage level identification (z-position)	PC4	Planned for OPAK	See PC2	FU1 / FU2
PC7	Fork lift	Mobile reader system	PC3, PC4	Yes	See PC1 and PC2	FU1 / FU2
PC8	Fork lift terminal	Worker order support	PC3, PC4	Planned for OPAK	See PC1 and PC2	FU1 / FU2
PC9	RFID 868 MHz/13,56 MHz (PEID) tagged to packing material (octabin or bags) with recycled material (PP of PA granulate)	For testing	PC3	No	Demonstration of tracking and tracing of material coming from EOL plastic material	FU1 / FU2

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
PC10	RFID 868 MHz/13,56 MHz (PEID) tagged to EOL plastic part (e. g. ELV bumper)	RFID carrying use data, parts ID	SS4, SS5	No	Demonstration of tracking and tracing of EOL plastic material going to recycling	FU3
PC11	Truck loading platform	For testing	SS4, SS5	Planned for OPAK	See PC1 and PC2	FU1 / FU2
PC12	Warehouse storing rack	For testing	SS4, SS5	Yes	See PC1 and PC2	FU1 / FU2
PC13	Packing material	For testing	PC1, SS4, SS5	Yes	See PC1 and PC2	FU1 / FU2
PC14	Car bumper	For testing	PC10, SS4, SS5	No	See PC10	FU3

Table 16: Physical components (PCs) of the A3 PROMISE demonstrator

3.5 A3 – The demonstrator software/support-systems (SSs)

ID	Software / support system	Describe its functionality	Describe the necessary interfaces of this software/support system to other PC IDs, SS IDs etc	Is this software / support system already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to the Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
SS1	Production machines	Recycling processes like milling, granulating, mixing, cutting	SS4, SS5, PC3, PC4	No	User of product data.	FU1 / FU2, FU3
SS2	Logistic systems	Transport of the materials	SS4, SS5, PC3, PC4	Yes	Continuous data flow, just in time processes	FU1 / FU2, FU3
SS3	Control systems	Weight, temperature	SS4, SS5, PC3, PC4	No	Support of decision support systems	FU1 / FU2
SS4	Warehouse management system	Software support for warehouse management	PC3, PC4, PC11, PC12	Planned for OPAK	Warehouse management support system	FU1 / FU2, FU3
SS5	Indoor / outdoor navigation system	For testing	PC4, PC11, PC12	Planned for OPAK	See PC1 and PC2	FU1 / FU2, FU3

Table 17: Software / support systems (SSs) of the A3 PROMISE demonstrator

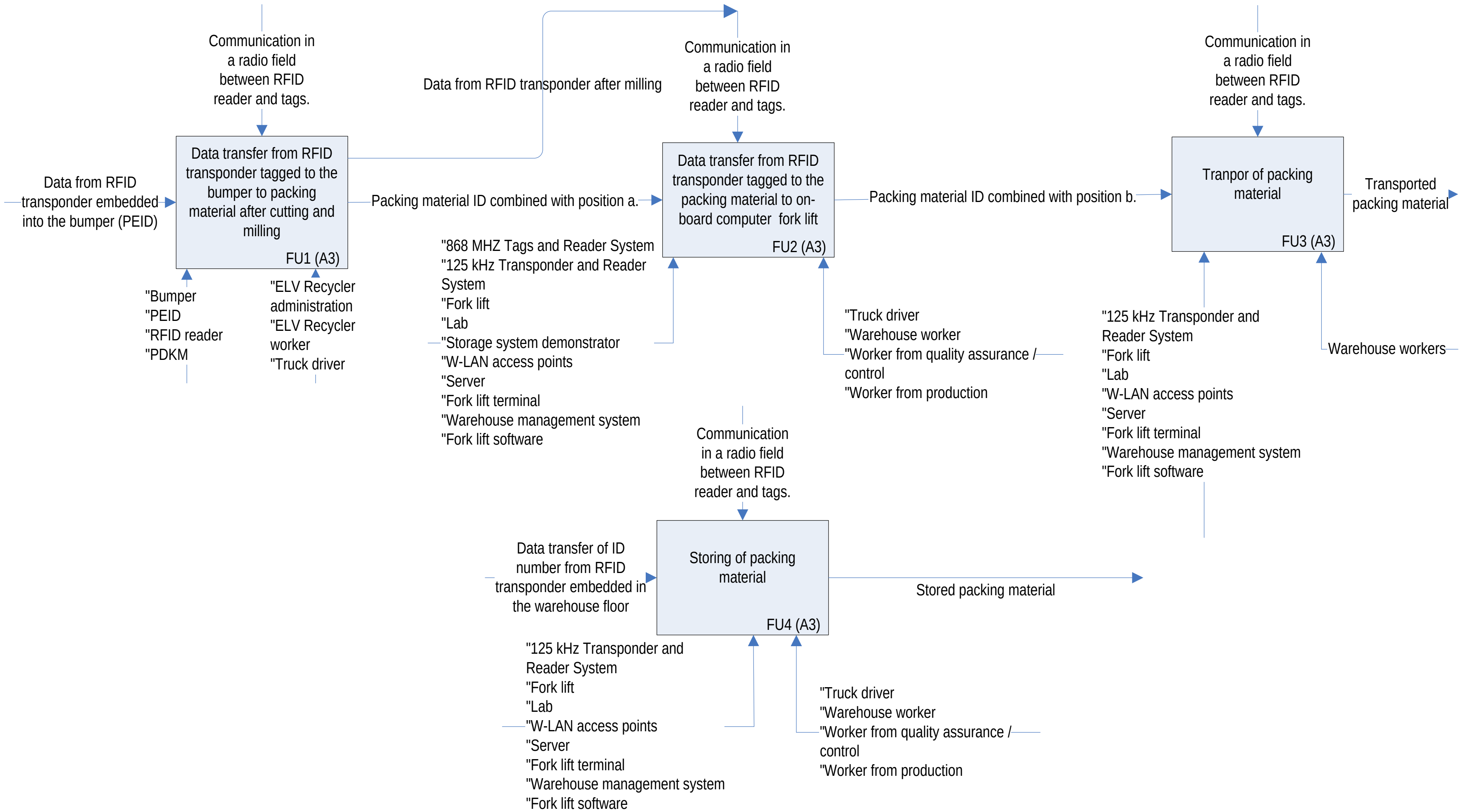
3.6 A3 – Description of the functionality (FUs) of the demonstrator

ID	Functionality	Comments to the functionalities	Define the inputs needed to achieve this functionality and relate the input to other FU IDs (e.g. output data from FU3)	Define the outputs from this functionality	What are the controls? ID the controls by using C1, C2 etc	Technologies/Physical components/Systems/Actors involved Describe the technologies involved, or assumed technology/systems needed	Rationale Describe why this functionality is needed	Priority High, Medium, Low	Related to objective ID (Sec 1.2)
FU1	Data transfer from RFID transponder tagged to the bumper to packing material after cutting and milling	Access to the PROMISE PDKM system	Data from RFID transponder embedded into the bumper (PEID)	Data from RFID transponder after milling	Communication in a radio field between RFID reader and tags.	Technologies / Systems Bumper PEID RFID reader PDKM Actors ELV Recycler administration ELV Recycler worker Truck driver	See OB2, OB3, OB4	H H H	OB2 OB3 OB4
FU2	Data transfer from RFID transponder tagged to the packing material to on-board computer fork lift	The data transfer must be in real time by having an W-LAN access from the fork lift to the PROMISE PDKM system	Packing material ID (output data from FU1) combined with position a.	Packing material ID combined with position b.	Communication in a radio field between RFID reader and tags.	Technologies / Systems 868 MHz Tags and Reader System 125 kHz Transponder and Reader System Fork lift Lab Storage system demonstrator W-LAN access points Server Fork lift terminal Warehouse management system Fork lift software Actors Truck driver Warehouse worker Worker from quality assurance / control Worker from production	See OB2	H M M	OB2 OB3 OB4

ID	Functionality	Comments to the functionalities	Define the inputs needed to achieve this functionality and relate the input to other FU IDs (e.g. output data from FU3)	Define the outputs from this functionality	What are the controls? ID the controls by using C1, C2 etc	Technologies/Physical components/Systems/Actors involved Describe the technologies involved, or assumed technology/systems needed	Rationale Describe why this functionality is needed	Priority High, Medium, Low	Related to objective ID (Sec 1.2)
FU3	Transport of packing material	The data transfer must be in real time by having an W-LAN access from the fork lift to the PROMISE PDKM system (for the navigation of the fork lift).	Data transfer of ID number from RFID transponder embedded in the warehouse floor	Transported packing material	Communication in a radio field between RFID reader and tags.	<u>Technologies / Systems</u> 125 kHz Transponder and Reader System Fork lift Lab W-LAN access points Server Fork lift terminal Warehouse management system Fork lift software <u>Actors</u> Warehouse worker	See OB2	H M	OB2 OB4
FU4	Storing of packing material	The data transfer must be in real time by having an W-LAN access from the fork lift to the PROMISE PDKM system (for the navigation of the fork lift).	Data transfer of ID number from RFID transponder embedded in the warehouse floor	Stored packing material	Communication in a radio field between RFID reader and tags.	<u>Technologies / Systems</u> 868 MHz Tags and Reader System 125 kHz Transponder and Reader System Fork lift Lab Storage system demonstrator W-LAN access points Server Fork lift terminal Warehouse management system Fork lift software <u>Actors</u> Truck driver Warehouse worker Worker from quality assurance / control Worker from production	See OB2	H M	OB2 OB4

Table 18: Functionalities (FUs) of the A3 Demonstrator

3.7 A3 – Draft illustration of the demonstrator's functionalities



3.8 A3 – Additional information related to the BIBA/INDYON Demonstrator

In this section, the demonstrators added other relevant information related to the Demonstrator not already covered. Each Demonstrator was free to form this section as needed and this section can e.g. serve as a reminder for the WP Ax (and other WPs) when these start.

Recycling of Car Bumpers with RFID Technology as an Example for A3

For a better understanding of the opportunities of the RFID technology in the product life cycle management, this chapter describes a possible recycling scenario for car bumpers.

Figure 1 describes possible application fields for the RFID technology in the life cycle of car bumpers with an attached or embedded tag from the producer side: After use and dismantling the single bumper or bumper fraction goes to the collection point (e. g. an open container) by passing a reader gate. This reader gate reads all data from the single bumper tag and writes data on the tag (see Table 19).

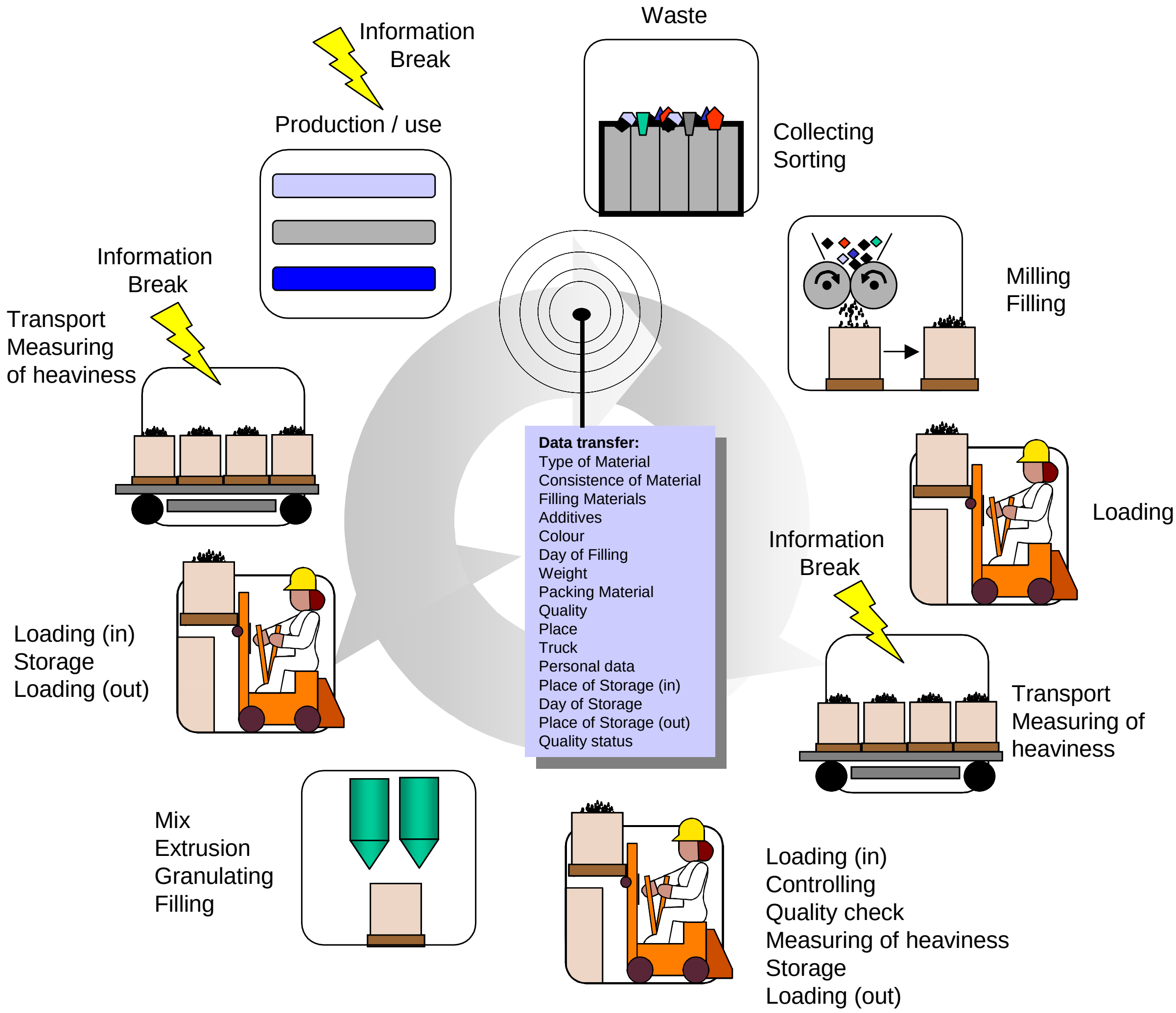


Figure 1: Use of RFID technology in the life cycle of bumpers

The milling starts after a sufficient amount of bumpers is available. Before the milling, a manual or automated sorting system sorts the bumpers for recycling from the container fractions. After milling and filling the material goes via a truck to another recycling facility. There the material goes into a storage system. On customer demand this facility produces new plastic granulate, which is basis for new plastic products.

The different process steps have different requirements of data exchange. Table 19 describes examples for an information exchange between the transponder and the collecting / sorting production, transport, loading and storing systems.

The transponder technology enables in this example the data acquisition of the collected material types and -mix at the collecting point, i. e. at the place of waste collecting, in temporary storage facilities systems or in storage systems of external logistic services.

Advantages are the ubiquitous availability of data about the material during the whole recycling process. Breaks in the information chain (cf. Figure 1) are buffered via the transponder chips. The fast information exchange by passing reading systems is more efficient than the manual scanning of barcodes.

As an additional functionally it is possible to control the temperature of the packed material (granulated plastic is self inflammable).

Process step	Data exchange (examples)
Collecting / Sorting	Bumper transponder to production system: Additives, brand, colour, consistence of material, bumper identification number (external), type of material, weight Recycler production system to bumper transponder: Day of storage, personal data, place of storage (in), bumper identification number (internal), quality
Production	Production system to packing transponder: Additives, consistence of material, day of filling, personal data, place of filling, packing unit identification number, status, type of material, weight, machine number Packing transponder to production system: Packing identification number, temperature
Transport	Packing transponder to truck: Packing unit identification number, material, place of storage on truck, weight, temperature Truck to packing transponder Personal data, truck number plate
Loading	Packing transponder to fork lift: Packing unit identification number, material, place of storage on truck, weight Fork lift to packing transponder: Day and time of loading, fork lift identification number, personal data
Storing	Packing transponder to storage system: All collected data on the transponder (e. g. additives, consistence of material, material, packing material, personal data, packing unit identification number, temperature, weight) Storage system to packing transponder: Storage place, date and time, quality status

Table 19: Date exchange during the recycling process of bumpers (examples)

Real Time Decision Support

The ubiquitous availability of information accompanying the material flow can be further used in order to realise innovative decision support tools, which can be adopted for various issues within enterprise networks and the process chains in the field waste and recycling management.

Tools on top of data acquisition solutions as mentioned above can conduct further processing of the data coming along with individual entities (like bumpers) or batches. During this process data becomes information, which can be used to make better decisions on the operational, tactical and even strategic level. Examples for potential improvements on each of these levels are as follows:

Operational level

- Reaction on interference during the collection process (e. g. due to road construction) of waste or recycling material
- Reaction on unavailability of vendor parts or material in production and recycling
- Allocation for required resources for inbound and outbound flow of material / products for warehousing (loading unloading, packing, unpacking etc.)
- Control and better utilisation of transportation networks, as well as production and warehousing resources because of better information and forecasts based on real time data

Tactical level

- Clustering of areas, route planning for collection of recycling material or waste considering seasonal variability
- Production or recycling planning based on reliable information and forecasts for demand and availability
- Specification and adaptation of suitable warehousing policies (e. g. for reordering or delivery)
- Short-term adaptations of existing (recycling) networks as a result of a breakdown of a partner (e.g. selection of a new supplier)

Strategic level

- Composition and decomposition and of recycling networks (design and global optimisation)
- Long-term decisions as the location of new facilities for production, warehousing etc.
- Assessment of new technologies systems for collection, production, transport, warehousing, loading, unloading etc.

Thus real-time information concerning the various decision problems along the composition, operation and decomposition recycling networks or process chains offers huge optimisation potentials. In addition real-time information allows better forecasts and estimations regarding uncertainties and variability, which are inherent everywhere in production or recycling. In combination with tools following a holistic approach decisions and solutions can be developed which fulfils all requirements regarding efficiency, robustness and sustainability at the same time.

Today there are quite a number of approaches available in order to support the planning, control and optimisation problems related to the operation of production or recycling networks. The range covers pure mathematical methods (systems of equations), methods from Operations Research (mathematical programming), Soft Computing (evolutionary algorithms, neural networks, fuzzy methods), System Dynamics, Benchmarking or Simulation. While thinking about suitable approach for the realisation of a decision support system all of these approaches come along with specific disadvantages. Most of them are caused by the complexity of the underlying system. In this context it is questionable whether mathematical models, Operations Research or system dynamics can build adequate representations of reality. Although Soft Computing can solve even NP (Non-deterministic Polynomial-time) -hard problems and therefore fulfils the requirements regarding complexity it must be considered as a black box as the way to come to the solution, which was delivered, cannot be comprehended by the user. Another approach, which is widely used in practice, is Benchmarking. But this method requires reference cases (which are not necessarily available) in order to allow estimations about the quality of a certain decision or system configuration. Furthermore all of the methods mentioned so far do not support a holistic view for the decision support as they are either focussed one certain aspects of networks or the underlying processes.

In contrast to the other methods simulation (nearly) don't have any limitations regarding the complexity and supports a holistic view on the system to be considered. In addition simulation allows the integration of variability and uncertainty, which are always inherent in existing production and recycling systems. Thus it appears as a good candidate for an innovative decision support system. Unfortunately there are also disadvantages coming along with simulation. First of all each simulation study requires a model of the reality which will be executed within the simulator in order to get insights into the dynamics of the model which allows to draw conclusions on the behaviour of the real system. Usually the modelling process requires significant effort in terms of time and money. Therefore the application of simulation for complex but short-term scenarios is difficult due to the time, which is required for model building.

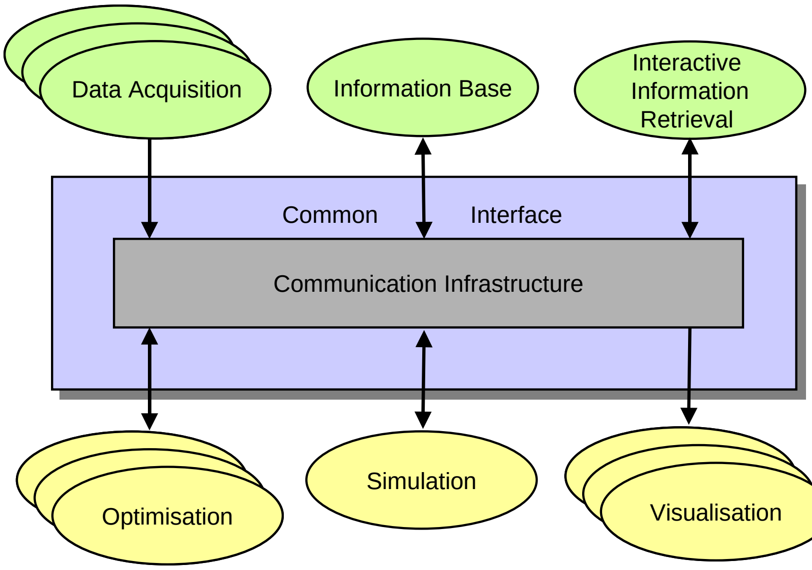


Figure 2: Architecture of a simulation-based decision support tool

Another problem covers the development of optimal or at least good solutions for a given decision problem. Due to its characteristic an environment for the emulation of systems simulation cannot propose such solutions on it's own. In fact they are developed by conducting various experiments with slightly different parameter sets in order get insights regarding the sensitivity of certain parameters concerning the overall model behaviour. Afterwards the model can be adapted considering this knowledge. However in order to find a good solution some expertise and experience in modelling and analysis of simulation data is required which domain experts as decision makers and thus the users of a decision support tool usually do not have.

However the obstacles depicted so far can be overcome with the availability of real-time information whereas the modelling effort can significantly decrease by utilising the available information in an (semi-) automatic way. Such an integrated simulation environment can be further interconnected with an optimisation module (whereas the feasibility of such an approach was already realised within the EU-funded project ONE – Optimisation methods for Networked Enterprises (Project No. GRD1-2000-25710), which in turn can support domain experts in order to identify good system configurations and make the right decisions. Figure 2 shows the architecture of such a simulation-based decision support tool.

The tool comprises several functional components addressing the acquisition of data, which are delivered by external entities (e. g. transponders while passing reader gates). After data processing the resulting information is stored within a global information base. This component provides all of the information, which is required by the other components and can be interactively accessed by the component for information retrieval. Further modules are the integrated simulator, which allows the execution of models by integrating real time information delivered from the information base. The optimisation of specific models or scenarios is furthermore supported by the communication with optimisation components whereas as different versions can be integrated into the environment each of which addressing different objectives. Finally different components for animation and visualisation allow the representation of dynamic aspects related to the underlying system or functional modules as the simulator. All of these different components are integrated by using the same communication infrastructure which is accessed by a common interface whereas the approach depicted here follows the architecture proposed by the High Level Architecture (HLA) which was developed by the American Department of Defence for distributed simulation (Originally the idea for the HLA was derived based from the problem of reutilisation of existing simulation environment in order to save development time and costs).

