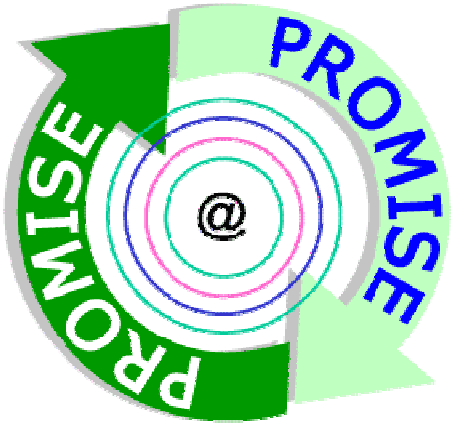
Appendix B: Application Scenarios

Appendix B: Application scenarios

In this appendix, all the application scenarios developed by the partners for the first deliverable DR3.1 of work-package R3 are presented. Where there are discrepancies between the Demonstrator and the Application Scenario, the demonstrator-document overrides all aspects of the scenario.



Application Scenario Description
CRF EOL

Written by:
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05.01.2005	1.1	Carl Christian Røstad, SINTEF	Updated v1.0 document – Chapter references below refers to the old chapter structure in v1.0 ♦ 3.14 Technical interfaces - DELETED (transferred to WP R1) ♦ 3.15 Facility and quality technical requirements – DELETED (transferred to WP R1) ♦ 3.16 Hardware and software platforms in use – DELETED (transferred to WP R1) ♦ 4.2 To-be, Future scenario concept - REMOVED ERRONUS DESCRIPTION TEXT ♦ 4.3 GAP analysis of As-is and To-be - REMOVED ♦ 4.6 Cost models - DESCRIPTION CHANGED ♦ 5.2 Describe possible downsides/upsides … - DESCRIPTION UPDATED ♦ 6.4 Improved LCA indications - REMOVED ♦ 6.5 Improved MOL/BOL/EOL options - REMOVED ♦ 7.1 Changed labour/work conditions - DESCRIPTION UPDATED ♦ 7.2 Social Impact on society - DESCRIPTION UPDATED ♦ 7.3 Ethical issues - DESCRIPTION CHANGED
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1 Application scenario description A1 CRF EOL

Where discrepancies, the Demonstrator-document overrides all aspects of this scenario.

Purpose and objective(s) of the scenario
Give a detailed description of the scenario objective – What is the purpose of the scenario

The envisaged scenario refers to the use of PEIDs for managing the passengers vehicles End of Life, the decision making and process management.

The overall scenario includes:

- The delivery of the ELV to a dismantler;
- The deregistration of the ELV;
- The depollution of the ELV;
- The separation of parts for reuse or remanufacturing;
- The separation of parts suitable for recycling;
- The delivery of the hulk to a presser;
- The delivery of the pressed hulk to a shredder;
- The transport of parts for reuse/remanufacturing, of the hulk to be pressed, of the hulk to be shredded, of the materials to be recycled to their destination.

The objective of the scenario is to assess the use of PEID (most probably RFID) for improved decision making (based on information concerning parts status and history stored on the RFID), materials tracking and for testing the achievement of recycling and reuse targets as stated by the European directives.

Scenario objective(s) rationale
Describe the rationale for the objective, i.e. why is the objective important and why the objective is important to fulfil

The ELV (**E**nd of **L**ife **V**ehicle) directive (EU/2000/53) introduced by the EU in 2000 addresses pollution arising from vehicles that have reached the end of their useful life. The directive specifies thresholds for the reuse, recycling and recovery of materials from ELVs. By 2006 the ratio of materials in an ELV which should be reused, recycled or recovered will reach 85% of the total vehicle weight and 95% by 2015.

Moreover, End of Life is an area where PEID seem to provide major benefits:

- ID/use/environmental historical information to support decision making and add value to the EoL processing.
- effective and efficient tracking capability, similarly to logistics area.
- support to operating/routing instructions;

Relations with PROMISE objectives
Relate the application scenario to the PROMISE objectives as described in the Declaration of Work

The proposed scenario relates to all four objectives of PROMISE inasmuch:

- It develops a new closed loop life cycle information model;
- It contributes to the definition of a PLM and IT infrastructure;
- It will contribute to new standards concerning EoL treatments;
- It develops new business models appropriate to the EoL phase.

Lifecycle phase relevance (BOL, MOL, EOL)
Relate the scenario application to BOL, MOL, EOL, and clearly state the relevance to BOL, MOL and/or EOL

The scenario covers most of EoL processing and decision making. It uses data which derive from MoL (maintenenance data) and from BoL (BOM and dismantling/processing work instructions).

Marketing and Engineering can derive useful information from EoL, identifying among other overdesigned components/subsystems.

Product considered in scenario Describe the products in the scenario (e.g. car, truck). Include related functionality and life cycle issues.
The products being considered in the scenario are the ELV and its components.

Interfaces between lifecycle phases Describe the interfaces between relevant BOL, MOL and/or EOL
BoL: Engineering is supposed to provide detailed data concerning BoM, materials, dismantling and processing information. At the moment we have no information on data Engineering may wish to collect from the ELV. Data concerning the rate of recycling and reuse may be of some use, for design purposes and for detecting potentially over-designed parts. MoL: – data will be collected concerning component use/ environment/ maintenance. This information may be collected at vehicle level (global information), and/or subsystem level (local information); this information will be used for EoL management as well; – detached parts may be reused directly or after some remanufacturing/repair as a used spare part.

Illustration of the application scenario

Provide an illustration of the application scenario that can be used for communication purposes (e.g. in trade magazines, on the front of reports, slide shows etc). Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