At the end such enhanced environments will support the decision maker in order to identify system configuration or concepts covering the whole life-cycle of products which are flexible, efficient, robust and sustainable at the same time by using an holistic approach while considering system inherent variability and uncertainties at the same time. Further application fields of the solution proposed here covers training and education of decision makers based on a "virtual reality" which can be provided by the tool.

A3 Demonstrator Options

Configuration

According to figure 4 there are different configuration possibilities for the data processing:

1. The first one is based on the central data management, means that the whole PDKM system is running via a central server system. Mobile units, like packing material, only need an identification number for tracking and tracing them in the supply chain (passive PEID).
2. The second possibility is also based on a central server concept but more autonomous based on decentralised data storage on the PEID (passive or active PEID with a higher storage capacity). Data (like in table 2) can be stored directly on the PEID, an access to a central server is not mandatory for each process step.
3. The third possibility is a PDKM system running directly on the PEID (active PEID). The controlling of such activities is still based on a central server.
4. The fourth possibility is a combination of the central and decentralised running PDKM system.

Data processing

Before, during and after changing the status of products or material (by filling, milling, mixing or extruding it) as well as changing the logistic position of the product, the information has to be processed (see figure 4). This is related to all types of data. In addition to table 2 these are e.g.:

- Temperature during processing, during storing or during transport (plastic granulate is self-inflammable),
- Quality data,
- Material composition,
- Logistic data like packing material, weight, orign, storage place, destiny or
- Previous product life data

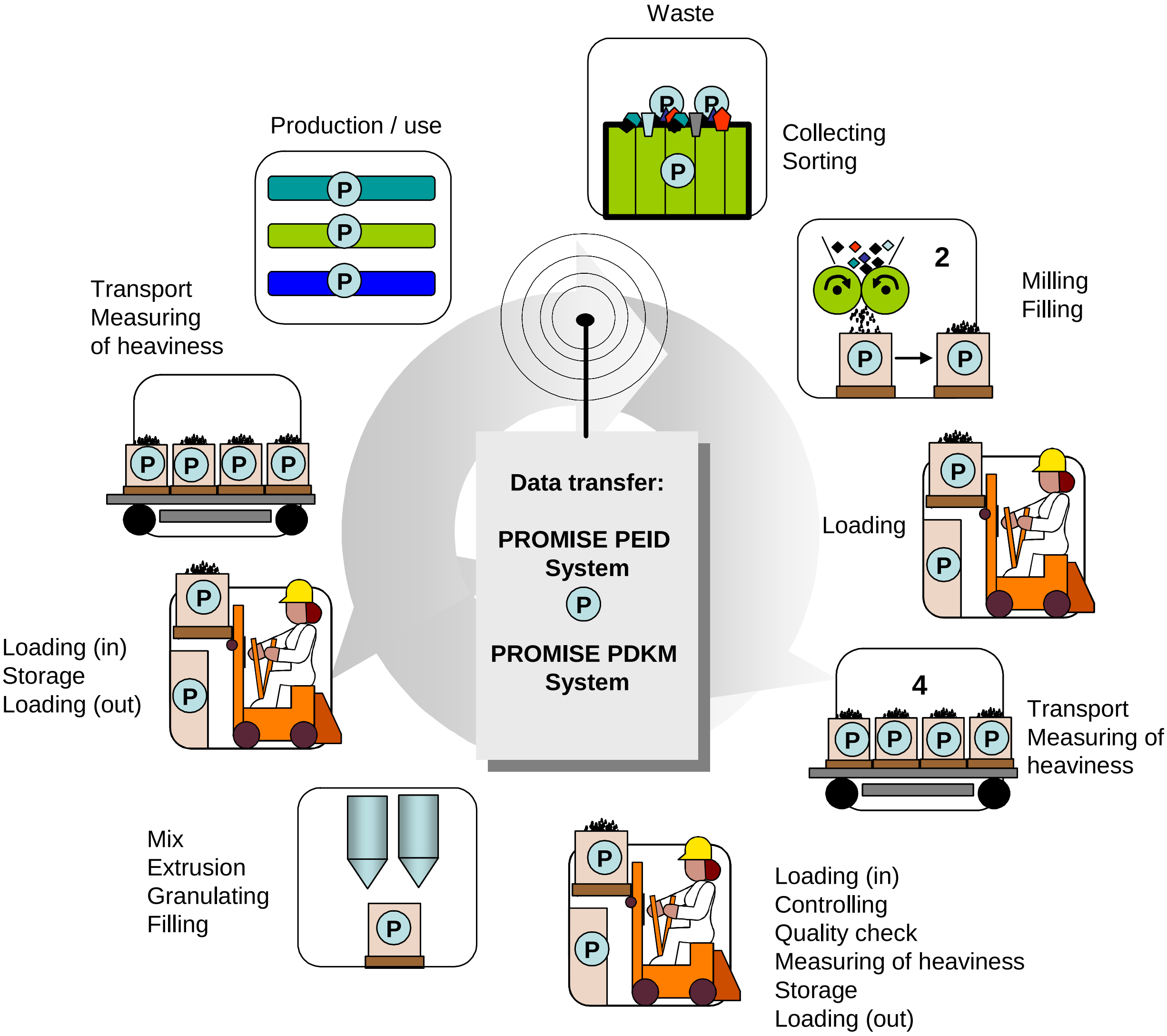


Figure 3: PROMISE EOL application scenario

A3 Demonstrator design

Demonstrator infrastructure basis

The demonstrator infrastructure is based on packing material for plastic scraps or granulates, labelled with RFID chips. The RFID technology enables the data acquisition of the collected material types and -mix at the collecting point, i.e. at the place of waste collecting, in temporary storage facilities systems or in storage systems of external logistic services. Parallel to this data acquisition, interfaces to a central material database assure an optimised production planning and controlling. Beside the RFID identification a RFID positioning system will be tested in combination (see figure 5).

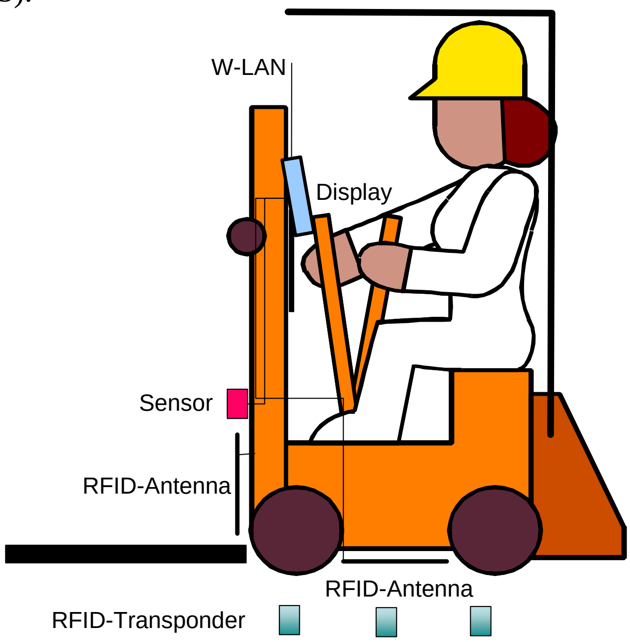


Figure 4: PROMISE EOL application scenario

The forklift in this demonstrator will be used as a mobile material / product identification and positioning system. For identification one RFID antenna is placed above the fork. This will be used for reading the information from the packing material. The second RFID antenna is placed under the bottom of the fork lift. This antenna reads the geographic data coming from the RFID transponder embedded into the warehouse ground. Combined with a W-LAN access data collected from the packing material and the warehouse ground can be transmitted to a central WMS which traces the material movements and placement in the warehouse (or production plant) and provides the driver of the forklift with new transport orders after finishing her or his job. This semi automated system is optimised for this special recycling industry type. A high investment in full automated systems does make no sense for this industry type because the logistic process can not be standardised due to the mixed material fractions and material consistencies. Especially the specific customer situation (customer on the input and output side which has to be served, see section 2.1) causes all types of transport systems.

Demonstrator enhancements

The described demonstrator is only working in a closed environment depended on the installed infrastructure which is based on passive RFID tags. Additionally the back end system is working on a traditional basis. Based on this and like described in section 5 it's planned to improve the system availability by using the PEID in combination with the PDKM system for closing the whole information and material loop.

PROMISE Demonstrator A4
CRF (MOL)

Written by:
Mario Gambera, CRF

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11.04.2005	0.2	Carl Christian Røstad	Updated structure based on input from the Munich meeting on the 11.-12. April 2004. The version was sent SAP, EPFL, BIBA, STOCKWAY and INFENEON for comments before distribution.
20.04.05	1.0	Mario Gambera	First draft covering all parts of the document
05.05.2005	1.1	Carl Christian Røstad	Updated structure of the document and added draft illustration of functionalities

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4 A4 CRF (MOL) – Definition of the demonstrator

4.1 A4 – The Demonstrator

Demonstrator	Describe functionality	Describe why this Demonstrator is focused in PROMISE
Truck	Transport goods	Monitoring info during MOL will allow to improve maintenance plan and to acquire info about vehicle mission profile

Table 20: The A4 PROMISE demonstrator

4.2 A4 – Objectives (OBs) of the Demonstrator

ID	Objective (one per ID)	Describe why
OB1	Develop a **predictive maintenance algorithms** able to predict **engine oil wear out** for the specific vehicle depending on ad-hoc mission profile indicators	Business point of view: Optimisation of maintenance policy will improve vehicle availability and safe of material. Research point of view: Oil Life Management Strategy is an active R&D filed where most important OEM are playing.
OB2	Collect prediction values as defined in OB1 on a ground station in order to remotely **manage a fleet of vehicles**	This is a first step for the fleet management. The results of the pred. Maint alg. Are transmitted to the ground station. Some first statistics about the fleet behaviour and component wear out are possible.
OB3	Collect ad-hoc mission profile indicator as defined in OB1 on a ground station in order to remotely monitor a fleet of vehicles, with the application of the predictive maintenance algorithms on the ground station	Monitor and analysis capabilities on the ground station will improve if it would be possible to send to the ground station mission profiles indicator used to define the predictive maintenance algorithm.
OB4	Collect ad-hoc mission profile indicator on a ground station in order to remotely monitor a fleet of vehicles, with the objective to have information about **the mission profile of each vehicle belonging to the fleet** Data elaboration should be able to: give residual autonomy for each vehicle feedback about vehicle "correct" usage feedback about fleet mission profile feedback about typical component usage maintenance management (policy, day by day maintenance).	Optimal monitor and analysis capabilities on the ground station by using all the useful mission profiles indicators.

Table 21: Objectives (OBs) of the A4 PROMISE demonstrator

Note: the objective from OB1 to OB4 are considered to be "incremental".
The starting point is OB1, i.e. the development of an algorithm of predictive maintenance applied on a single truck.
The capability to send to a ground station some amount of information with a certain frequency will allow to cover objective from OB2 to OB4.

4.3 A4 – Involved actors (ACs) in the whole lifecycle of the Demonstrator

ID	Actor	External / Internal	Describe how they will be involved, their role and impact of the PROMISE technology	Importance / Relevance High, Medium, Low	BOL	MOL	EOL
AC1	The users	E	Get the message of "residual autonomy" from the on board computer or other message from the ground station	L		X	
AC2	The Design dept	I	Gives specification for the Predictive maintenance algorithms Gives specification for the mission profile indicators Receives feedback about vehicle usage from the ground station	H	X		
AC3	Authorised Garage	I/E	Possible use of Authorised garage for the download of mission profiles indicators	M		X	
AC5	After Sales Department	I	Ideal Host of the "company wide "ground station. Maintenance management (policy, day by day maintenance). Send feedback to design department about vehicle mission profiles	H		X	
AC6	Fleet manager	E	Possible host for a ground station for the management of owned fleet. Management of day by day maintenance Control of use of the vehicles	M		X	

Table 22: Involved lifecycle actors (ACs) of the A4 PROMISE demonstrator

4.4 A4 – The demonstrator physical components (PCs)

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not?	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities
PC1	Sensors	Measure specific vehicle values (for ex. Oil temperature, engine rpm, engine load, etc)	Already existing interfaces with the On board computer	Yes	Primary source of information about vehicle behaviour	FU1
PC2	On board computer	Hosts predictive maintenance strategies (SS1 + SS2)		Yes		
PC3	Vehicle to ground communicator	Communicate with ground station		Yes / No	What can be transmitted, at what distance, what is the updating frequency	FU6 FU7 FU8 FU9
PC4	Ground station PC	Hosts Ground station DSS (SS3 + SS4)		No		

Table 23: Physical components (PCs) of the A4 PROMISE demonstrator

4.5 A4 – The demonstrator software/support-systems (SSs)

ID	Software / support system	Describe its functionality	Describe the necessary interfaces of this software/support system to other PC IDs, SS IDs etc	Is this software / DSS already available at your company today or not?	What is the relation to the Demonstrator objectives	Relate this to all relevant functionalitie s
SS1	Strategies for Mission profiles indicator management	Define, update, reset specific indicators for the description of vehicle mission profile, engine mission profile, engine oil mission profile. These indicators are updated based on sensor values.		No		FU2 FU3
SS2	Predictive maintenance algorithms	Starting from indicator for the description of the mission profile (vehicle, engine and engine oil), define a “residual autonomy” in terms of mileage for a specific component (for ex. Engine oil replacement)		No		FU4 FU5
SS3	Ground Station DB	Collects data (vehicle mission profile indicators, engine mission profile indicators, engine oil mission profile indicators, component residual autonomy) for each vehicle of the fleet		No		FU10
SS4	Ground station Data miner	Elaborate data from the ground station DB and derive messages / info for: residual autonomy for each vehicle feedback about vehicle “correct” usage feedback about fleet mission profile feedback about typical component usage maintenance management (policy, day by day maintenance).		No		FU10

Table 24: Software / support systems (SSs) of the A4 PROMISE demonstrator

Note:
Predictive maintenance strategies = Strategies for Mission profiles indicator management (SS1) + Predictive maintenance algorithms (SS2)
Ground Station DSS = Ground Station DB (SS3) + Ground station Data miner (SS4)

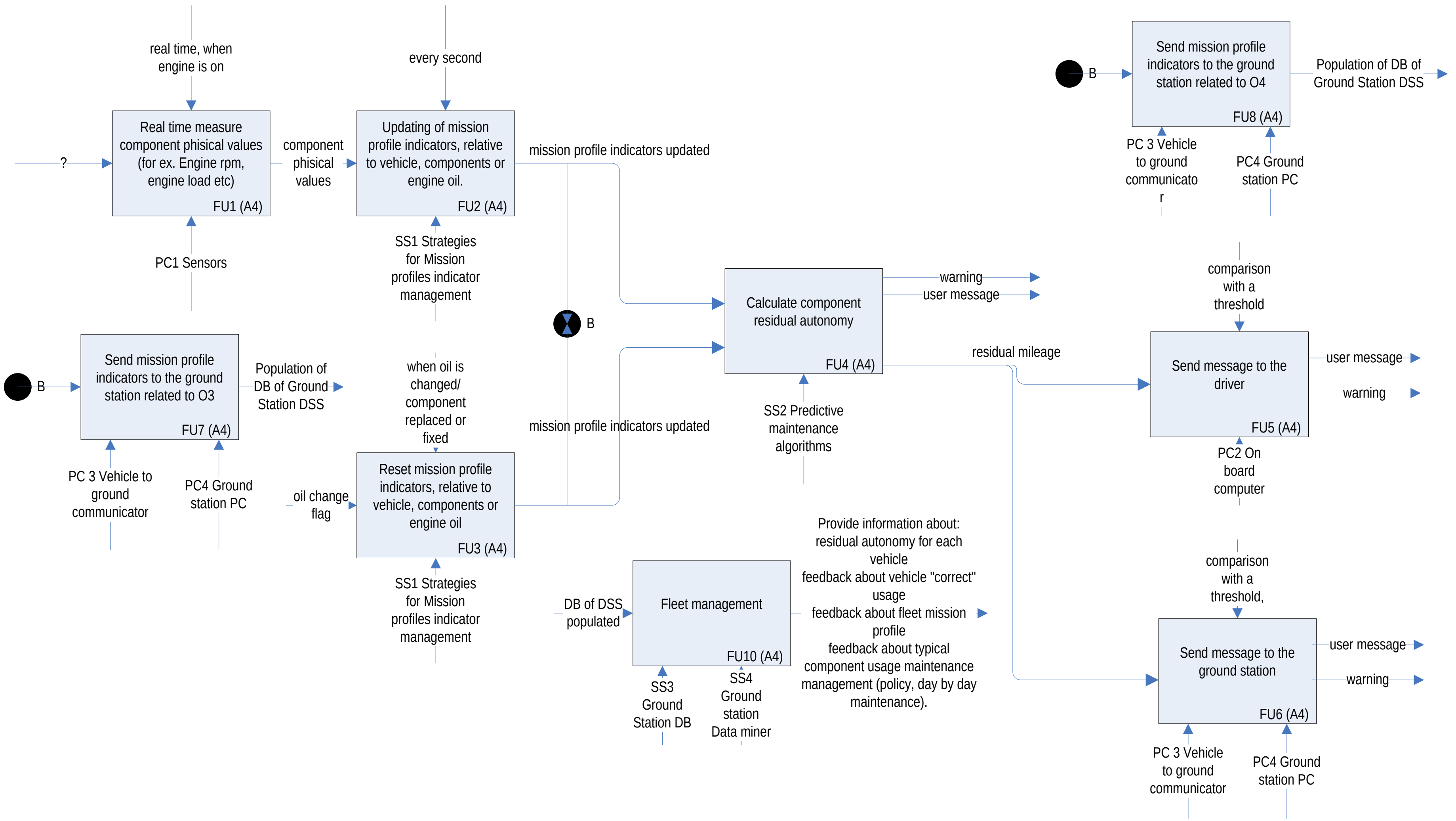
4.6 A4 – Description of the functionality (FUs) of the demonstrator

ID	Functionality	Comments to the functionalities	Define the inputs needed to achieve this functionality and relate the input to other FU IDs (e.g. output data from FU3)	Define the outputs from this functionality	What are the controls? ID the controls by using C1, C2 etc	Technologies/Physical components/Systems/Actors involved Describe the technologies involved, or assumed technology/systems needed	Rationale Describe why this functionality is needed	Priority High, Medium, Low	Related to objective ID (Sec 1.2)
FU1	Real time measure component phisical values (for ex. Engine rpm, engine load etc)		?	Component physical values	Real time, when engine is on	PC1		High	OB1
FU2	Updating of mission profile indicators, relative to vehicle, components or engine oil.		Physical values from sensors	Mission profile indicators updated	Every second	SS1		High	OB1
FU3	Reset mission profile indicators, relative to vehicle, components or engine oil		Oil change flag	Mission profile indicators updated	When oil is changed/ component replaced or fixed	SS1		Medium	OB1
FU4	Calculate component residual autonomy		Mission profile indicators	Residual mileage / user message / warning		SS2		High	OB1
FU5	Send message to the driver		Residual mileage	User message / warning	Comparison with a threshold	PC2		High	OB1
FU6	Send message to the ground station	See R1	Residual mileage	User message / warning	Comparison with a threshold	PC3, PC4		Medium	OB2
FU7	Send mission profile indicators to the ground station	See R2	Mission profile indicators	Population of DB of Ground Station DSS	See Ex. 1	PC3, PC4		Medium	OB3
FU8	Send mission profile indicators to the ground station	See R3	Mission profile indicators	Population of DB of Ground Station DSS	See Ex. 2	PC3, PC4		Medium	OB4

ID	Functionality	Comments to the functionalities	Define the inputs needed to achieve this functionality and relate the input to other FU IDs (e.g. output data from FU3)	Define the outputs from this functionality	What are the controls? ID the controls by using C1, C2 etc	Technologies/Physical components/Systems/Actors involved Describe the technologies involved, or assumed technology/systems needed	Rationale Describe why this functionality is needed	Priority High, Medium, Low	Related to objective ID (Sec 1.2)
FU10	Fleet management		DB of DSS populated	Provide information about: residual autonomy for each vehicle feedback about vehicle "correct" usage feedback about fleet mission profile feedback about typical component usage maintenance management (policy, day by day maintenance).		SS3, SS4		Medium	OB4

Table 25: Functionalities (FUs) of the A4 Demonstrator

4.7 A4 – Draft illustration of the demonstrator's functionalities



PROMISE Demonstrator A5
Caterpillar (MOL)

Written by:
Howard W. Ludewig Caterpillar Inc.
Updated by:
Tonya A.T. Garrett Caterpillar Inc

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11.04.2005	0.2	Carl Christian Røstad	Updated structure based on input from the Munich meeting on the 11.-12. April 2004. The version was sent SAP, EPFL, BIBA, STOCKWAY and INFENEON for comments before distribution.
08.04.2005	0.2	Howard W. Ludewig	Draft write up
26.04.2005	0.3	Tonya A.T. Garrett	Updated
28.04.2005	0.4	Tonya A.T. Garrett	Split into 2 documents: **MOL** & EOL
05.05.2005	1.0	Carl Christian Røstad	Updated structure of the document and added draft illustration of functionalities

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5 A5 CATERPILLAR (MOL) – Definition of the demonstrator

5.1 A5 – The Demonstrator

Demonstrator	Describe functionality	Describe why this Demonstrator is focused in PROMISE
Grenoble Track Type Loader (TTL) The demonstrator will be applied to the lift arm.	The demonstrator aggregates all kind of field data, product specific information, and additional information and transforms it – supported by decision support system – into knowledge that can be used to take productive and effective actions. The data must be accessible by the supply chain in a PDKM system.	This demonstrator covers the closure of information loop between product operation (MOL) and product recycle, reuse, remanufacture or disposal (EOL). However, to effectively impact these focus areas the demonstrator will also have to close the loop with manufacturing and design (BOL).

Table 26: The PROMISE MOL demonstrator

5.2 A5 – Objectives (OBs) of the Demonstrator

ID	Objective (one per ID)	Describe why
OB1	Primary objective: Prove the closure of information loop between information related to field application embedded in field data and knowledge required to manage the field population.	This demonstrator covers the closure of information loop between product operation (MOL) and knowledge-based actions.
OB2	Demonstrator shall aggregate available engineering data, field data, and ancillary information.	All required information and data will be used to manage the field population, including maintenance and logistics, (MOL) as well as making decisions.
OB3	Use product embedded devices such as RFID to track components and automatically maintain related data linkages such that it can be transformed into the required knowledge.	This provides a decision making process for MOL that is based on knowledge of the entire field population.

Table 27: Objectives (OBs) of the A5 PROMISE demonstrator

5.3 A5 – Involved actors (ACs) in the whole lifecycle of the Demonstrator

ID	**Actor**	**External / Internal**	**Describe how they will be involved, their role and impact of the PROMISE technology**	**Importance / Relevance** High, Medium, Low	**BOL**	**MOL**	**EOL**
AC1	Product Design	Internal	Optimize designs and support Dfx	M	X		
AC2	Manufacturing	Internal	Optimize manufacturing processes and forecasting build	H		x	
AC3	Dealers	External	Field support and maintenance	H			
AC4	Owner Operators	External	Work site management	H			
AC5	Suppliers	External	Forecasting product needs	H			
AC6	Logistics	Internal/External	Forecasting and tracking	H			

Table 28: Involved lifecycle actors (ACs) of the A5 PROMISE demonstrator

5.4 A5 – The demonstrator physical components (PCs)

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
OS1	Structural Component - Lift Arm of TTL product	Working component lifting loads (MOL)	Sensor will be physically attached in the lift arm.	The physical component (lift arm) already exists on a TTL, but no sensors are used today. .	Maximize use of lift arm (remaining life measured, not estimated) , develop preventive maintenance MOL, reduce risk of component failure, increase user safety working conditions,	FU 1 Data acquisition FU 2 Data transfer, FU 3Data management FU 4 preventive actions
OS2	Sensor	Sense the remaining life of OS1	A method to communicate sensor data in the PDKM system needs to be determined.	The mentioned sensor is under development at another company and must be obtained.		

Table 29: Physical components (PCs) of the A5 PROMISE demonstrator

5.5 A5 – The demonstrator software/support-systems (SSs)

ID	Software / support system	Describe its functionality	Describe the necessary interfaces of this software/support system to other PC IDs, SS IDs etc	Is this software / support system already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to the Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
SS1	Data acquisition system for sensors	Capture data from sensor and store it	Sensor software reader (wireless system)	Software is not available at CAT. It should be provided by another company to be used	Capture data from field application during MOL product	FU1
SS2	Data management system	To transform data on information	Transform data on stress range application	Software will be used to transform information into decision SS3 Software is not available. It should be hire to be used	Transform data into information during MOL product	FU2
SS3	Data management system	Transform information into decision	Transform stresses ranges into fatigue life calculation	Software should transform information into fatigue life prediction in order to evaluate residual life of the component during MOL Software is not available at CAT. It should be provided by external company to be used	Transform information into knowledge in order to develop preventive maintenance	FU3
SS4	PDKM	Transform decision into action	Transform result of calculation into action to applied preventive maintenance	Software should transfer decision in order to define action for preventive maintenance through MOL actors (dealers, users,… Software should be developed	Application of preventive maintenance on Ids product.	FU4

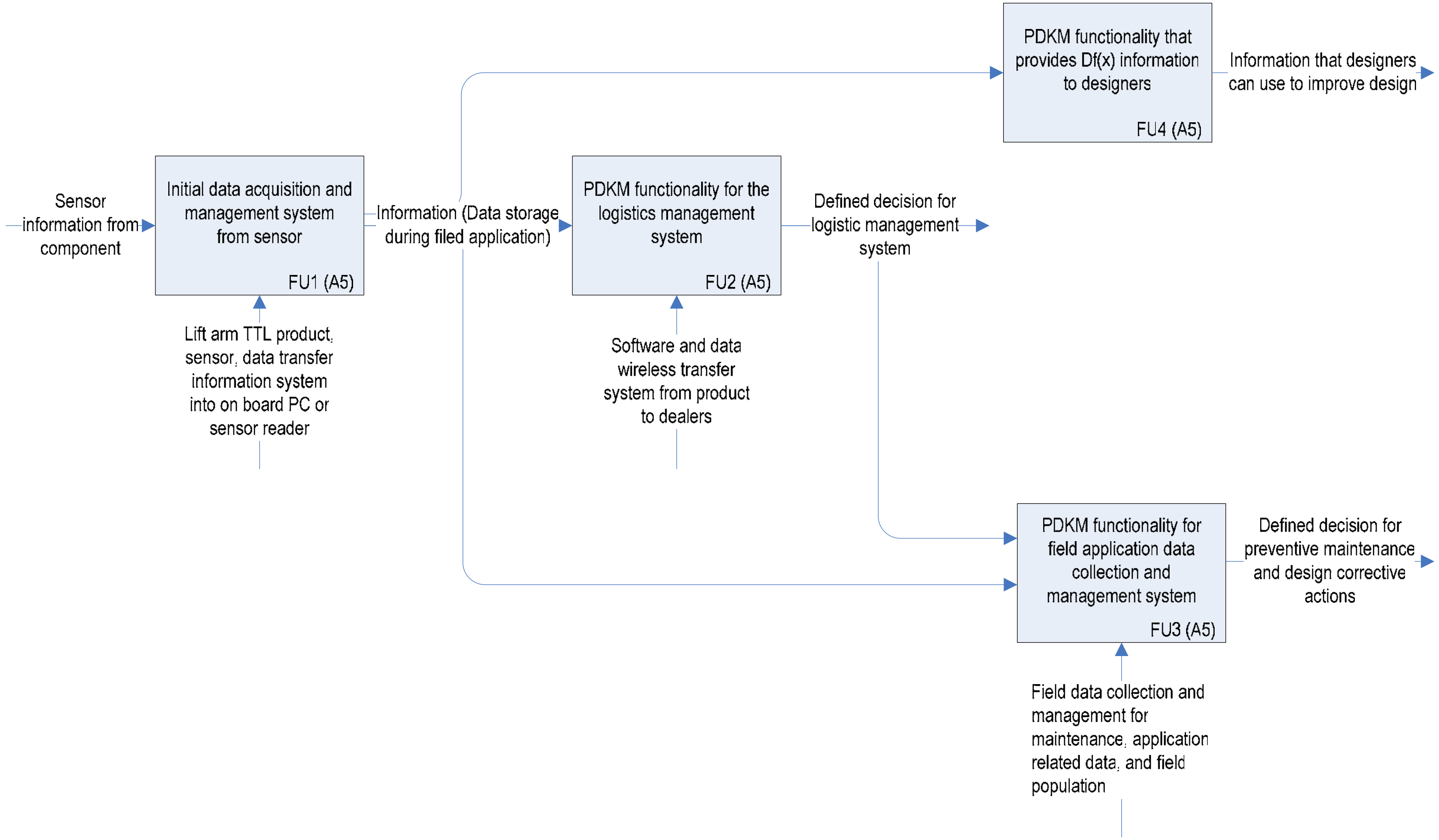
Table 30: Software / support systems (SSs) of the A5 PROMISE demonstrator

5.6 A5 – Description of the functionality (FUs) of the demonstrator

ID	Functionality	Comments to the functionalities	Define the inputs needed to achieve this functionality and relate the input to other FU IDs (e.g. output data from FU3)	Define the outputs from this functionality	What are the controls? ID the controls by using C1, C2 etc	Technologies/Physical components/Systems/Actors involved Describe the technologies involved, or assumed technology/systems needed	Rationale Describe why this functionality is needed	Priority High, Medium, Low	Related to objective ID (Sec 1.2)
FU1	initial data acquisition and management system from sensor	Flexible and user configurable Intuitive user interface that is automated where possible.	Sensor information from component	Data storage during filed application		Lift arm TTL product, sensor, data transfer information system into on board PC or sensor reader	This function provides the data needed for field replacement and remanufacturing	H	0B3 ; 0B2
FU2	PDKM functionality for the logistics management system	Flexible and user configurable Intuitive user interface that is automated where possible.	Information output from FU1	Define decision for logistic management system		Software and data wireless transfer system from product to dealers	This function provides for a logistic system that can forecast need based on field population and failure data	H	0B2; 0B1
FU3	PDKM functionality for field application data collection and management system	Flexible and user configurable Intuitive user interface that is automated where possible.	Information output from FU1, FU2	Define decision for preventive maintenance and design corrective actions		Field data collection and management for maintenance, application related data, and field population. Provides feedback knowledge to design and manufacturing relative to field applications.	This provides the functionality to track components through the life of a product. This capability includes: Component life Repair Maintenance Application severity Field population	H	0B1
FU4	PDKM functionality that provides Df(x) information to designers	?	Information from FU1	Information that designers can use to improve design					0B1

Table 31: Functionalities (FUs) of the A5 Demonstrator

5.7 A5 – Draft illustration of the demonstrator's functionalities



PROMISE Demonstrator A6
FIDIA (MOL)

Written by:
Daniele PANARESE, FIDIA
Michele SURICO, FIDIA

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27.04.2005	0.3	Fabrizio MEO	
05.05.2005	1.0	Carl Christian Røstad	Updated structure of the document and added draft illustration of functionalities

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6 A6 FIDIA (MOL) – Definition of the demonstrator

6.1 A6 – The Demonstrator

Demonstrator	Describe functionality	Describe why this Demonstrator is focused in PROMISE
Milling machine	Milling is the process of cutting away material by a rotating cutter. Fidia Milling Machines are integrated systems for the machining of complex forms for the moulds and dies industry. Milling systems are made up of multiple mechanical axes moved by electric drives that are able to translate and rotate the milling head in the workspace. The milling head is made up of a rotating spindle equipped by a set of many different machining tools that allow the realization of various and complex forms. The milling systems are controlled by a numerical control.	This demonstrator is related to the improvement of technical aspects of the product functionalities after exploiting field knowledge gathered through the product lifecycle.

Table 32: The A6 PROMISE demonstrator

6.2 A6 – Objectives (OBs) of the Demonstrator

ID	Objective (one per ID)	Describe why
OB1	Traceability of components	The components do not reside on the same machine throughout their lifecycle. Often after a repair intervention a fixed component is re-installed on a different machine. It would be highly desirable to keep track of the 'history' and the characteristics of the components installed on each machine because knowing their exact features makes easier the technical interventions.
OB2	Predictive Maintenance	We can get useful information about the components state performing periodic checks on the machine. Storing this data enables statistical analysis of the components lifecycle, such as finding the relation between the wear and the failure rate. This can help to single out the machines failure causes, allowing the optimization of the technical interventions and thus minimizing machine unavailability.
OB3	Design improvement	The constant improvement of the machine design is essential to offer the customers products more fitting to their requirements. Also a better components design can allow easier technical interventions.

Table 33: Objectives (OBs) of the A6 PROMISE demonstrator

6.3 A6 – Involved actors (ACs) in the whole lifecycle of the Demonstrator

ID	Actor	External / Internal	Describe how they will be involved, their role and impact of the PROMISE technology	Importance / Relevance High, Medium, Low	BOL	MOL	EOL
AC1	Design department	Internal	OB1 and OB2 allow to gather data on the state of each machine critical component. The design department will receive the feedback, perform statistical analysis on this data and keep track of the overall components performance. This knowledge will be exploited to manufacture better machines (OB3).	High	X		X
AC2	Technical assistance service	Internal	OB1, OB2 and OB3 allow to increase the quality of technical assistance. The Promise technology could help to: 1) restrict the field of failure causes (thus making easier the assistance interventions) 2) suggest the best replacements parts for each technical intervention	High		X	
AC3	Customer	External	For the time being a failure on a milling machine implies the sudden interruption of the manufacturing process (with the consequent loss of production) and the intervention of a technician to fix the machine The development of each and every objective would greatly: 1) reduce the customer's related costs 2) extend the milling machine lifecycle	High		X	

Table 34: Involved lifecycle actors (ACs) of the A6 PROMISE demonstrator

6.4 A6 – The demonstrator physical components (PCs)

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
PC1	Computerized Numerical Control (CNC)	CNC is the interface between the mechanical machine and the human user. The CNC controls the motion of the mechanical axes.	CNC is installed on the milling machine. It runs a Windows or Linux operative system (SS2). It reads data from sensors (PC4). It will read data from RFIDs (PC3).	This component is already available	The Predictive Maintenance Tool (SS4) that will be developed in order to gather, elaborate and manage data coming from the A/P RFIDs installed on the machine will run on the CNC. This is essential for OB2 and OB3.	FU1
PC2	Mechanical axis	A milling machine is made up of multiple mechanical axes moved by electric drives that translate and rotate the milling head in the workspace to allow the machining of complex moulds.	Mechanical axis is made up by servodrive, electrical drive, encoder, screw (PC7), nut (PC6), bearings (PC5). Its motion is controlled by CNC (PC1). Position sensors (PC4) are installed on mechanical axis.	Components available.	OB1 and OB2 reserve particular attention to the critical components of the mechanical axis (e.g. nuts, bearings, screws).	FU3
PC3	RFIDs	RFIDs will store the configuration of the electronic boards (firmware version, updating, etc.) and data about the machine installed critical components (type, batch number, fixing interventions, etc.).	Wireless communication up to 5 meters of distance with the CNC (PC1) Read/write operations with the CNC (PC1) to upload or download data about components.	Component not available. It will be available in PROMISE project.	It would be highly desirable that RFIDs could follow the components during their life (OB1), thus allowing the Predictive Maintenance Software Tool (SS4) to work correctly (OB2).	FU1, FU2, FU3

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
PC4	Sensors	Position sensors on milling machine retrieve the position of the milling head in the workspace. Temperature sensors monitor temperature inside the working area of the machine.	Wire communication with CNC (PC3). Data from sensors will be elaborated by Predictive Maintenance Software Tool (SS4).	Position transducers and temperature sensors are already in use. Accelerometers are possible future sensors if needed by Predictive Maintenance Tool (SS4) development.	Sensors as well as RFIDs (see above) represent the product embedded devices from which field data is gathered in order to develop a life cycle management (OB2).	FU3
PC5	Bearings	Components designed to reduce friction between moving parts.			Critical components for OB1 and OB2	FU2, FU3
PC6	Nut	Component designed to convert rotative motion in linear motion			Critical components for OB1 and OB2	FU2, FU3
PC7	Screw	Component designed to transmit motion between electrical motor and mechanical axis			Critical components for OB1 and OB2	FU2, FU3
PC8	Electronic boards	Electronic boards elaborate signals and data	Are installed in slots on CNC (PC1) but also on the rack of the milling machine. It is needed to install RFIDs (PC3) on these components. Information regarding these components will be managed in Backend software (SS1)		The objective OB1 will allow the traceability of the Numerical Control electronic boards.	FU2, FU3
PC9	Central PC	Central PC (located at Technical Assistance Service Department in the Builder Site) will host the Backend software (SS1). It will provide product lifecycle management.	Remote connection is possible between Central PC and local CNC (PC1).	Point to point remote connection is available at the Technical Assistance Service. It will be evaluated the opportunity (e.g. security issues) to develop Internet communication.	All the data required for OB1 will be stored in the Central PC.	FU2, FU3

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
PC10	RFIDs receivers	Receive data for the CNC (PC1) from RFIDs (PC3).	Wireless communication up to 5 meters of distance with RFIDs (PC3). Standard connection (PCI bus, Serial, USB, etc…) to CNC (PC1).	Component not available. It will be available in PROMISE project.	It is needed to allow communication between the RFIDs and the CNC.	FU1, FU2, FU3

Table 35: Physical components (PCs) of the A6 PROMISE demonstrator

6.5 A6 – The demonstrator software/support-systems (SSs)

ID	Software / support system	Describe its functionality	Describe the necessary interfaces of this software/support system to other PC IDs, SS IDs etc	Is this software / support system already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to the Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
SS1	Backend software	This will be the PLM system. Backend SW must be able to perform statistical analysis on components data collected from several monitored machines. This will improve the knowledge about the product.	Backend software will run on central PC (PC9). Backend software will be remotely connected to local CNC (PC1) by a point to point modem connection or the internet.	When available, this SW will run on the central PC at technical assistance department. It will be based mainly on database application.	It provides feedback to the design department useful to understand the components lifecycle and to identify defective series (OB3). It also keeps track of all the components history (OB1).	FU2
SS2	Operative system	The demonstrator is equiped with a computer running Windows or Linux operative system.	It is the interface for all the SW modules.	It is already available.	It is the background for the Predictive Maintenance Software Tool	FU2, FU3
SS3	RFIDs-CNC Interface	It will allow the receiver antenna (PC10) to communicate with the CNC.	Driver interface (e.g. ActiveX, dll).	It must be provided with the RFIDs. It should be a SW application allowing communication between RFIDs and CNC.	Needed for all objectives.	FU1
SS4	Predictive Maintenance Software Tool	It must collect data periodically (e.g. every 3 months) from sensors and transform them into information and knowledge. Decision support will be required at this step.	This module will run on local CNC (PC1), take data from sensors (PC4), elaborate incoming data (SS4).	To be developed (e.g. Visual C++ application). Periodically it will execute standard test (already available) and gather data to transform into knowledge (this will be developed in PROMISE project) about installed components state from (already known) relevant parameters.	It allows OB2 (predictive maintenance) and OB3 (design improvement).	FU3

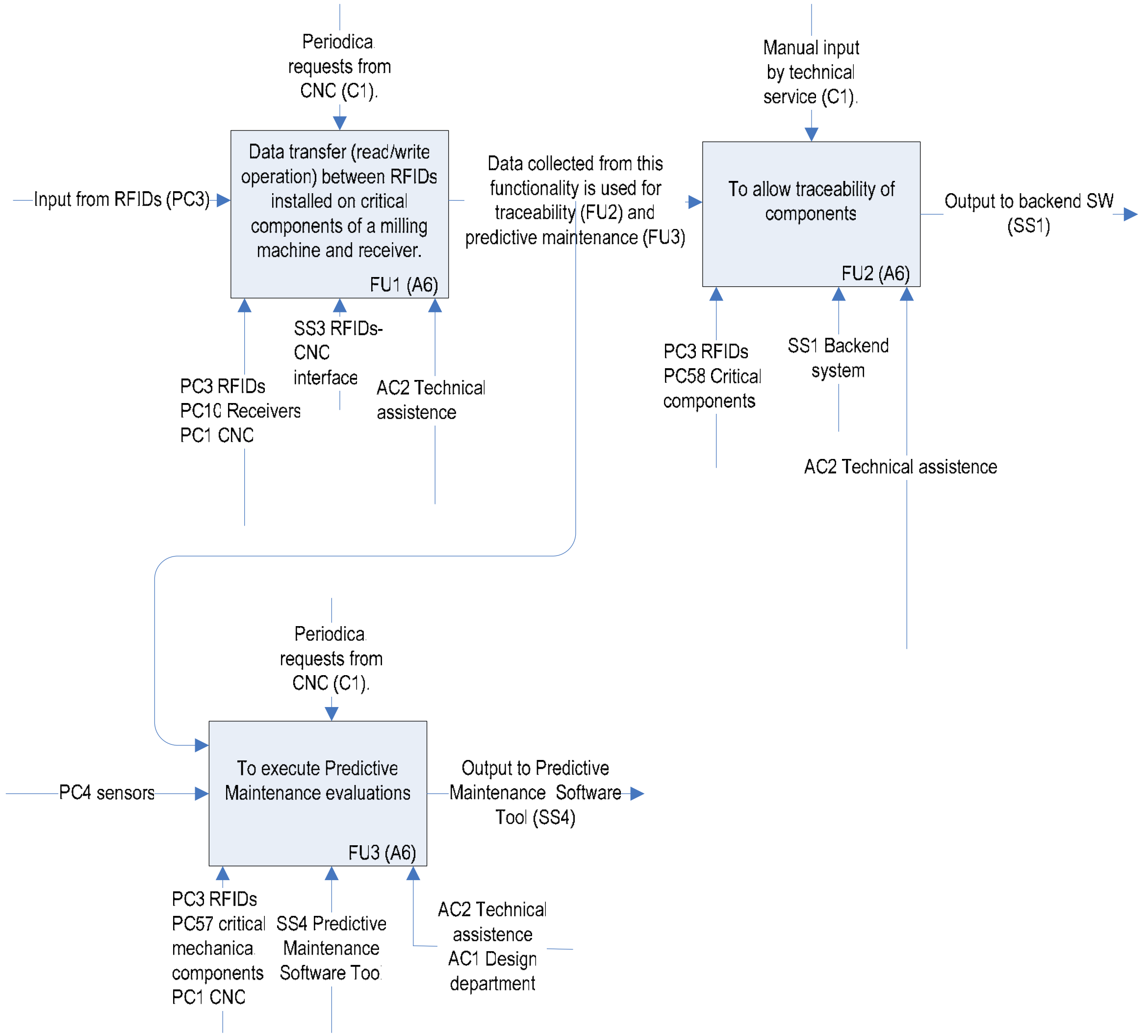
Table 36: Software / support systems (SSs) of the A6 PROMISE demonstrator

6.6 A6 – Description of the functionality (FUs) of the demonstrator

ID	Functionality	Comments to the functionalities	Define the inputs needed to achieve this functionality and relate the input to other FU IDs (e.g. output data from FU3)	Define the outputs from this functionality	What are the controls? ID the controls by using C1, C2 etc	Technologies/Physical components/Systems/Actors involved Describe the technologies involved, or assumed technology/systems needed	Rationale Describe why this functionality is needed	Priority High, Medium, Low	Related to objective ID (Sec 1.2)
FU1	Data transfer (read/write operation) between RFIDs installed on critical components of a milling machine and receiver.	The data transfer should be periodical (e.g. every three months).	Input from RFIDs (PC3)	Data collected from this functionality is used for traceability (FU2) and predictive maintenance (FU3)	Periodical requests from CNC (C1).	Components involved: RFIDs (PC3), receivers (PC10), CNC (PC1). Actors involved: technical assistence (AC2). Technology: RFIDs-CNC interface (SS3).	This functionality is needed to exchange data between transmitter antenna and receiver antenna. CNC should be able to read data from and write data on RFIDs.	High	OB1 and OB2
FU2	To allow traceability of components.	RFIDs should store technical data (e.g. from data sheets) about the installed components. Moreover the RFIDs should collect data of all the technical assistence interventions performed on each component.	Input from (FU1)	Output to backend sw (SS1)	Manual input by technical service (C1).	Components involved: RFIDs (PC3), critical components (PC5÷8). Actors involved: technical assistence (AC2). Technology: backend system (SS1).	This functionality is needed to gain traceability of the machine parts.	High	OB1
FU3	To execute Predictive Maintenance evaluations.	The decision support software gathering data from RFIDs should run locally on the PC of the Numerical Control. This SW should: 1) perform suitable tests on the machine 2) elaborate data and extract relevant parameters 3) make decisions based on these parameters.	Input from (FU1), sensors (PC4)	Output to Predictive Maintenance Software Tool (SS4)	Periodical requests from CNC (C1).	Components involved: RFIDs (PC3), critical mechanical components (PC5÷7), CNC(PC1). Actors involved: technical assistence (AC2), design department (AC1). Technology: Predictive Maintenance Software Tool (SS4).	System must be able to handle data and information from RFIDs in order to allow predictive maintenance operations.	High	OB2, OB3

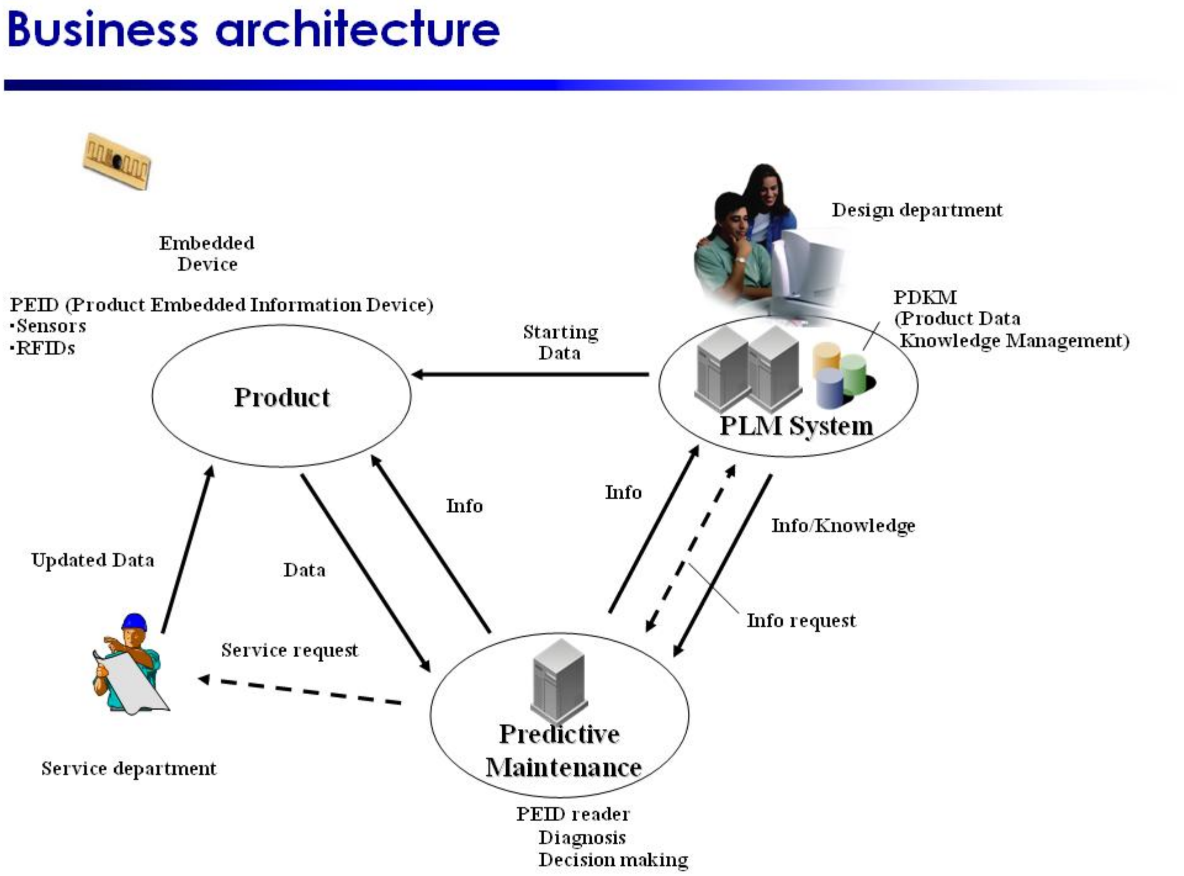
Table 37: Functionalities (FUs) of the A6 Demonstrator

6.7 A6 – Draft illustration of the demonstrator's functionalities

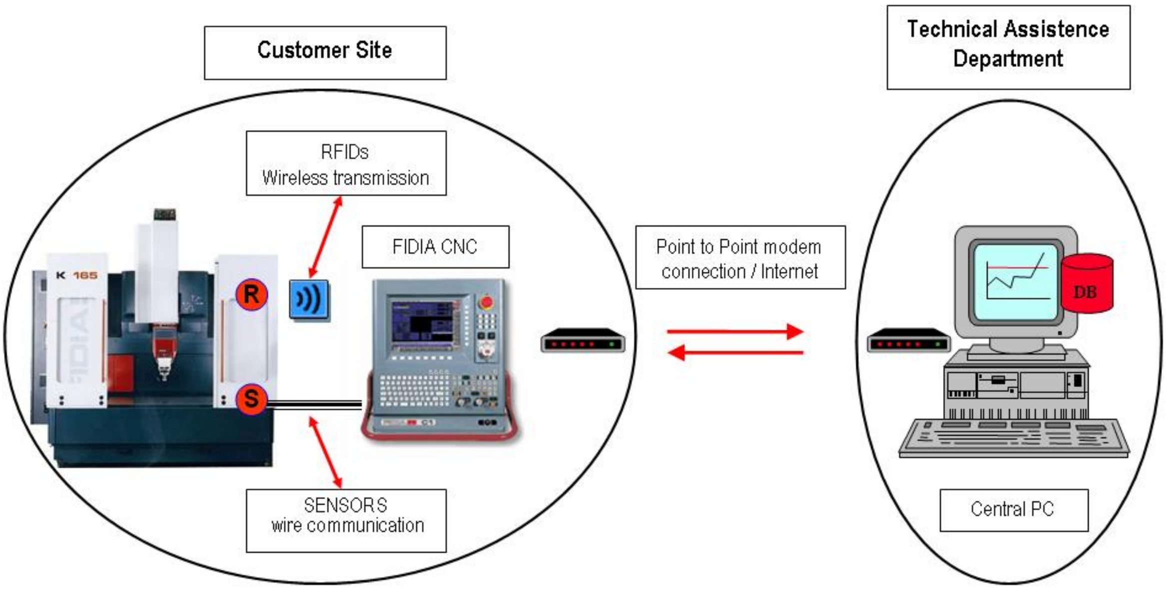


6.8 A6 – Additional information related to the business, hardware, software and network architecture of the FIDIA demonstrator

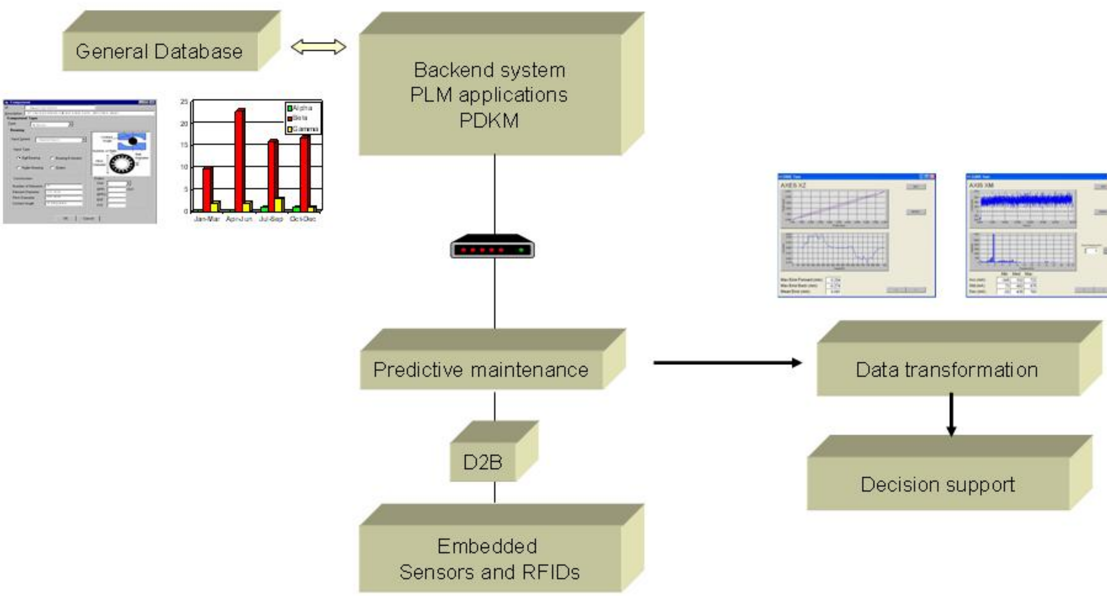
In this section, the demonstrators added other relevant information related to the Demonstrator not already covered. Each Demonstrator was free to form this section as needed and this section can e.g. serve as a reminder for the WP Ax (and other WPs) when these start.



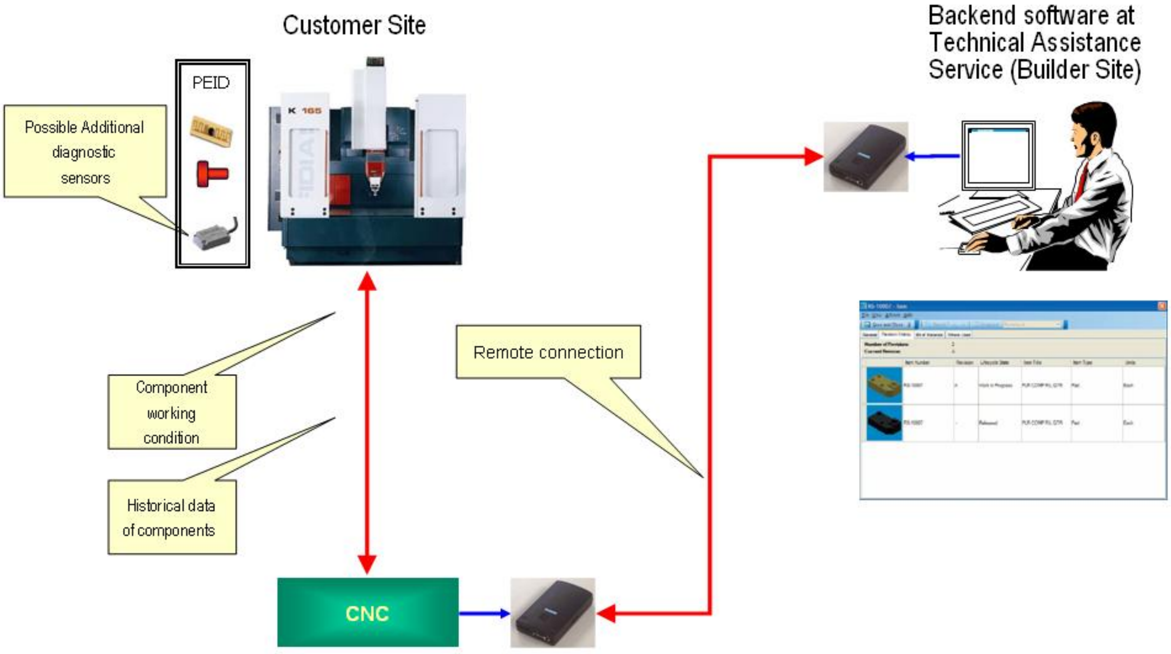
Hardware architecture



Software architecture



Network architecture



PROMISE Demonstrator A7
MTS (MOL)

Written by:
Lorenzo Marra, MTS

DELIVERABLE NO	Relates to DR3.2: PROMISE Demonstrator WP A7
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11.04.2005	0.2	Carl Christian Røstad	Updated structure based on input from the Munich meeting on the 11.-12. April 2004. The version was sent SAP, EPFL, BIBA, STOCKWAY and INFENEON for comments before distribution.
27.04.2005	V 00	Marra Lorenzo	Previous document as been rewritten in order to adapt to this new template.
05.05.2005	1.0	Carl Christian Røstad	Updated structure of the document and added draft illustration of functionalities

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7 A7 MTS (MOL) – Definition of the demonstrator

7.1 A7 – The Demonstrator

Demonstrator	Describe functionality	Describe why this Demonstrator is focused in PROMISE
Condensing wall hung gas boilers	max power output 27KW for domestic application, with both Central Heating and Domestic hot water production.	Improving maintenance and service operations related to boilers and as a result increase performance and up-time of boilers, and thus achieve customer satisfaction. MTS is focusing on gas boilers, and especially the condensing ones, as these are the products that will have the biggest market-share in the future, as they have the highest efficiency and lowest emission. MTS is therefore interested in studying predictive maintenance on these boilers, in order to improve MOL operation on products that will be amongst the most imporant MTS products in the future.

Table 38: The A7 PROMISE demonstrator

7.2 A7 – Objectives (OBs) of the Demonstrator

ID	Objective (one per ID)	Describe why
OB1	To systematically collect and store the data relevant to the application and to apply **evolutionary diagnostic** and **prognostic algorithms** over the product lifespan (**MOL**), which will let be possible to do **"Predictive Maintenance"** on gas boilers.	Prognostic algorithms will enable Service Companies to do **"Predictive Maintenance"** on gas boilers. Prognostic algorithms, by analyzing continuously data acquired from PEID (developed for MTS's specific demonstrator by RC2, in WP R4 and R5) from demonstrator (gas boiler), must be able to recognize that a specific component or system is going to have a failure in a certain time span and with a certain probability percentage. The Service Companies will then have the time to plan a visit to the boiler's owner bringing with them the right spare part, before the component breaks down, and so the owner will have 100% boiler availability, not suffering from a cold house.
OB2	Test the **PEID,** developed under MTS specifications by RC2, in WP R4 and R5, on the gas boilers, in order to assess its capability to collect data from boiler serial protocol and from additional sensors, store and transmit data with long distance communication capability	The bigger obstacle to the introduction in each boiler of a data logging/analysis/shipment system (PEID) to a remote collecting point (PLM/PDKM/decision making support system) is mainly the cost of the PEID. The target price for PEID will be reached when every house will have and IP connection already available. In Promise project the goal is to prove the concept.
OB3	Test the **back-end, PDKM, PLM, DSS,** developed in RC-3 and RC-4 according MTS demonstrator needs, to prove that it is able to handle all data coming from PEID, analyze it through predictive algorithms, send e-mail to Service Companies to advise of a predicted failure, with a **WEB** interface accessible by Service Company/MTS who can see list of all errors, make graphs of data, set parameters like e-mail, dial the PEID and see real time values of all data/sensor logged from the boiler, and download to a local PC in xls format from the PDKM through a web interface all data	The goal is to handle info on MOL from the source of data (PEID connected to the boiler and to additional sensors), to analyze it (predictive algorithm) and to let the users (Service Companies and MTS) to access this info, for predictive maintenance.

ID	Objective (one per ID)	Describe why
	received from PEID and all info generated by data analysis (e.g. trends of Predictive maintenance indicators). It must also be accessible to boiler manufacturer for changing parameters needed to tune predictive algorithms.	

Table 39: Objectives (OBs) of the A7 PROMISE demonstrator

7.3 A7 – Involved actors (ACs) in the whole lifecycle of the Demonstrator

ID	Actor	External / Internal	Describe how they will be involved, their role and impact of the PROMISE technology	Importance / Relevance High, Medium, Low	BOL	MOL	EOL
AC1	Service Companies	External	Service Companies have Service Contracts with boiler's owners. If they can be advised in advance that a specific component is going to have a failure (thanks to predictive algorithms) they can visit the boiler's owner and replace the component which is going to break down. So they can do **Predictive Maintenance**. Their work will also be more efficient, as they now in advanced what to do on a certain boiler, not making anymore repairing error, in other words, avoiding to replace a component which is perfectly working because the Service Engineers was not able to identify the problem occurred.	High		X	
AC2	Boiler's owners	External	Thanks to **Predictive Maintenance**, the boiler's owner can receive from Service Companies an higher service level, having the gas boiler always available, never suffering from cold house and cold Domestic Hot Water	High		X	
AC3	MTS After sale service	Internal	MTS could provide to Service Companies an "advanced service tool", which is the Predictive Maintenance information, under the payment of a certain e.g. "yearly fee", and can decrease the amount of component replaced by error during warranty period	High		X	

Table 40: Involved lifecycle actors (ACs) of the A7 PROMISE demonstrator

7.4 A7 – The demonstrator physical components (PCs)

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
PC1	Gas boiler	Produce heat for central heating and domestic hot water	The gas boiler has control board in which a serial protocol is available. This serial protocol is a source of data related to all sensors/actuators present in the boiler and of data related to boiler status. This serial protocol must be implemented in the PEID so it can log the data contained in it. So PC1 is connected to PC6 (PEID)	Yes, it is available. It is a standard MTS product, available in warehouse. **No modification on the MTS standard boiler must be done**, not to affect boiler safety. PEID and additional sensors will be plugged outside the boiler.	OB1, OB2 and OB3	FU1
PC2	Heating circuit	To distribute hot water generated from gas boiler to heating system (radiators, floor-heating system,…)	-PC1, as the boiler is connected to heating circit; -PC7 (additional sensors) as some sensors will surely connected to the heating circuit (e.g. pressure sensor, flow sensor, temperature sensors,…)	Yes, it is available as the boiler needs it to be installed.	If the water pressure in the Heating circuit is below a threshold (e.g. 0.7 bar) the boiler will go in lock-out. Now the boiler is equipped with a pressure stat, whose switch status (open/closed) is read by boiler control board. If the water pressure is lower than 0.7 bar the contact will open and the control board will generate a lock out. In PROMISE we want the PEID to collect/analyze/ship to PLM the pressure measured from an additional pressure sensor in order to understand if the pressure is decreasing (e.g. owing to a leakage) and before it reaches the	FU1

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
					threshold generates a Predictive alarm. The relation to the objective is **OB O1 (PREDICTIVE MAINTENANCE)**	
PC3	Flame detection system	It is build of electrode rod placed in the flame, connection cable to boiler control board, in which a circuit compares the flame signal to a threshold. Its function is to determine if, after the ignition sequence took place, the burner is really lit and so the flame is present, avoiding unburned gas to come out. If the flame signal is over the threshold the gas valve is kept open otherwise it is closed and a lock-out is generated.	The signal form flame detection system is available from MTS serial protocol already present in MTS boiler control board. The interface is to the PEID which must implement MTS serial protocol from which it can log, store and transmit data related to flame signal The PC3 is interfaced to PC6 (PEID) through MTS serial protocol	This physical component is built in the boiler (PC1)	At the moment we use the flame signal in an ON/OFF way, to determine if the flame is present/not present, but we know that the flame detection system has a degradation that lowers very slowly the flame signal down until it is under the threshold and the boiler goes into lock-out. The goal is to identify which are indicators able to detect the degradation and make a prediction of when the signal will go under the threshold. If a Service company will be advised by e.g. e-mail of this prediction he can plan in advance a visit to the customer in order to replace the degraded component in the chain (to be assessed which one it is) with a new one. The relation to the objective is **OB O1 (PREDICTIVE MAINTENANCE)**	FU1
PC4	Pump	To let water circulate through heating circuit (primary circuit)	Status of the pump can be retrieved from MTS serial protocol already present in MTS boiler control board. The interface is to the PEID which must implement MTS serial protocol from which it can log, store and transmit data related to the pump. The PC4 is interfaced to: -PC6 (PEID) through MTS	This physical component is built in the boiler (PC1)	The pump component can degrade in different way and, at the end, it can happen that the pump is completely stuck, or rotates too slow or the motor and the impeller and linked anymore by the axis. It can also happen that, owing to air bubbles the impeller rotates in air and doesn't generate water circulation. The goal is to identify which are indicators (current, Voltage, cos Φ, pressure increase after pump start, flow rate generated,…) able to	FU1

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
			serial protocol -PC7 (additional sensors) as some additional sensors will have to measure info related to pump (e.g. current, voltage and cos Φ)		detect the degradation , and via predictive algorithms, predict the failure letting Service Company to do Predictive maintenance. The relation to the objective is **OB O1 (PREDICTIVE MAINTENANCE)**	
PC5	Domestic Hot water heat exchanger	To exchange heat from primary circuit water to secondary circuit water (**D**omestic **H**ot **W**ater, **DHW**)	Information related to DHW temperature, and Flow and Return temp of primary circuit can be retrieved from the serial protocol already present in MTS boiler control board. The interface is to the PEID (PC6) which must implement MTS serial protocol from which it can log, store and transmit data related to DHW exchanger. The interface is also to PC7 (additional sensors) as some additional sensors will have to measure info related to DHW function (e.g. temperature of cold inlet water, water flow,….)	This physical component is built in the boiler (PC1)	It is a plated heat exchanger, and so it performances is degraded by limestone which will depot on the plates surfaces, thus decreasing the heat exchange factor. When the limestone layer on the plate gets too high, the boiler will work in DHW with very frequent cycling (ON/OFF) and the user will notice the DHW temperature also cycling from too hot to too cold. Then the user has to call Service Company which will replace the DHW exchanger with a new one. The goal is to identify which are indicators to detect the degradation process and predict when the limestone will get so big to let boiler cycling ON/OFF. .If a Service company will be advised by e.g. e-mail of this prediction he can plan in advance a visit to the customer in order to replace the DHW heat exchanger. The relation to the objective is **OB O1 (PREDICTIVE MAINTENANCE)**	FU1

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
PC6	PEID	Read data from MTS serial protocol and from additional sensors, log them and transmit to PLM/PDKM/DSS. Additional sensors and what data to be logged will be defined together with partners involved in predictive maintenance algorithm	PC6 (PEID) has interface to: -PC1 boiler (in particular to boiler control board serial protocol, already present in MTS boiler and that must be implemented by PEID); -PC7 additional sensors, as they are needed to collect data relevant to predictive maintenance on PC1, PC2, PC3, PC4 and PC5 -SS2, as data collected must be sent to PLM/PDKM/DSS for predictive maintenance purpose	No, it is not available. PEID, both its hardware and its software (e.g. protocol for exchange data to PDKM/PLM/DSS, software to log and store data,…) will be developed in RC2	OB1, OB2 and OB3	FU1 and FU2
PC7	Additional sensors	Additional sensors to be logged by the PEID and installed externally to the boiler will be defined together with partners involved in predictive maintenance algorithm	PC6: additional sensors output are collected by PEID; PC1 PC2, PC3, PC4, PC5: additional sensors will be connected to physical component for measuring data relevant for predictive maintenance on them.	Some sensors can be found in standard market other should be developed inside the PEID (e.g. circuit to measure Voltage, current and Cos Φ of the boiler)	The relation to the objective is **OB O1 (PREDICTIVE MAINTENANCE)**	FU1

Table 41: Physical components (PCs) of the A7 PROMISE demonstrator

7.5 A7 – The demonstrator software/support-systems (SSs)

ID	Software / support system	Describe its functionality	Describe the necessary interfaces of this software/support system to other PC IDs, SS IDs etc	Is this software / support system already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to the Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
SS1	WEB site	It is the way for Service Companies and MTS to access to all data received from the PEID through long-distance communication capability (e.g. list of all diagnostic event predicted on a certain boiler, see in a graphic way the trend of variables, indicators, sensors logged by the PEID and transmitted to the PLM/PDKM) set parameters like e-mail to which the predictive diagnostic event info is sent to, set parameters needed to tune predictive algorithms, dial the PEID attached to the boiler and see real time value of all data/sensors acquired. They can also download to a local PC in xls format from the PDKM through a web interface all data received from PEID and all info generated by data analysis (e.g. trends of Predictive maintenance indicators).	The WEB site must have an interface to **SS2**, as it will show on a web page data stored in PDKM database and predictive maintenance request generated by predictive algorithm and Decision Support System.	No, it is not available as it will be the Promise WEB site.	OB-03	FU3 and FU2

ID	Software / support system	Describe its functionality	Describe the necessary interfaces of this software/support system to other PC IDs, SS IDs etc	Is this software / support system already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to the Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
SS2	PDKM/Decision making support system/predictive algorithms	Store data coming from PEID; analyze them with predictive algorithm and generate failure prediction.	This must have an interface to **PC6 PEID** because the PDKM/Decision Support System/predictive algorithms must elaborate data coming from PEID.	No, it is not available as it will be result of the Promise project.	The related objective is ID OB 01 **(PREDICTIVE MAINTENANCE)** and OB3	FU3 and FU2

Table 42: Software / support systems (SSs) of the A7 PROMISE demonstrator

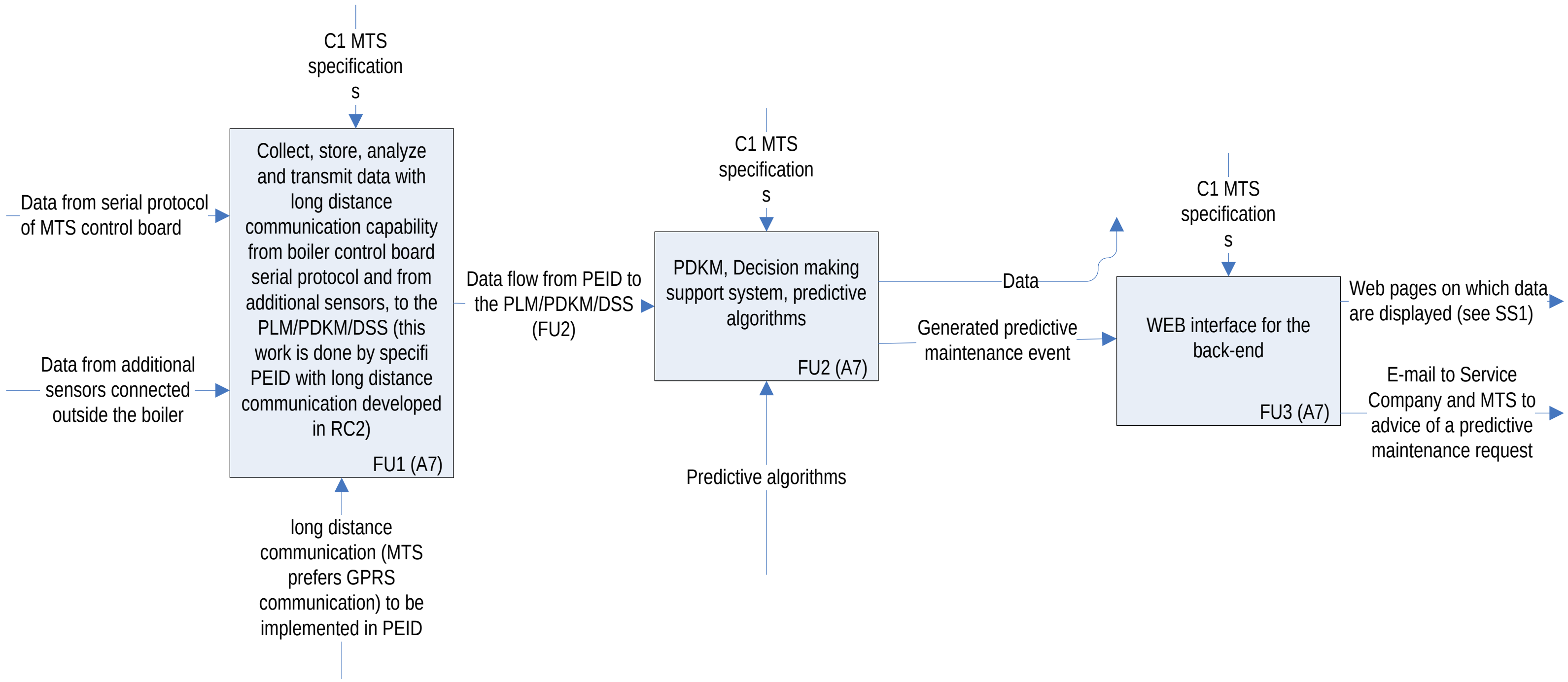
7.6 A7 – Description of the functionality (FUs) of the demonstrator

ID	Functionality	Comments to the functionalities	Define the inputs needed to achieve this functionality and relate the input to other FU IDs (e.g. output data from FU3)	Define the outputs from this functionality	What are the controls? ID the controls by using C1, C2 etc	Technologies/Physical components/Systems/Actors involved Describe the technologies involved, or assumed technology/systems needed	Rationale Describe why this functionality is needed	Priority High, Medium, Low	Related to objective ID (Sec 1.2)
FU1	Collect, store, analyze and transmit data with long distance communication capability from boiler control board serial protocol and from additional sensors, to the PLM/PDKM/DSS (this work is done by specifi PEID with long distance communication developed in RC2).	How many data, type of data, type of sensors, samples time of each single data, memory space necessary, MIPS required must be defined with the partners involved in designing predictive algorithms.	- data received from serial protocol of MTS control board - data received from additional sensors connected outside the boiler	- data flow from PEID to the PLM/PDKM/DSS (FU2). When/how often data must be send out will be decided with partners involved in predictive algorithms	- C1 MTS specifications	-long distance communication (MTS prefers GPRS communication) to be implemented in PEID	This function is needed because data collected, stored, analyzed and transmitted will be the base on which predictive algorithms will work to extract a failure prediction.	High	ID OB1 and ID OB2.
FU2	PDKM, Decision making support system, predictive algorithms	Store data coming from PEID; analyze them with predictive algorithm and generate failure prediction.	-data received from PEID (FU1)	-data coming from PEID are handled and stored in the Database -decision support system/predictive algorithms analyse data and generate a predictive maintenance event	- C1 MTS specifications	-predictive algorithm: MTS has not know in this field, and so will cooperate with Partners involved in predictive maintenance, providing its knowledge on the boiler and its capability to realize experiments to generate data on which predictive algorithm can be developed and tuned	This function is needed to extract a failure prediction on a specific component from data received from PEID (FU1)	High	ID OB1 and ID OB2.
FU3	WEB interface for the back-end	Promise Users, which are Service Companies and MTS, must have a WEB interface to be able to have functions as described in SS1, and OB3	-data available from FU2	-web pages on which data are displayed (see SS1) -e-mail to Service Company and MTS to advice of a predictive maintenance request	- C1 MTS specifications	-MTS has no specific requirement	This function is to give to the Promise Users (MTS and Service companies, AC1 and AC3) info on MOL (predictive maintenance e-mail) from the source of data (PEID connected to the boiler and to additional sensors), to analyze it and to let the users (Service	High	ID OB1, OB2 and ID OB3.

ID	Functionality	Comments to the functionalities	Define the inputs needed to achieve this functionality and relate the input to other FU IDs (e.g. output data from FU3)	Define the outputs from this functionality	What are the controls? ID the controls by using C1, C2 etc	Technologies/Physical components/Systems/Actors involved Describe the technologies involved, or assumed technology/systems needed	Rationale Describe why this functionality is needed	Priority High, Medium, Low	Related to objective ID (Sec 1.2)
							Companies and MTS) to access this info.		

Table 43: Functionalities (FUs) of the A7 Demonstrator

7.7 A7 – Draft illustration of the demonstrator's functionalities



PROMISE Demonstrator A8
Wrap (MOL)

Written by:
Pier Andrea Pracchi, Wrap
Emanuela Antognoli, Wrap

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11.04.2005	0.2	Carl Christian Røstad	Updated structure based on input from the Munich meeting on the 11.-12. April 2004. The version was sent SAP, EPFL, BIBA, STOCKWAY and INFENEON for comments before distribution.
28.04.2005	0.3	Pier Andrea Pracchi	Updated structure based on input from Carl Rostad
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8 A8 WRAP (MOL) – Definition of the demonstrator

8.1 A8 – The Demonstrator

Demonstrator	Describe functionality	Describe why this Demonstrator is focused in PROMISE
Refrigerator	Cooling system in residential use	The reason for this focus lies on the fact that a regular lifecycle for a refrigerator is about 10 years and for that period of time the manufacturer isn't aware of what really is going on with the appliance since there are no pre-scheduled checks/inspections (like in the automotive industry for example). When a refrigerator stops working all its perishable load (food) is lost and that causes a lot of trouble and complication for the owner. In addition, for a multitude of reasons, the condition in which the appliance operates may vary and sometimes inefficiencies of the compressor level might develop and thus lowering its electric efficiency (sometimes also downgrading to different class: i.e.: A --> B). The result is larger electric bills for the owner and a relative large environmental impact. Ideally, white goods appliance manufacturers (like WRAP) are looking to deliver SERVICE and not just the product, to either increase customer fidelization level as well as the quality of the product

Table 44: The A8 PROMISE demonstrator

8.2 A8 – Objectives (OBs) of the Demonstrator

ID	Objective (one per ID)	Describe why
OB1	Faster End-of-line testing	Reduces in-line time of the good
OB2	Compressor efficiency	Longer life for the goods and environmental impact reduced
OB3	Cooling circuit pressure	Longer life for the goods and environmental impact reduced
OB4	Internal/External Temperature	Better food conservation and parameter for compressor efficiency

Table 45: Objectives (OBs) of the A8 PROMISE demonstrator

8.3 A8 – Involved actors (ACs) in the whole lifecycle of the Demonstrator

ID	Actor	External / Internal	Describe how they will be involved, their role and impact of the PROMISE technology	Importance / Relevance High, Medium, Low	BOL	MOL	EOL
AC1	Service company	Internal	Data collection, User service delivery	High		x	
AC2	Production	Internal	In-line testing procedures	Medium		x	
AC3	Electronic Design	Internal	Design of the Control Board	Medium	x		

Table 46: Involved lifecycle actors (ACs) of the A8 PROMISE demonstrator

8.4 A8 – The demonstrator physical components (PCs)

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
PC1	NTC	Determines Temperature	Refrigerator Digital Control Board	Yes, its is part of the actual BOM	Vital Information on appliance behaviour	FU5
PC2	Compressor	Proper functioning of the Fridge	Refrigerator Digital Control Board	Yes, its is part of the actual BOM	Vital Information on appliance behaviour	FU5
PC3	No Frost Resistor	Quantify the building up of the Frost	Refrigerator Digital Control Board	Yes, its is part of the actual BOM	Vital Information on appliance behaviour	FU5
PC4	Proxy Device	Data acquisition from refrigerator; electric quantity measurement	Refrigerator Power Cable	It's under development and will be completed for the purpose of this project	Acts as a PEID	FU1,2,3,4

Table 47: Physical components (PCs) of the A8 PROMISE demonstrator

8.5 A8 – The demonstrator software/support-systems (SSs)

ID	Software / support system	Describe its functionality	Describe the necessary interfaces of this software/support system to other PC IDs, SS IDs etc	Is this software / support system already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to the Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
SS1	Predictive maintenance software	To acquire data from the refrigerator and to extract knowledge on its behaviour by the use of proper algorithm (any malfunctioning, possible inefficiency)	PC4	No it has to be developed through the cooperation with the partner involved. We need to determine which are the needed components component that have to be monitored in order to predict a possible failure.	The output of the SW is vital in order to deliver predictive maintenance to the appliance	FU2,3

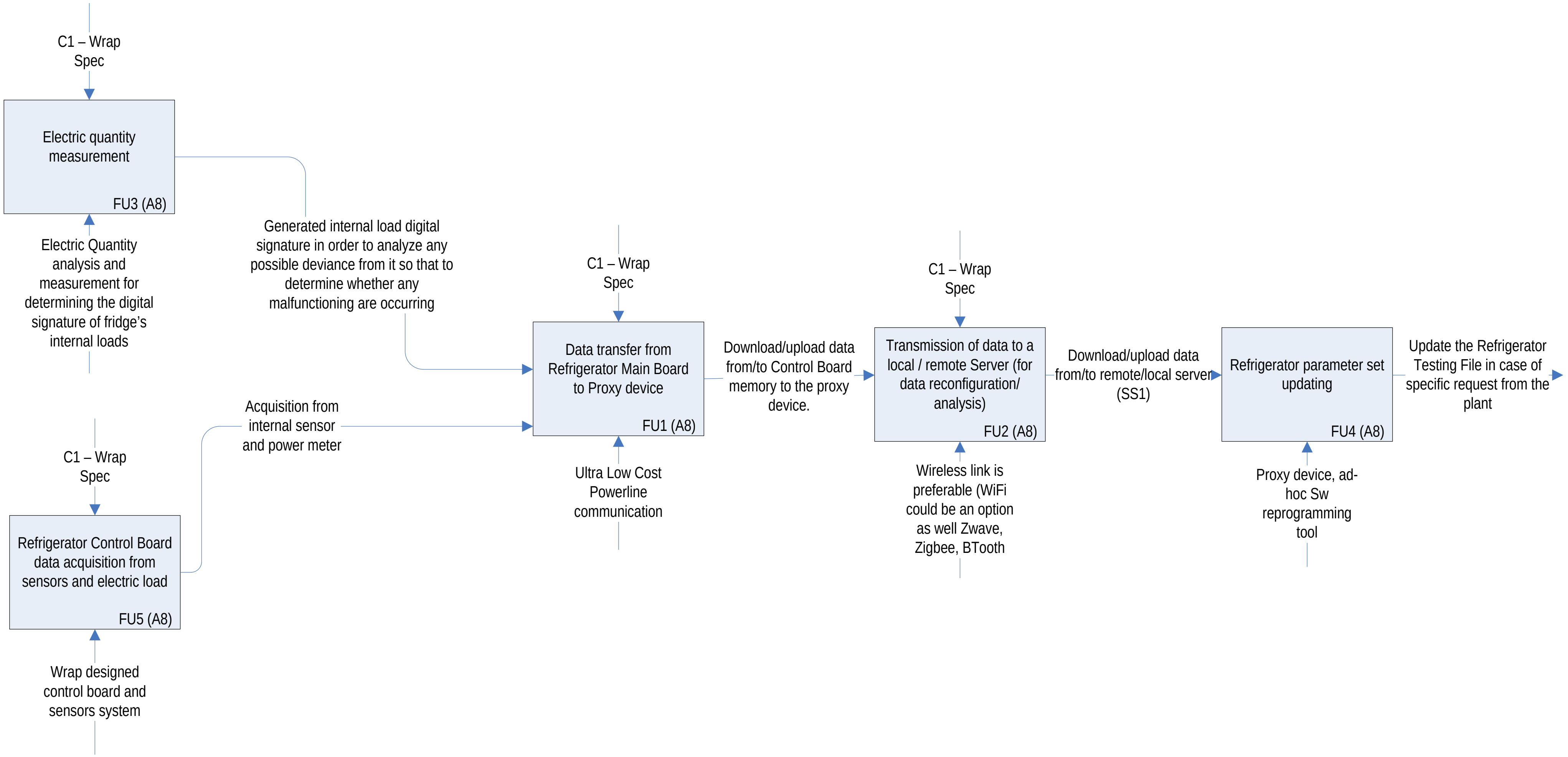
Table 48: Software / support systems (SSs) of the A8 PROMISE demonstrator

8.6 A8 – Description of the functionality (FUs) of the demonstrator

ID	Functionality	Comments to the functionalities	Define the inputs needed to achieve this functionality and relate the input to other FU IDs (e.g. output data from FU3)	Define the outputs from this functionality	What are the controls? ID the controls by using C1, C2 etc	Technologies/Physical components/Systems/Actors involved Describe the technologies involved, or assumed technology/systems needed	Rationale Describe why this functionality is needed	Priority High, Medium, Low	Related to objective ID (Sec 1.2)
FU1	Data transfer from Refrigerator Main Board to Proxy device	At least one resistive load in the WG appliance (i.e.: lamp)	Output from FU5,3	Download/upload data from/to Control Board memory to the proxy device. The format of the data will be defined at a second time.	C1 – Wrap Spec	Ultra Low Cost Powerline communication (the outcome of TEAHA – IST FP6 Funded Proj.)	To download statistical and operational – functional - information from the appliance	High	OB-ALL
FU2	Transmission of data to a local / remote Server (for data reconfiguration/analysis)	Communication node (for both tx and rx) to enable communication	Output from FU1	Download/upload data from/to remote/local server (SS1)	C1 – Wrap Spec	Wireless link is preferable (WiFi could be an option as well Zwave, Zigbee, BTooth …..)	To download data from the proxy to a remote / local server	High	OB-ALL
FU3	Electric quantity measurement	Power Meter within the proxy device		The output is to generate internal load digital signature in order to analize any possible deviance from it so that to determine whether any malfunctioning are occurring	C1 – Wrap Spec	Electric Quantity analysis and measurement for determining the digital signature of fridge's internal loads	Interfaces with the Micro controller on board the Proxy device	High	OB-ALL
FU4	Refrigerator parameter set updating	File setting parameter knowledge (which parameter needs to be updated)	Output from remote server FU2	To update the Refrigerator Testing File in case of specific request from the plant (it is possible to shorten the time of the testing or to run a through one)	C1 – Wrap Spec	Proxy device, ad-hoc Sw reprogramming tool	defrosting cycle length can be varied when needed and specifically to production there is the need to make it the most flexible as possible	High	OB1
FU5	Refrigerator Control Board data acquisition from sensors and electric load	Refrigerator Digital control board		Acquisition from internal sensor and power meter	C1 – Wrap Spec	Wrap designed control board and sensors system	To acquire and generate information from the whole refrigerator	High	OB-ALL

Table 49: Functionalities (FUs) of the A8 Demonstrator

8.7 A8 – Draft illustration of the demonstrator's functionalities



PROMISE Demonstrator A9
INTRACOM (MOL)

Written by:
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Maria Anastasiou, INTRACOM

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11.04.2005	0.2	Carl Christian Røstad	Updated structure based on input from the Munich meeting on the 11.-12. April 2004. The version was sent SAP, EPFL, BIBA, STOCKWAY and INFENEON for comments before distribution.
28.04.2005	0.3	Dimitra Pli, INTRACOM Maria Anastasiou, INTRACOM	
05.05.2005	1.0	Carl Christian Røstad	Updated structure of the document and added draft illustration of functionalities

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9 A9 INTRACOM (MOL) – Definition of the demonstrator

9.1 A9 – The Demonstrator

Demonstrator	Describe functionality	Describe why this Demonstrator is focused in PROMISE
INTRACOM Broadband Access System, IBAS. The IBAS system contains a set of components for delivery of narrowband voice services across an Access Network.	It is a Next Generation Multi-Service Access Node (MSAN) featuring broadband and narrowband subscriber interfaces. It is one of the DSLAM family products, which is the last element in the access network before the subscriber's home, and is thus the vehicle for delivering broadband services. IBAS product includes software and hardware components (line cards).	It is for INTRACOM one of the key products under development, and it will be used as the corner stone of Next Generation Access Network.

Table 50: The A9 PROMISE demonstrator

9.2 A9 – Objectives (OBs) of the Demonstrator

ID	Objective (one per ID)	Describe why
OB1	To efficiently collect, integrate and manage information about the product	The collected information will be appropriately managed providing to the evolved actors the tools to correspond efficiently and effectively when a problem occurs and support decisions about product improvements.
OB2	To receive information about product operation	This raw data will provide valuable input to obtain knowledge about the product.
OB3	To transform operational data to valuable knowledge	The transformed data are going to be used for the decision support system.
OB4	To support decision making	The engineers and technicians will be able to be supported about product improvements and problems solving/preventive maintenance.

Table 51: Objectives (OBs) of the A9 PROMISE demonstrator

9.3 A9 – Involved actors (ACs) in the whole lifecycle of the Demonstrator

ID	Actor	External / Internal	Describe how they will be involved, their role and impact of the PROMISE technology	Importance / Relevance High, Medium, Low	BOL	MOL	EOL
AC1	Technicians (service, maintenance team)	Internal	Technicians will be facilitated in their everyday work by being able to exploit knowledge gained through previous similar situations. The technician will be able to find in the knowledge base special characteristic of the customer site, as well as to the history of the related IBAS, cases with similar symptoms, the diagnosis made, as well as the solution given. At the customer site, the technician will have access to PROMISE system. Additional effort will be required by technicians to register in the appropriate way information related to the diagnosis made, solution given, as well as to customer site specific information. Customer support will have filtered access to the information coming from the EMS systems in order to perform preventive maintenance.	High		X	
AC2	Engineers (designers, product manager)	Internal	Established processes will facilitate engineers to be informed about repetitive faults that occur and could lead to decision-making about improvements to the product.	High	X		
AC3	Customers	External	Simple troubleshooting information shall be available on line for customers. In addition, their collaboration is required to provide INTRACOM with product operation information.	High		X	

Table 52: Involved lifecycle actors (ACs) of the A9 PROMISE demonstrator

9.4 A9 – The demonstrator physical components (PCs)

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
PC1	RFID tag	The RFID tag would be used in order IBAS location to be identified.	PC2	No, it is going to be developed in the framework of PROMISE	Although initially INTRACOM did not intend to use RFID in its application, the analysis indicated that RFID could be used for identifying the location of the specific IBAS.	
PC2	RFID reader	The RFID reader would be used to read the information coming from the RFID tag.	PC1	No, it is going to be developed in the framework of PROMISE	As described above the need to use an RFID tag was identified during the analysis, consequently an RFID reader will be used.	

Table 53: Physical components (PCs) of the A9 PROMISE demonstrator

Regarding the use of an RFID tag and RFID reader that was identified during this analysis, it will be specified in detail.

9.5 A9 – The demonstrator software/support-systems (SSs)

ID	Software / support system	Describe its functionality	Describe the necessary interfaces of this software/support system to other PC IDs, SS IDs etc	Is this software / support system already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to the Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
SS1	SIS	Contains problems, solutions and card history. The lab personnel uses SIS system to register the problems and solutions, as well as to keep the cards' history. It only contains information about cards manipulated by the lab.	SS4, SS5	This system is available in our company today, but some adjustments and integrations will be needed in order to interoperate with the other relevant systems.	The database SIS should interoperate with the PROMISE PDKM.	FU2, FU3, FU6, FU8
SS2	EMS	Efficient operation management and supports the following functional areas: - Fault Management - Configuration Management - Performance Management - Security Management	SS4, SS5	This system exists at NOC (Network Operation Centre) of the operator. In cases that INTRACOM is the operator of the system EMS is available, otherwise depends on the Service Level Agreement.	Customer support will have filtered access to the information coming from the EMS system in order to perform preventive maintenance.	FU1, FU7
SS3	Call tracking system	Tracks the calls made by customers, the problem described, the technician allocated and the solution	SS4, SS5	This system is available in our company today, but some adjustments and integrations will be needed in order to interoperate with other relevant systems.	Information of the call tracking system to be integrated in the PDKM.	FU4, FU5, FU6, FU9
SS4	Decision Support System	Support the work of technicians (best practices, symptom problem, solution), preventive maintenance and identify repetitive problems (product improvements)	SS1, SS2, SS3	This system is going to be developed in the framework of PROMISE.	Information coming from the EMS, SIS, Call tracking system will be integrated in the Decision Support System.	FU3, FU4, FU5, FU10

ID	Software / support system	Describe its functionality	Describe the necessary interfaces of this software/support system to other PC IDs, SS IDs etc	Is this software / support system already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to the Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
SS5	PDKM	Contains all the information about the product, the users and the customers. Support the work of technicians, engineers, and customers by providing all the necessary information.	SS1, SS2, SS3, SS4	This system is going to be developed in the framework of PROMISE	PDKM should interoperate with all relevant systems providing support to all involved actors.	FU1-FU10

Table 54: Software / support systems (SSs) of the A9 PROMISE demonstrator

9.6 A9 – Description of the functionality (FUs) of the demonstrator

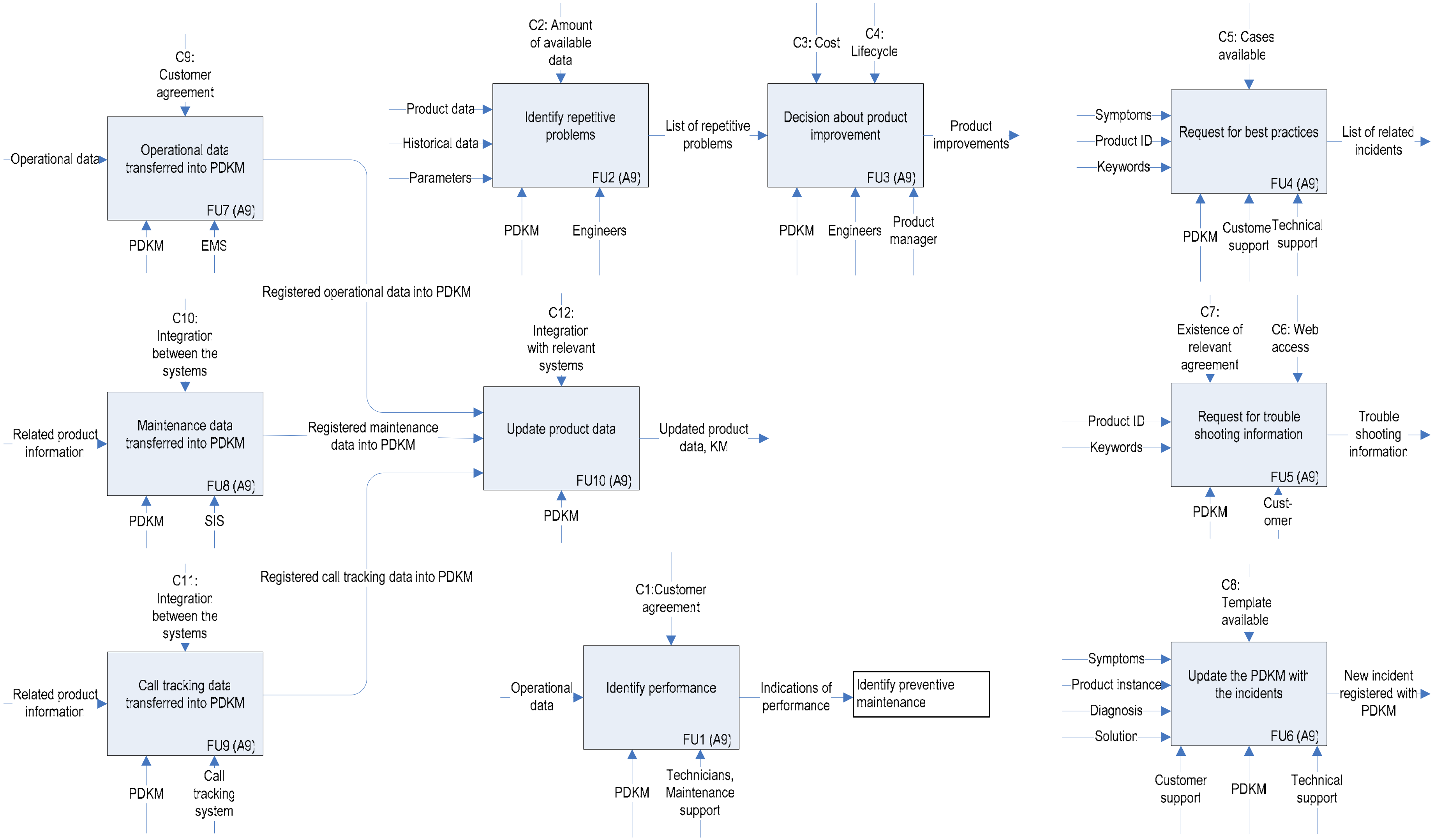
ID	Functionality	Comments to the functionalities	Define the inputs needed to achieve this functionality and relate the input to other FU IDs (e.g. output data from FU3)	Define the outputs from this functionality	What are the controls? ID the controls by using C1, C2 etc	Technologies/Physical components/Systems/Actors involved Describe the technologies involved, or assumed technology/systems needed	Rationale Describe why this functionality is needed	Priority High, Medium, Low	Related to objective ID (Sec 1.2)
FU1	Identify performance	INTRACOM-002 INTRACOM-007	Operational data	Indications of performance, Identify preventive maintenance	C1: Customer agreement	PDKM, Technicians-Maintenance support	The technicians will be able to be supported about the performance of the product	High	OB2
FU2	Identify repetitive problems	INTRACOM-007	Historical data, Data about product Parameters	List of repetitive problems	C2: Amount of available data	PDKM, Engineers	The engineers will be supported to identify preventive maintenance	High	OB2
FU3	Decision about product improvement	INTRACOM-001 INTRACOM-002 INTRACOM-010	FU2 output	Product improvement	C3: Cost C4: Lifecycle	PDKM, Engineers, Product manager	The engineers will be supported to decision making about product improvements	High	OB4 OB3
FU4	Request for best practices	INTRACOM-010	Symptoms, Product ID, Keywords	List of related incidents*	C5: Cases available	PDKM, Technical support Customer support	Technicians will be facilitated by the knowledge gained through previous similar situations.	High	OB4
FU5	Request for trouble shooting information	INTRACOM-010	Keywords Product	Trouble shooting information	C6: Web access C7: Existence of relevant agreement	PDKM, Customers	Simple troubleshooting information shall be available on line for customers	High	OB4
FU6	Update the PDKM with the incidents	INTRACOM-003 INTRACOM-007 INTRACOM-009	Symptoms, Product instance, Diagnosis, Solution	New incident registered with PDKM	C8: Template available	PDKM, Technical support Customer support	Updating the PDKM with incidents the technicians will be supported when a problem occurs by the knowledge gained through previous similar situations.	High	OB1 OB2
FU7	Operational data transferred into PDKM	INTRACOM-001 INTRACOM-008 INTRACOM-009	Operational data	Registered operational data into PDKM	C9: customer agreement	PDKM, EMS	All the information relevant to operational data will be processed to PDKM to support all involved actors.	High	OB2
FU8	Maintenance data transferred into PDKM	INTRACOM-001 INTRACOM-008 INTRACOM-009	Related product information	Registered maintenance data into PDKM	C10: Integration between the systems	PDKM, SIS	All the information relevant to maintenance data will be processed to PDKM to support all involved actors.	High	OB1

ID	Functionality	Comments to the functionalities	Define the inputs needed to achieve this functionality and relate the input to other FU IDs (e.g. output data from FU3)	Define the outputs from this functionality	What are the controls? ID the controls by using C1, C2 etc	Technologies/Physical components/Systems/Actors involved Describe the technologies involved, or assumed technology/systems needed	Rationale Describe why this functionality is needed	Priority High, Medium, Low	Related to objective ID (Sec 1.2)
FU9	Call tracking data transferred into PDKM	INTRACOM-001 INTRACOM-008 INTRACOM-009	Related product information	Registered call tracking data into PDKM	C11: Integration between the systems	PDKM, Call tracking system	All the information relevant to call tracking data will be processed to PDKM to support all involved actors.	High	OB1
FU10	Update product data	INTRACOM-001 INTRACOM-003 INTRACOM-004 INTRACOM-007 INTRACOM-009	Output from FU7, FU8, FU9	Updated product data, KM	C12: Integration with relevant systems	PDKM, Engineers, Product manager Technicians-Maintenance support Customer support	The information gathered will facilitate all actors to perform their every day work efficiently and effectively.	High	OB1, OB3, OB4

Table 55: Functionalities (FUs) of the A9 Demonstrator

* Incident: product instance, symptoms, problems, solution

9.7 A9 – Draft illustration of the demonstrator's functionalities



PROMISE Demonstrator A10
BOMBARDIER TRANSPORTATION (BOL)

Written by:
Markus Frey, et al., Bombardier Transportation

DELIVERABLE NO	Relates to DR3.2: PROMISE Demonstrator WP A10
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ELECTRONIC FILE CODE	dr3_2 appendix a demonstrators~2.doc
CONTRACT NO	507100 PROMISE A Project of the 6th Framework Programme Information Society Technologies (IST)
ABSTRACT:	This is the final version of the document and will form the basis for the deliverable DR3.2.

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ACTION	**BY**	**DATE (dd.mm.yyyy)**
SUBMITTED (author(s))	Markus Frey	29.04.2005
VU (WP Leader)	Bombardier Transportation	
APPROVED (QIM)	To be approved in deliverable DR 3.2	

Revision History

Date (dd.mm.yyyy)	Version	Author	Comments
01.04.2005	0.1	Carl Christian Røstad	This is the first draft version of the document. This document will be the basis for the discussions in the meeting in Munich 11.-12. April
11.04.2005	0.2	Carl Christian Røstad	Updated structure based on input from the Munich meeting on the 11.-12. April 2004. The version was sent SAP, EPFL, BIBA, STOCKWAY and INFENEON for comments before distribution.
19.04.2005	0.3	Markus Frey, et al.	Inclusion of BT Draft
25.04.2005	0.4	Martin Vögeli, Markus Frey	First update of BT Draft
29.04.2005	0.5	Martin Vögeli, Anders Hynen, Martin Frank, Daniel Küffer, Markus Frey	Final update of BT Draft
05.05.2005	1.0	Carl Christian Røstad	Updated structure of the document and added draft illustration of functionalities

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10 A10 BOMBARDIER TRANSPORTATION (BOL) – Definition of the demonstrator

10.1 A10 - Abbreviations used in the A10 demonstrator

BOL Beginning of Life
BT Bombardier Transportation
CM Condition Monitoring
CBM Condition Based Maintenance
DfX Design for X (where X can stand for: RAM/LCC, Product Safety, Environment, etc.)
EboK Engineering book of Knowledge
FRACAS Failure Reporting Analysis and Corrective Action System
IS Information System
LCC Life Cycle Cost
MOL Middle of Life
P & O People & Organisation
PDKM Product Data & Knowledge Management
PDM Product Data Management
PEID Product Embedded Information Device
RAM Reliability, Availability & Maintainability
TCMS Train Control and Management System
WBS Work Breakdown Structure (with various vehicle, system & location elements)

10.2 A10 – The Demonstrator

Demonstrator	Describe functionality	Describe why this Demonstrator is focused in PROMISE
DfX Demonstrator	The demonstrator aggregates all kind of field data and additional information and transforms it – supported by decision support system – into DfX knowledge, accessible by the engineers in a PDKM system.	This demonstrator covers the closure of information loop between product operation (MOL) and design (BOL).
Product: traction chain of el. locomotive	The traction chain of an electric locomotive transforms electrical energy into the wheel movement, transferring traction force to the rail or transforms brake forces into electrical energy.	The traction chain is a central function of an electric locomotive, where BT gathers various field data which can be used to validate the demonstrator.

Table 56: The A10 PROMISE demonstrator

10.3 A10 – Objectives (OBs) of the Demonstrator

ID	Objective (one per ID)	Describe why
OB1	**Overall objective:** **Prove the closure of information loop between experience embedded in field data and knowledge (concentrated on Design for X aspects).**	**This demonstrator covers the closure of information loop between product operation (MOL) and design (BOL).**
OB2	Demonstrator shall aggregate available field data and additionally needed other information.	For the transformation process all necessary data shall be considered from various sources.
OB3	Semi-automatic transformation of field data into appropriate DfX knowledge governed by specialist engineer.	The specialist shall finally decide on the transformed DfX knowledge.
OB4	Transformation process shall be adequately supported by a decision support system	The decision support system shall aggregate necessary data & information into deciding basis & decision proposals and provide them to the specialist engineer.
OB5	Knowledge Management functionality as part of PDKM environment shall manage DfX knowledge structured according to a predefined work breakdown structure (WBS).	PDKM environment is the main engineering system to manage information. WBS is the main form how to structure information.

Table 57: Objectives (OBs) of the A10 PROMISE demonstrator

10.4 A10 – Involved actors (ACs) in the whole lifecycle of the Demonstrator

ID	Actor	External / Internal	Describe how they will be involved, their role and impact of the PROMISE technology	Importance / Relevance High, Medium, Low	BOL	MOL	EOL
AC1	Service organisation (incl. commissioning)	Internal	Provision and input of field data into system	High		X	
AC2	DfX Specialist engineer	Internal	Trigger and govern the transformation of field data into DfX knowledge	High	X	X	
AC3	Engineer / designer	Internal	a) Provision and input of field data into system in form of reports of failure analyses, solved problems, etc. b) Appropriate usage of provided DfX knowledge	High	X		
AC4	Operator	External	Disclosure on usage of locomotive	Medium		X	X
AC5	IS specialist	Internal	Administration and support of tools	Low	X	X	X
AC6	Maintainer	External	Provision and input of field data into system	High		X	

Table 58: Involved lifecycle actors (ACs) of the A10 PROMISE demonstrator

10.5 A10 – The demonstrator physical components (PCs)

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
PC1	Converter (incl. power electronics)	A traction converter is a converter that is resistant to shock and vibration. The traction converter comprises all those components vibration. The traction converter comprises all those components between the line side and the output of the motor converter.	Converters are mounted inside the machine room of the locomotive. Interface to the: o electrical- or optical bus system to the vehicle control unit o traction motor (sensor) o temperature sensors of the traction motor o speed sensor of the traction motor o cooling tower o transformer o auxiliary converter o main circuit breaker o line side (sensor) o other converters (fibre optic)	PC1 is available. Data are available from the Control Electronic PC1.3 which sent the information to the superior diagnosis system on vehicle level. Inspection of traction converter during preventive-/corrective maintenance. Measuring and recording of electrical characteristic during preventive or corrective maintenance or repair according to the operation manual. o Vibration monitoring not available on locomotive o Standby time monitoring (DC-link charged) is not available on locomotive o Switching On/Off time monitoring is not available for converter	OB1 - example of most important electrical systems in traction chain	FU1 – provides field data
PC1.1	Gate drive unit	Control unit for the IGBT in an Integrated Power Module.	Gate Drive Unit is linked to o Control electronic PC1.3 o Power modules PC1.2 o power supply	PC1.1 is available. Data are available from the Control Electronic PC1.3 which sent the information to the superior diagnosis system on vehicle level. o Vibration monitoring not available on Gate Drive o Switching On/Off power supply monitoring not available Inspection of power gate drive unit during preventive maintenance => normally only records if module is damaged or failed.	Considered as example of important component in traction chain	ditto

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
				Measuring and recording of electrical characteristic during preventive maintenance or repair.		
PC1.2	Power modules	Mechanical entity comprising the semi-conductors and associated components for one complete switching unit in a traction converter.	Power modules is linked to o Control electronic PC1.3 o Gate Drive Unit PC1.1 o Cooling system PC1.5	PC1.2 is available. o Vibration monitoring not available o Switching On/Off time monitoring is not available for power modules Inspection of power modules during preventive maintenance => normally only records if module is damaged or failed. Measuring and recording of electrical characteristic during preventive maintenance or repair.	Considered as example of important electrical component in traction chain	ditto
PC1.3	Control electronics	The control electronics forms part of the vehicle control electronics and comprises those parts interacting with the traction converter.	Control electronics is linked to o Traction converter PC1.0 o Gate Drive Unit PC1.1 o Power modules PC1.2 o Sensors PC1.4 o Cooling system (sensor) PC1.5 o Contactors PC1.6	PC1.3 is available. Data are available from the Control Electronic PC1.3 which sent the information to the superior diagnosis system on vehicle level. Inspection of control electronics during preventive maintenance => normally only records if module is damaged or failed. Measuring and recording of electrical characteristic during preventive maintenance or repair.	Considered as example of important electrical component in traction chain	ditto
PC1.4	Sensors	The sensor measuring voltage, current, temperature, pressure, speed of a certain circuit	Sensor is linked to o Traction converter PC1.0 o Sensors PC1.4 o Cooling system (sensor) PC1.5 o Contactors PC1.6 o Others PC1.7	PC1.4 is available. Data are available from the Control Electronic PC1.3 which sent the information to the superior diagnosis system on vehicle level.	Considered as example of important electrical component in traction chain	ditto

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
PC1.5	Cooling system	The cooling circuit is a self-enclosed system and includes all those components required to force-cool the electrical components of the traction converter.	Cooling system is linked to o Traction converter PC1.0 o Sensors PC1.4 o Contactors PC1.6 o Indirect Control electronic PC1.3	PC1.5 is available. o Vibration monitoring not available No permanent monitoring of leakages in the cooling system. Data are available from the Control Electronic PC1.3 which sent the information to the superior diagnosis system on vehicle level. Inspection of cooling system during preventive-/corrective maintenance. Measuring and recording of hydraulic and electrical characteristic during preventive or corrective maintenance or repair according to the operation manual.	Considered as example of most important mechanical interface in traction chain	ditto
PC1.6	Contactors	The contactor closes and opens a circuit	Contactor is linked to o Traction converter PC1.0 o Gate Drive Unit PC1.1 o Power modules PC1.2 o Control electronics PC1.3 o Sensors PC1.4	PC1.6 is available. o Switching On/Off cycle monitoring not available on contactors Data are available from the Control Electronic PC1.3 which sent the information to the superior diagnosis system on vehicle level. Inspection of contactors during preventive-/corrective maintenance. Measuring and recording of mechanical and electrical characteristic during preventive or corrective maintenance or repair .		ditto
PC2	Rail – wheel contact	Transmission of weight force between running surfaces of wheel and rail and guiding forces between wheel flange and rail by means of form fit. Transmission of different forces between the running wheel and the fixed rail by means of friction: ▪ Traction force ▪ Brake force	▪ Running surface is integral part of the wheel PC2.1 ▪ Speed is measured and recorded by speedometer system SS1 ▪ Wheel slip and slide is measured and controlled by wheel slip / slide protection system PC2.7	▪ PC2 is available ▪ Data are available from wheel slip / slide protection system PC2.7 ▪ Data are available from speedometer system SS1 o Data currently not available for DfX demonstrator	OB1 - example of most important mechanical interface in traction chain	ditto

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
		▪ Friction forces due to relative movements (lateral, rotation round the z-axis) between wheel and rail				
PC2.1	Wheel (profile)	Carries and guides the wheel set in the track and transmits traction forces, brake forces and guiding forces to the rail.	▪ Wheel contains running surface PC2 ▪ Wheel profile combined with the rail profile defines substantially the running behaviour ▪ Wheel is (mostly) fitted onto the axle PC2.2 by means of press fit	o PC2.1 is available o Derailment detection not available on locomotive o Stability monitoring not available on locomotive o Wear monitoring not available on locomotive ▪ Wear is currently monitored during preventive maintenance by means of measuring key measures of the profile or recording the wheel profile electronically and measuring wheel diameter, out of round, etc.. Data available in depots / workshops in form of attachments to protocols (in paper or electronically)	Considered as example of a component of the most important mechanical interface in traction chain	ditto
PC2.2	Axle	Torque and force transmission between wheels, gearbox and journal bearings. In case of the axle hung gearbox of the locomotive, carries and guides the gearbox. In connection with the traction chain the axle is a “solid” link between the wheels..	▪ Wheels PC2.1 are press fitted on the axle ▪ Journal bearings PC2.3 sit on the axle Interface to gearbox PC3.x by means of bearings and / or press fitted gearwheel	N/A	Considered as a “solid” linking component in the traction chain, with a service life >= service life of the vehicle.	ditto
PC2.3	Journal bearing	Bearing the axle	▪ Journal bearing is fitted on the axle PC2.2 and sits in the axle box PC2.4,	o Hot box detection not available on locomotive o Vibration monitoring not available on locomotive ▪ PC2.3 is available Condition of bearing is currently monitored during preventive maintenance by means of inspections on the whole bearing and inspections of bearing parts while overhauling the bearing. Data available in depots / workshops in form of reports.	Considered as example of a component of the traction chain	ditto

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
PC2.4	Axle box	Houses the journal bearing PC2.3 and transmits forces.	The axle box is connected to the bogie frame PC 2.11 by: ▪ Primary spring PC 2.8 ▪ Primary damper PC2.10 ▪ Primary traction rod PC2.9	N/A	Considered as a “solid” linking component in the traction chain, with a service life >= service life of the vehicle.	ditto
PC2.5	Wheel flange lubricating system	Lubricates wheel flange to reduce flange wear	▪ Spray nozzle normally fitted to a support on the bogie frame PC2.11. ▪ Position has to be such, that lubricant gets applied to the wheel flange only, PC2.1. ▪ Lubricant on running surface PC2 reduces friction coefficient thus reducing transmission of traction forces	▪ PC2.5 is available ▪ Functional checks during operation and preventive maintenance => normally no records ▪ Check of application zone during preventive maintenance => normally no records	Considered as example of a component that has influence to the traction chain	ditto
PC2.6	Sanding system	Distributes sand to the running surface of the rail to improve the adhesion coefficient.	▪ Sand tube normally fitted to a support on the bogie frame PC2.11. ▪ Position has to be such, that sand reaches contact zone between wheel and rail PC2	▪ PC2.6 is available ▪ Functional checks during operation and preventive maintenance => normally no records ▪ Check amount of sand and application zone during preventive maintenance => normally no records	Considered as example of a component that has influence to the traction chain	ditto
PC2.7	Wheel slip/slide protection system	Controls slip between wheel and rail to maximise friction coefficient and to minimise wheel wear and prevents wheel from blocking in case of braking	▪ Sensors measuring the number of resolution are fitted on the axle box PC2.4 or in traction motor PC3.x ▪ Sensors transmit signal to WSP electronics by means of cables.	▪ PC2.7 is available ▪ Data currently not available for DfX demonstrator	Considered as example of a component of the traction chain	ditto

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
PC2.8	Primary spring	Suspension between axle box and bogie frame	Primary spring ▪ rests on the axle box PC2.4 ▪ supports bogie frame PC2.11 ▪ transmits also forces in lateral & longitudinal direction	o No permanent monitoring of springs available ▪ PC2.8 is available ▪ Inspection of springs during preventive maintenance => normally only records if spring is damaged or failed ▪ Measuring and recording of spring characteristic during preventive maintenance. Data (diagrams) available in depots / workshops in form of attachments to protocols (in paper or electronically)	Considered as example of a component that has influence to the traction chain	ditto
PC2.9	Primary traction rod with rubber bearings	Longitudinal (and some times lateral)guidance of axle box / wheel set	Primary traction rod is linked by means of rubber bearings to: ▪ the axle box PC2.4 ▪ the bogie frame PC2.11	o No permanent monitoring of traction rod available ▪ PC 2.9 is available ▪ Inspection of traction rods during preventive maintenance => normally only records if rubber bearing or rod (body) is damaged or failed	Considered as example of a component of the traction chain	ditto
PC2.10	Primary damper	Damping of vertical movements between bogie frame and axle box.	Primary damper is linked by means of "rubber" bearings to: ▪ the axle box PC2.4 ▪ the bogie frame PC2.11	o No permanent monitoring of dampers available on the locomotives ▪ PC2.10 is available ▪ Inspection of dampers during preventive maintenance => normally only records if damper is leaking, is damaged or failed ▪ Measuring and recording of damper characteristic during preventive maintenance. Data (diagrams) available in depots / workshops in form of attachments to protocols (in paper or electronically)	Considered as example of a component that has influence to the traction chain	ditto

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
PC2.11	Bogie frame	In connection with the traction chain the bogie frame is a "solid" link to form a bogie	The bogie frame is linked to:. ▪ Wheel flange lubricating system, PC2.5 ▪ Sanding system, PC2.6 ▪ Primary springs, PC2.8 ▪ Primary traction rod, PC2.9 ▪ Primary damper, PC2.10 ▪ Secondary springs, PC2.12 ▪ Secondary vertical dampers, PC2.13 ▪ Secondary lateral dampers, PC2.14 ▪ Secondary yaw dampers, PC 2.15 ▪ Secondary traction rod, PC 2.16 ▪ Torque reaction link to traction motor, PC3.1	▪ N/A	Considered as a "solid" linking component in the traction chain, with a service life >= service life of the vehicle.	ditto
PC2.12	Secondary spring	Suspension between bogie and car body	Secondary spring ▪ rests on the bogie frame, PC2.11 ▪ supports locomotive (car) body, PC2.17 ▪ transmits also forces in lateral & longitudinal direction	o No permanent monitoring of springs available ▪ PC2.12 is available ▪ Inspection of springs during preventive maintenance => normally only records if spring is damaged or failed ▪ Measuring and recording of spring characteristic during preventive maintenance. Data (diagrams) available in depots / workshops in form of attachments to protocols (in paper or electronically)	Considered as example of a component that has influence to the traction chain	ditto

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
PC2.13	Secondary vertical damper	Damping of vertical movements between car body and bogie	Secondary vertical damper is linked by means of “rubber” bearings to: ▪ the bogie frame, PC2.11 ▪ the locomotive (car) body, PC2.17	o No permanent monitoring of dampers available on the locomotives ▪ PC2.13 is available ▪ Inspection of dampers during preventive maintenance => normally only records if damper is leaking, is damaged or failed ▪ Measuring and recording of damper characteristic during preventive maintenance. Data (diagrams) available in depots / workshops in form of attachments to protocols (in paper or electronically)	Considered as example of a component that has influence to the traction chain	ditto
PC2.15	Secondary yaw damper	Damping of yaw movements between car body and bogie	Secondary yaw damper is linked by means of “rubber” bearings to: ▪ the bogie frame, PC2.11 the locomotive (car) body, PC2.17	o No permanent monitoring of dampers available on the locomotives ▪ PC2.15 is available ▪ Inspection of dampers during preventive maintenance => normally only records if damper is leaking, is damaged or failed ▪ Measuring and recording of damper characteristic during preventive maintenance. Data (diagrams) available in depots / workshops in form of attachments to protocols (in paper or electronically)	Considered as example of a component that has influence to the traction chain	ditto
PC2.16	Secondary traction rod with rubber bearings	Flexible traction and brake force transmission between bogie and car body	Secondary traction rod is linked by means of rubber bearings to: ▪ the bogie frame, PC2.11 ▪ the locomotive (car) body, PC2.17	o No permanent monitoring of traction rod available ▪ PC2.16 is available ▪ Inspection of traction rods during preventive maintenance => normally only records if rubber bearing or rod (body) is damaged or failed ▪ Measuring and recording of bearing characteristic during preventive maintenance. Data (diagrams) available in depots / workshops in form of attachments to protocols (in paper or electronically)	Considered as example of a component of the traction chain	ditto

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
PC2.18	Coupling device: Pair of buffers and sprung screw coupling or (semi) automatic coupler	Flexible traction and brake force transmission between two railway vehicles.	Coupling device is: ▪ built on to the locomotive (car) body, PC2.17 ▪ linked to the coupling device of the next vehicle	o No permanent monitoring of coupling devices available on the locomotives ▪ PC2.18 is available ▪ Inspection of coupling devices during preventive maintenance => normally only records if coupling device is damaged or failed ▪ Measuring and recording of spring characteristic during preventive maintenance. Data (diagrams) available in depots / workshops in form of attachments to protocols (in paper or electronically)	Considered as example of a component that is part of the traction chain	ditto
PC3	Traction motor & gearbox (incl. bogie integration)	The traction motor used to rotate the axle of an electric or diesel electric locomotive. It is mounted close to the axle and transmits power through a gearbox. The 3-phase traction motor is compact, robust and shall has a high reliability.	Traction motors are integral part of the traction chain Interface to the: o Bogie frame o traction converter (PC1, PC1.1, PC1.2) o Sensor (PC1.4) motor temperature sensors speed sensors o Control Electronics (PC1.3)	PC3 is available. Data are available from the Control Electronic PC1.3 (indirect from PC1.4) which sent the information to the superior diagnosis system on vehicle level. Inspection of traction motor during preventive-/corrective maintenance. Measuring and recording of electrical characteristic during preventive or corrective maintenance or repair according to the operation manual. o Vibration monitoring not available on locomotive o Standby time monitoring (DC-link charged and pulsing) is not available on locomotive o Switching On/Off time monitoring is not available for motor	OB1 - example of important electro-mechanical system in traction chain	ditto
PC3.1	Torque reaction link of traction motor	Flexible torque reaction link between traction motor and bogie frame	Torque reaction link interface to: o Bogie frame o Traction motor o Gear box	PC3.1 is available. Inspection of traction motor during preventive-/corrective maintenance. Measuring and recording of characteristic during preventive or corrective maintenance or repair. o no resonance/oscillation measurements are available o no measurements on locomotive for stress due	OB1 - example of important electro-mechanical system in traction chain	ditto

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
				vibration and shock		
PC3.2	Traction motor monitoring and sensors	Traction motors are equipped with sensors for monitoring the rotor speed and the stator temperature. The motor speed sensor provides the input signal for the speed and traction effort control to the drive control unit.	Traction motors monitoring and sensors are part of the traction chain Interface to the: o Bogie frame PC2.11 o traction converter (PC1, PC1.1, PC1.2) o Control Electronics (PC1.3)	PC3 is available. Data are available from the Control Electronic PC1.3 (indirect from PC1.4) which sent the information to the superior diagnosis system on vehicle level. Inspection of traction motor during preventive-/corrective maintenance. Measuring and recording of electrical characteristic during preventive or corrective maintenance or repair according to the operation manual. o Vibration monitoring not available on locomotive o Standby time monitoring (DC-link charged and pulsing) is not available on locomotive o Switching On/Off time monitoring is not available for motor	OB1 - example of important electro-mechanical system in traction chain	ditto
PC4	Line voltage system	Voltage source from which the vehicle takes its traction energy and, in braking mode, uses for energy recovery.			Excluded from demonstrator to reduce complexity, all other subsystems of the traction chain will not be considered	n/a
PC5	Transformer	The main transformer is used for converting the line voltage into a voltage level that can be conveniently handled by modern power electronic devices without connecting semi-conductors in series, and be supplied to the traction motors without further transformation.			ditto	n/a

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
PC6	Auxiliary converter	Auxiliary converter converts either direct or alternating voltage from the contact line, main transformer, heating train line or DC-link into a direct or alternating voltage. The output signal may have either a variable or fixed voltage and frequency. AUX are used to charge vehicle batteries, to supply electronics, to drive ventilators and compressors.			ditto	n/a
PC7	Other subsystems (Brake resistors, filters etc)				ditto	n/a
PC8	PEID's	PEID's shall gather and provide various data about the behaviour of the loc and its main components in operation	PEID's are interfaced with the TCMS via a bus system	Various kinds of PEID's (e.g. sensors) are already installed and are considered within the demonstrator. Most probably no additional or newly designed PEID's will be necessary.	OB1 – only already installed PEID's are included (see left)	FU2

Table 59: Physical components (PCs) of the A10 PROMISE demonstrator

10.6 A10 – The demonstrator software/support-systems (SSs)

ID	Software / support system	Describe its functionality	Describe the necessary interfaces of this software/support system to other PC IDs, SS IDs etc	Is this software / support system already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to the Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
SS1	Train Control and Management System (TCMS)	The vehicle control and communication system of the locomotive	Powerful serial bus systems are used for information transfer between traction vehicles (train control level) and between the components of the vehicle itself (vehicle control level).	The MITRAC® vehicle and train control system consists of a multi-computer architecture for the functions on train and vehicle control level as well as controllers for the drive control level. The latter are designed for specific traction converter requirements such as high processing speed. The processing of train and vehicle functions is realised in the vehicle and train control software, which is a control application running on the Display and Control Processing Unit (DCPU) hardware.	Excluded from demonstrator TCMS manages some of the needed field data, which will be gathered within the Field Info Database	FU2
SS2	Diagnostic System	The diagnostic system serves both for visualising the main locomotive operating values and for diagnostic purposes.	Diagnostic facilities are spread over all train and vehicle functions and are hierarchically structured to train, vehicle and subsystem levels.	On the subsystem level, diagnostic messages are generated if disturbances, faults or failures occur in the monitored processes. They are transferred to the next hierarchic level, the vehicle diagnostic system, to be stored in a non-volatile memory. The stored data are represented on displays in the driver's cab (or in the coaches) for two target groups: operational personnel like locomotive drivers (operational diagnostics) and maintenance personnel (maintenance diagnostics).	Excluded from demonstrator Diagnostic system holds some of the needed field data, which will be gathered within the Field Info Database	FU2
SS3	Maintenance management system	The program BTRAM (based on MAXIMO resp. VIPSCARSIS) is used within BT as Configuration and Maintenance Management	Interfacing can be developed to PDM, MRP/ERP systems	Configuration Management is used to described the process of tracking the maintenance and repair history of vehicles and their registered component parts throughout the lifecycle	Excluded from demonstrator Maintenance Mgt system manages some of the needed field data, which will be gathered within the Field Info Database	FU2

ID	Software / support system	Describe its functionality	Describe the necessary interfaces of this software/support system to other PC IDs, SS IDs etc	Is this software / support system already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to the Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
SS4	Field info database	Database manages all kind of field data captured by CM/CBM, FRACAS, Service and/or PEID's and their aggregation into information	Provides necessary input data / information to DfX Transformer SS6	A single system for all kind of field data is not available. Currently the field data is mainly managed contract specific. • Condition Monitoring / Condition Based Maintenance • Diagnosis System • Event Recorder • Maintenance Management Systems • Inspection Information • Failure Reporting Analysis and Corrective Action System (FRACAS)	OB2 – Field info database makes first aggregation of field data	FU1
SS5	Other information sources	Provision of additional necessary information on product, lessons-learnt, standards, etc.	Provides necessary input data / information to DfX Transformer SS6	Available are • PDM system • Lotus Notes databases • eBoK's (Intranet) • Internet • and other similar data & information sources (DfX basic data, standards, etc.)	OB2 – sources are providing needed data & information	FU3
SS6	DfX Transformer	The DfX Transformer accesses all specified input data and information sources, processes this data & information into DfX knowledge according the defined transformation methods, provides the specified DfX knowledge to PDKM system	Transforms data from Field Info Database SS4 & Other Info Sources SS5 into knowledge managed by PDKM SS8, and is supported by Decision Support System SS7	Not available It has to be considered that the input data is based on different types of configurations, e.g. field data on 'as-maintained' and design data on 'as-designed'.	OB2 – further aggregation of data & information OB3 – supports transformation process	FU4

ID	Software / support system	Describe its functionality	Describe the necessary interfaces of this software/support system to other PC IDs, SS IDs etc	Is this software / support system already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to the Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
SS7	Decision support system	The Decision Support System supports specialist engineer in the transformation process by aggregating necessary data & information into deciding basis & decision proposals	Support transformation process interfacing to DfX Transformer SS6	Not available	OB4 – supports decision making process	FU5
SS8	PDKM environment	PDKM environment shall incorporate KM functionalities to manage the knowledge provided by the DfX transformer, structured according to a predefined work breakdown structure (WBS) with various vehicle, system and location elements.	Manages the output of transformation process from DfX Transformer SS6	PDM System (UGS Teamcenter 2.0) is available, but a specific KM functionality / system is not available.	OB5 – supports management of DfX knowledge	FU6

Table 60: Software / support systems (SSs) of the A10 PROMISE demonstrator

10.7 A10 – Description of the functionality (FUs) of the demonstrator

ID	Functionality	Comments to the functionalities	Define the inputs needed to achieve this functionality and relate the input to other FU IDs (e.g. output data from FU3)	Define the outputs from this functionality	What are the controls? ID the controls by using C1, C2 etc	Technologies/Physical components/Systems/Actors involved	Rationale Describe why this functionality is needed	Priority High, Medium, Low	Related to objective ID
FU1	Field info database to manage all kind of field data	Database shall manage all kind of field data captured by CM, FRACAS (VIPSCARSIS, MAXIMO), Service and/or PEID's and shall standardize this electronic data for transfer to the demonstrator (see Use Case Diagram).	Collection of field data related to functions, systems and / or components, which are relevant for a function, as: • date, time and location when / where failure occurred • operating circumstances • environmental conditions • symptoms • effect on train service • operator's actions after failure • primary / secondary fault assignment • circumstances under which fault was first become apparent • operating distance, time, cycles, since it was put into service	Provide standardized field data related to function, systems and / or components, which are relevant for the design of a function, covering detailed information about: • date, time and location when / where failure occurred • operating circumstances • environmental conditions • circumstances under which fault was first become apparent • symptoms • effect on train service • operator's actions after failure • operating distance, time, cycles, since it was put into service • primary / secondary fault assignment Input data to FU4 and FU5	C1 Actors are governing the field info database according P&O definition C2 Data input is activated by the communication unit of TCMS C3 Data output is activated by requests of the DfX Transformer	A great number of event data is recorded in Diagnosis Systems (e.g. GSM-R, MITRAC Remote), but those data are not linked to failure occurrences which are stored in the MAXIMO data base Involved actors are • Operator • Maintainer • Service organisation / commissioning engineers • DfX specialist engineer	Development of proven design, standardized assessment of recorded field data to identify repeat defects, systematic problems and the root causes such that corrective actions can be established. Detailed information of functions, systems and / or components which did not cause problems aren't available. Field experiences about functions are totally missing. Field data are only gathered during warranty period and in case problems / failures have been detected which are relevant for validation of the vehicle.	Medium	OB2
FU2	Read in different kind of field data from different sources	Demonstrator shall accept all kind of field data captured and processed by field data base and from other sources as: CM/CBM, FRACAS (VIPSCARSIS, MAXIMO), Service and/or PEIDs and shall aggregate this electronic data into appropriate information (see Use Case Diagram).	Field data from FU1 and other sources related to function, systems and / or components, which are relevant for a function	▪ Process input data for further steps. ▪ Check data for plausibility as far as possible.	C4 Activation by DfX Demonstrator requiring information	Data exchange technologies between different kind of systems & tools	All kind of field data shall be accessible for transformation process	High	OB2
FU3	Read in additional necessary information on product, lessons-learnt, standards, etc.	Allow the access of the DfX Transformer to electronic information in PDM, Lotus Notes databases, EboK's (Intranet), Internet (see Use Case Diagram).	a) Lessons learned – structured according WBS – from their different engineering phases of existing platform projects, related to functions, systems and / or components b) Requirements related to functions - customer specific requirements - standards and / or guidelines - safety specific requirements	▪ Process input data for further steps. ▪ Check data for plausibility as far as possible.	C4 Activation by DfX Demonstrator requiring information	Data exchange technologies between different kind of systems & tools	a) Enhancement of explicit Know-how, "lessons learnt" information is incorporated in functions of new vehicles, reduce or eliminate possible failure mechanisms early in the design phase where they may be easier	Medium	OB2

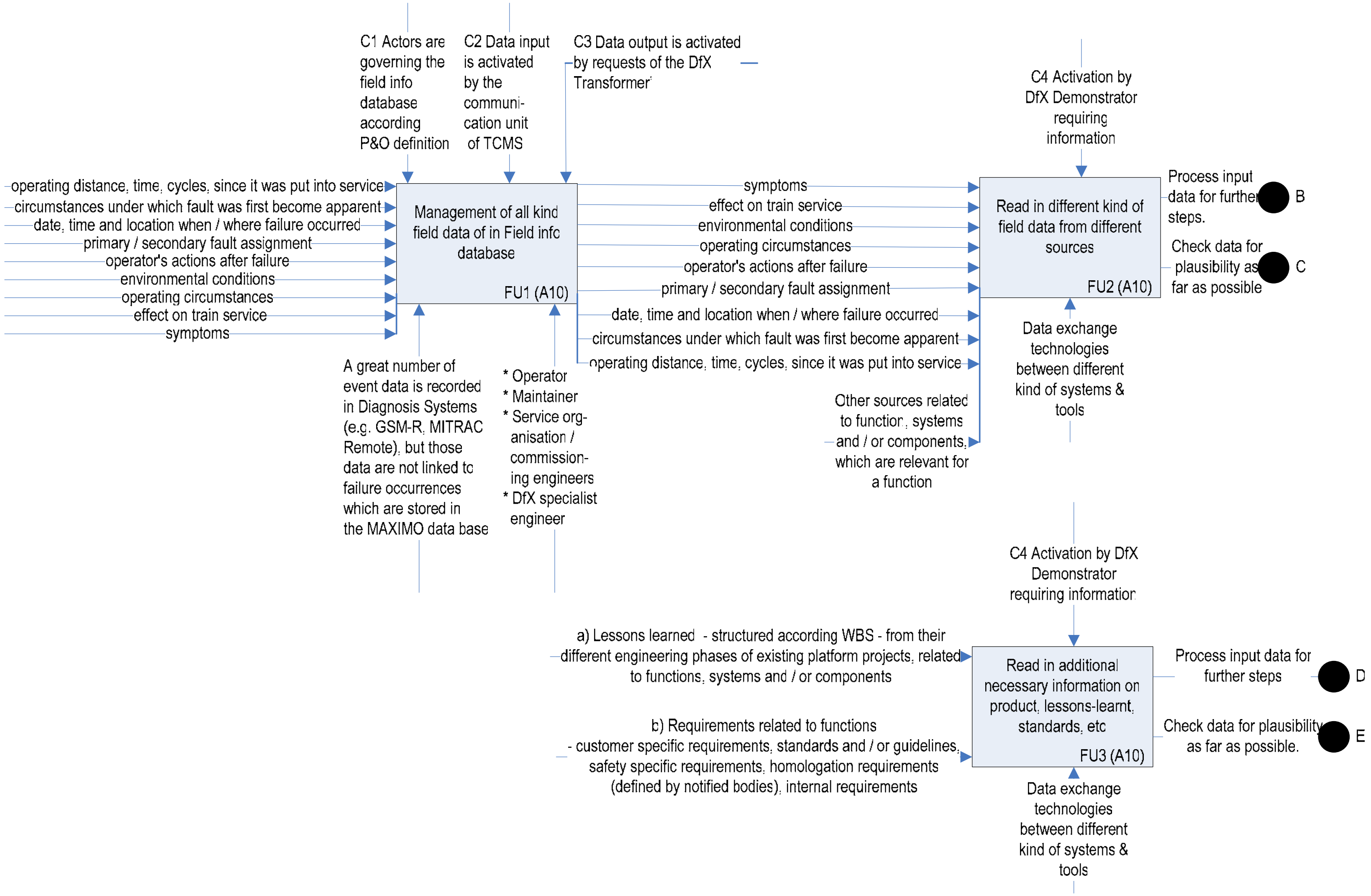
ID	Functionality	Comments to the functionalities	Define the inputs needed to achieve this functionality and relate the input to other FU IDs (e.g. output data from FU3)	Define the outputs from this functionality	What are the controls? ID the controls by using C1, C2 etc	Technologies/Physical components/Systems/Actors involved	Rationale Describe why this functionality is needed	Priority High, Medium, Low	Related to objective ID
			- homologation requirements (defined by notified bodies) - internal requirements				to locate and correct; share of experience among different projects b) All different requirements are taken into account during the design phase		
FU4	Transformation of data into DfX knowledge	Transformer processes, semi-automatically DfX knowledge following defined transformation methods under governance of specialist engineer. Transformer provides the DfX knowledge to PDKM system (see Use Case Diagram). DfX knowledge shall be periodically updated if additional field data or other information is available. For the aggregation and transformation process the different configuration (as-designed, as-built, as-maintained) of the input data shall be considered appropriately. The tool supporting the transformation process shall be easy to use and preferably integrated with the other tools in a portal.	Selection off all relevant data for each function, system or component Output data from FU2 and FU3	Provision of DfX knowledge to PDKM system Input to FU6	C5 DfX Specialist Engineers are governing the DfX Transformer according P&O definition C6 Decision support system requires information and/or provides necessary deciding basis & decision proposals	Involved actors: • DfX Specialist Engineers ⇨ DfRAM/LCC Provide reliability value of functions, systems and / or components and dependency on / influence to (e.g. min / max values) due to: - operation distance - operating time (driving- and stand by mode) - operating cycles - minimal, nominal and maximum load - ambient temperature - preventive maintenance ⇨ DfSafety Provide information about system conditions – same as for RAM/LCC – that are relevant for the BT safety hazards: - Asphyxiation - Burns - Biological hazards - Chemicals - Collision - Crush - Cut - Derailment - Fall - Electrocution - Impact - Medical equipment incompatibility - EMC (e.g. interference	Central functionality of DfX demonstrator The pure calculated or measured reliability figures are often not very meaningful without knowing on which information the values are based e.g. field data and / or calculation model. Knowing the impact of different factors on the reliability supports the selection of systems / components in the design process	High	OB3

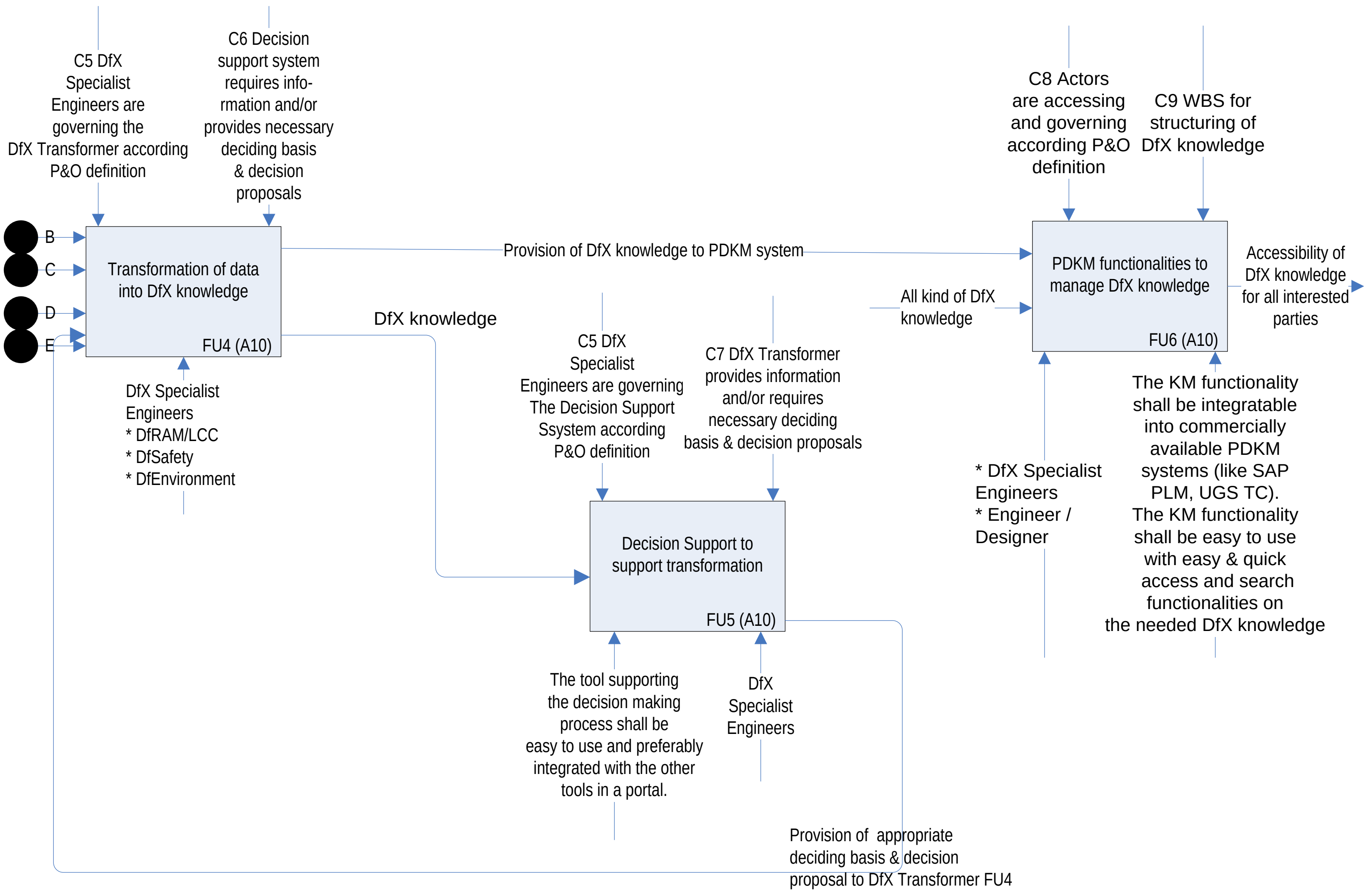
ID	Functionality	Comments to the functionalities	Define the inputs needed to achieve this functionality and relate the input to other FU IDs (e.g. output data from FU3)	Define the outputs from this functionality	What are the controls? ID the controls by using C1, C2 etc	Technologies/Physical components/Systems/Actors involved	Rationale Describe why this functionality is needed	Priority High, Medium, Low	Related to objective ID
						with signalling system) ⇨ DfEnvironment: Provide information of products, systems and components regarding - Material choice (BT list of prohibited & restricted material) considering the categories 'prohibited material', 'restricted material', 'recycled material' and 'renewable material' - End-of-use aspects (recycling, marking, take back obligations, disposal cost) - Energy related issues (total energy use, energy solutions) - Emissions (e.g. noise) - Energy consumption - EMC behaviour			
FU5	Decision Support to support transformation	The Decision Support System shall aggregate necessary data & information and provide appropriate deciding basis & decision proposals to the DfX transformation process.	The necessary input shall be provided by the DfX Transformer FU4	Provision of appropriate deciding basis & decision proposal to DfX Transformer FU4	C5 DfX Specialist Engineers are governing the Decision Support Ssystem according P&O definition C7 DfX Transformer provides information and/or requires necessary deciding basis & decision proposals	Involved actors: • DfX Specialist Engineers The tool supporting the decision making process shall be easy to use and preferably integrated with the other tools in a portal.	The transformation process requires various kind of decisions. Therefore a support is needed to provide the DfX Specialist with needed deciding basis and / or decision proposals.	Low	OB4

ID	Functionality	Comments to the functionalities	Define the inputs needed to achieve this functionality and relate the input to other FU IDs (e.g. output data from FU3)	Define the outputs from this functionality	What are the controls? ID the controls by using C1, C2 etc	Technologies/Physical components/Systems/Actors involved	Rationale Describe why this functionality is needed	Priority High, Medium, Low	Related to objective ID
FU6	PDKM functionalities to manage DfX knowledge	PDKM functionalities shall manage the knowledge provided by the DfX transformer, structured according to a predefined work breakdown structure (WBS) with various vehicle, system and location elements.	All kind of DfX knowledge Output of FU4	Accessibility of DfX knowledge for all interested parties	C8 Actors are accessing and governing according P&O definition C9 WBS for structuring of DfX knowledge	Involved actors: • DfX Specialist Engineers • Engineer / Designer The KM functionality shall be integratable into commercially available PDKM systems (like SAP PLM, UGS TC). The KM functionality shall be easy to use with easy & quick access and search functionalities on the needed DfX knowledge.	The transformed DfX knowledge must be accessible to all interested parties (mainly engineers/designers) Integrity of DfX knowledge must be managed.	Medium	OB5

Table 61: Functionalities (FUs) of the A10 Demonstrator

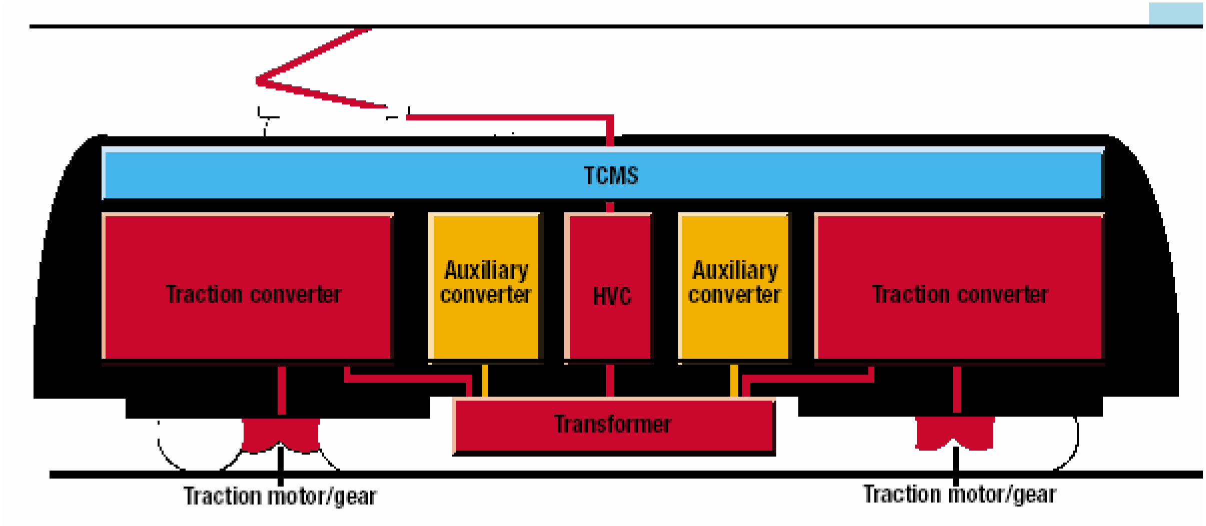
10.8 A10 – Draft illustration of the demonstrator's functionalities




C5 DfX Specialist Engineers are governing the DfX Transformer according P&O definition
C6 Decision support system requires info-rmation and/or provides necessary deciding basis & decision proposals
C8 Actors are accessing and governing according P&O definition
C9 WBS for structuring of DfX knowledge
B
C
D
E
Transformation of data into DfX knowledge
FU4 (A10)
Provision of DfX knowledge to PDKM system
PDKM functionalities to manage DfX knowledge
FU6 (A10)
Accessibility of DfX knowledge for all interested parties
All kind of DfX knowledge
DfX knowledge
C5 DfX Specialist Engineers are governing The Decision Support Ssystem according P&O definition
C7 DfX Transformer provides information and/or requires necessary deciding basis & decision proposals
DfX Specialist Engineers
* DfRAM/LCC
* DfSafety
* DfEnvironment
* DfX Specialist Engineers
* Engineer / Designer
The KM functionality shall be integratable into commercially available PDKM systems (like SAP PLM, UGS TC).
The KM functionality shall be easy to use with easy & quick access and search functionalities on the needed DfX knowledge
Decision Support to support transformation
FU5 (A10)
The tool supporting the decision making process shall be easy to use and preferably integrated with the other tools in a portal.
DfX Specialist Engineers
Provision of appropriate deciding basis & decision proposal to DfX Transformer FU4

10.9 A10 – Additional information and illustrations related to the BT-LOC demonstrator

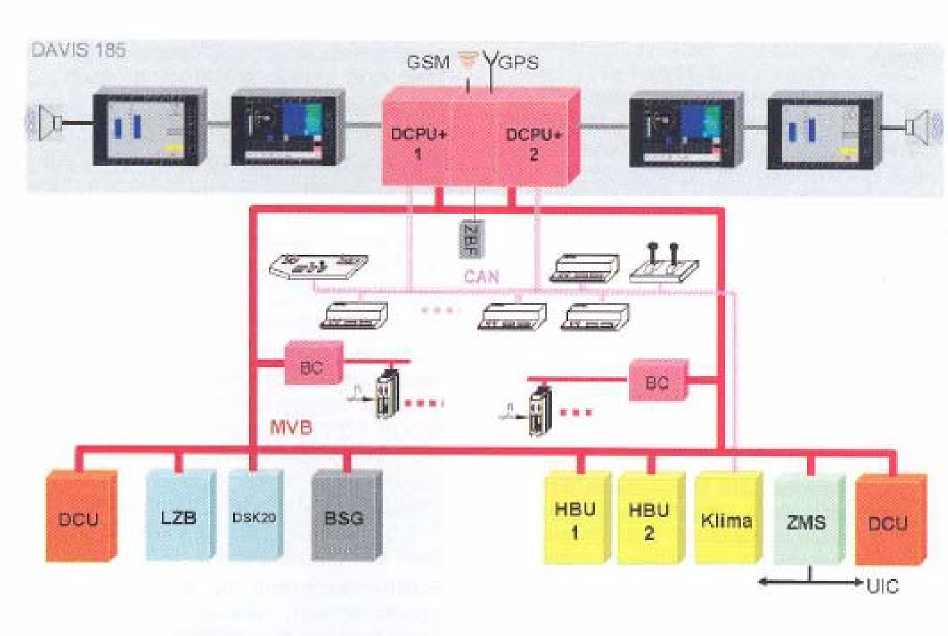
A) Traction chain of el. locomotive:



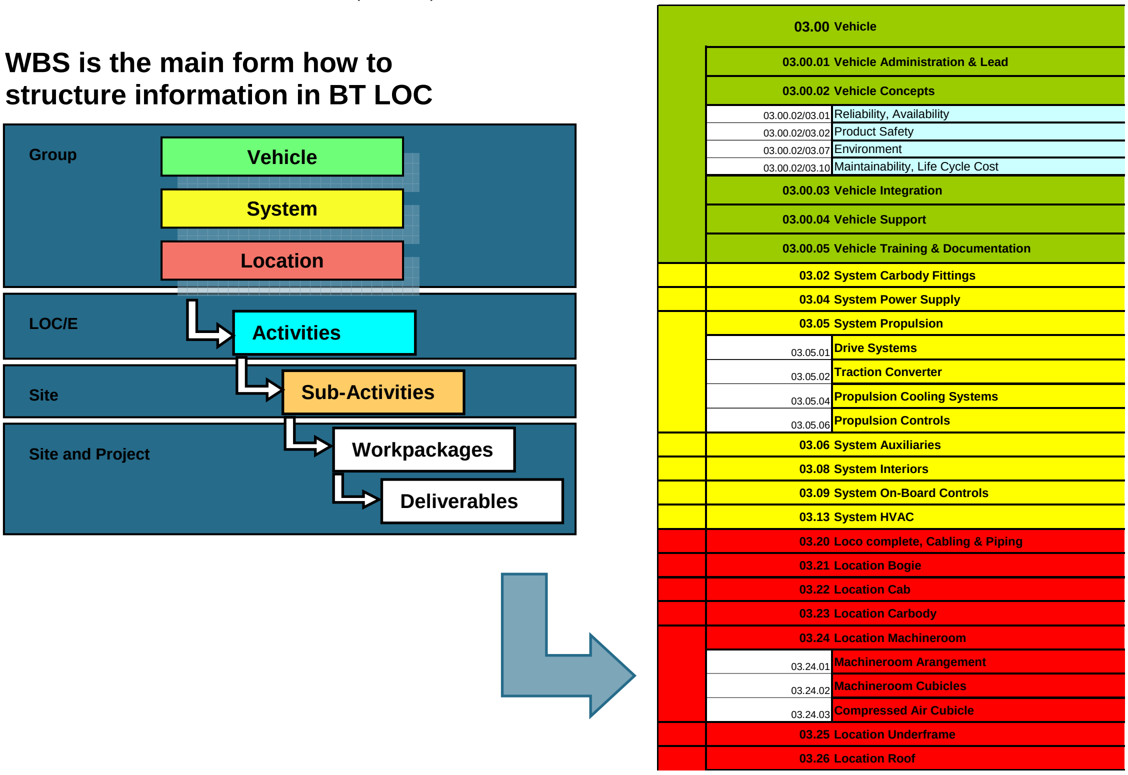
B) Train Control and Management System

TCMS includes

- Sensors
- Vehicle bus
- Diagnosis system
- External communication via GSM



C) Work Breakdown Structure (WBS)



PROMISE Demonstrator A11
POLIMI (BOL)

Written by:
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DELIVERABLE NO	Relates to DR3.2: PROMISE Demonstrator WP A11
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WORK PACKAGE NO	WP R3
VERSION NO.	1.3
ELECTRONIC FILE CODE	dr3_2 appendix a demonstrators~2.doc
CONTRACT NO	507100 PROMISE A Project of the 6th Framework Programme Information Society Technologies (IST)
ABSTRACT:	This is the final version of the document and will form the basis for the deliverable DR3.2.

STATUS OF DELIVERABLE		
ACTION	**BY**	**DATE** (dd.mm.yyyy)
SUBMITTED (author(s))	Andrea Matta	26.04.2005
VU (WP Leader)	POLIMI	
APPROVED (QIM)	To be approved in deliverable DR 3.2	

Revision History

Date (dd.mm.yyyy)	Version	Author	Comments
01.04.2005	0.1	Carl Christian Røstad	This is the first draft version of the document. This document will be the basis for the discussions in the meeting in Munich 11.-12. April
11.04.2005	0.2	Carl Christian Røstad	Updated structure based on input from the Munich meeting on the 11.-12. April 2004. The version was sent SAP, EPFL, BIBA, STOCKWAY and INFENEON for comments before distribution.
26.04.05	1.2	Maurizio Tomasella, Andrea Matta	New version of the document, based on version 0.2 received from Carl Christian. To be submitted SINTEF.
05.05.2005	1.3	Carl Christian Røstad	Updated structure of the document and added draft illustration of functionalities

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11 A11 POLIMI (BOL) – Definition of the demonstrator

11.1 A11 – The Demonstrator

Demonstrator	Describe functionality	Describe why this Demonstrator is focused in PROMISE
WPA11/BOL/Adaptive Production. The demonstrator is a software for the support of the decision on the selection of the best change action to introduce in the production system related to the *cylinder head* of the FIAT multi jet diesel engine.	The demonstrator provides robust support to the decision maker in deciding how to modify the production system layout, technology and equipment to satisfy the new product and/or process requirements. In more detail,. the possible adaptation actions are: • Introduction of new machines in the production line. • Introduction of new part transporters in the production line. • Introduction of additional WIP buffers in the production line. • Introduction of new work operators in the production line. • Modification of process parameters. • Modification of the number of fixtures flowing in the production line.	This Demonstrator closes the loop between MOL/EOL and BOL. Indeed the information collected from the field during the MOL and EOL phases is transformed into knowledge which, in turn, generates new ideas for improving the product. The improvement of the product may cause changes of the related production systems often costly or sometimes infeasible. The demonstrator creates the conditions for closing this loop.

Table 62: The A11 PROMISE demonstrator

11.2 A11 – Objectives (OBs) of the Demonstrator

ID	Objective (one per ID)	Describe why
OB1	Production system reconfiguration	The optimal adaptation of the production system is important because it allows the continuous improvement of the product.
OB2	What if analysis	The What If analysis is important to quantify the impact of a potential modification of the product and/or the process. Indeed the product/process designer often considers a large variety of alternative modifications that are difficult to assess in terms of performances obtained at the factory shop floor level. For example it is not possible, without such an analysis, to properly assess the impact of all these alternatives in terms of system throughput, production cost, etc.

Table 63: Objectives (OBs) of the A11 PROMISE demonstrator

11.3 A11 – Involved actors (ACs) in the whole lifecycle of the Demonstrator

ID	Actor	External / Internal	Describe how they will be involved, their role and impact of the PROMISE technology	Importance / Relevance High, Medium, Low	BOL	MOL	EOL
AC1	Production system designer	Internal	He is responsible for the design of the production system and directly uses the decision support software, i.e. the demonstrator. He proofs the feasibility of new systems configurations by using the demonstrator, and chooses the adaptations to be implemented into the present production system, i.e. the new system configuration.	HIGH	X		
AC2	Product designer	Internal	He designs the product, e.g. he modifies the product following what has been gathered from the field. He evaluates the impact of the design modifications on the production system performance, both in terms of technical and economic performance, directly before the implementation of such modifications.	MEDIUM	X		
AC3	Process designer	Internal	He designs the production process, e.g. he modifies the production process following what has been gathered from the field. Then he can make the same evaluations as the product designer, but concerning process modifications instead of product ones.	MEDIUM	X		
AC4	Production planner	Internal	He manages the production system, e.g. plans how to produce the products. He is involved in the adaptation of the production system to the new requirements because he is the one who can directly measure the implications of different potential system configurations on the production capacity offered by each configuration to the firm, thus allowing the production planner to evaluate different plans and modes of use directly comparing the system performance to the market demand. This is also enabled by the possibility of having this demonstrator and of using it in everyday practice.	LOW	X		

Table 64: Involved lifecycle actors (ACs) of the A11 PROMISE demonstrator

11.4 A11 – The demonstrator physical components (PCs)

ID	Physical component	Describe its functionality	Describe the necessary interfaces of this physical component to other PC IDs, SS IDs etc	Is this physical component already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
No physical component needed for A11 Demonstrator, which is simply a software. This software will be able to simulate different configurations for the production system of anyone of the products considered in PROMISE (though the demonstrator will be developed basically considering the case of the cylinder head of the FIAT multijet diesel engine). The same software will provide support for decision making to actors described in section 2.3.						

Table 65: Physical components (PCs) of the A11 PROMISE demonstrator

11.5 A11 – The demonstrator software/support-systems (SSs)

ID	Software / support system	Describe its functionality	Describe the necessary interfaces of this software/support system to other PC IDs, SS IDs etc	Is this software / support system already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to the Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
SS1	PROMISE DSS	The full functionality of the PROMISE Decision Support System, as to be still defined inside task TR9.1 from WPR9.	See Table 6 and section 2.7 for details.	It shall be the PROMISE official Decision Support System.	OB1, OB2	
SS2	A11 Demonstrator	The demonstrator provides robust support to the decision maker in deciding how to modify the production system layout, technology and equipment to satisfy the new product and/or process requirements. In more detail,. the possible adaptation actions are: • Introduction of new machines in the production line. • Introduction of new part transporters in the production line. • Introduction of additional WIP buffers in the production line. • Introduction of new work operators in the production line. • Modification of process parameters.	See Table 6 and section 2.7 for details.	Software tools for the configuration of production systems have already been developed by POLIMI. The software for A11 demonstrator will be developed.	OB1, OB2	FU4

ID	Software / support system	Describe its functionality	Describe the necessary interfaces of this software/support system to other PC IDs, SS IDs etc	Is this software / support system already available at your company today or not? Please describe how and in what form it is available, or what is needed in order to get it available	What is the relation to the Demonstrator objectives	Relate this to all relevant functionalities (FU IDs)
		• Modification of the number of fixtures flowing in the production line. In particular, with regard to Table 6, its functionality is mainly FU4.				
SS3	PROMISE PDKM- Data Base	With regard to Table 6, its functionalities are mainly FU1 and FU2.	See Table 6 and section 2.7 for details.	It shall be the PROMISE official PDKM system.	OB1, OB2	FU1, FU2
SS4	SDKM- Data Base	With regard to Table 6, its functionality is mainly FU3.	See Table 6 and section 2.7 for details.	Some kind of Data Base for production systems is now under construction inside POLIMI for other purposes.	OB1, OB2	FU3

Table 66: Software / support systems (SSs) of the A11 PROMISE demonstrator

11.6 A11 – Description of the functionality (FUs) of the demonstrator

ID	Functionality	Comments to the functionalities	Define the inputs needed to achieve this functionality and relate the input to other FU IDs (e.g. output data from FU3)	Define the outputs from this functionality	What are the controls? ID the controls by using C1, C2 etc	Technologies/Physical components/Systems/Actors involved Describe the technologies involved, or assumed technology/systems needed	Rationale Describe why this functionality is needed	Priority High, Medium, Low	Related to objective ID (Sec 1.2)
FU1	To receive data concerning the product, with or without modification with respect to the present product.		Information request, from FU4.	O1-product data, to FU4.	C1- Internal Capacity. C2- Budget constraint.	M1-SS3.		HIGH	OB1, OB2
FU2	To receive data concerning the process, with or without modification with respect to the present process.		Information request, from FU4.	O1-process data, to FU4.	C1- Internal Capacity. C2- Budget constraint.	M1-SS3.		HIGH	OB1, OB2
FU3	To receive data concerning the production system, with or without modification with respect to the present system.		Information request, from FU4.	O1-production system data, to FU4.	C1- Internal Capacity. C2- Budget constraint.	M1-SS4.		HIGH	OB1, OB2
FU4	To optimize the configuration of the production system, adapting it to product and process modifications..		I1-product data, from FU1. I2-process data, from FU2. I3-production system data, from FU3. I4-Performance for the configuration evaluated, from FU5.	O1-A feasible configuration for the production system.	C1- Internal Capacity. C2- Budget constraint.	M1-AC1,AC2,AC3,AC4. M2- Configuration rules.		HIGH	OB1
FU5	To evaluate the performance of the production system.		I1- production system configuration, from FU4.	O1- Performance for the configuration evaluated, to FU4.	C3- Maximum computational time.	M1- Evaluation tools (e.g. analytical Methods, simulation).		HIGH	OB2

Table 67: Functionalities (FUs) of the A11 Demonstrator

11.7 A11 – Draft illustration of the demonstrator's functionalities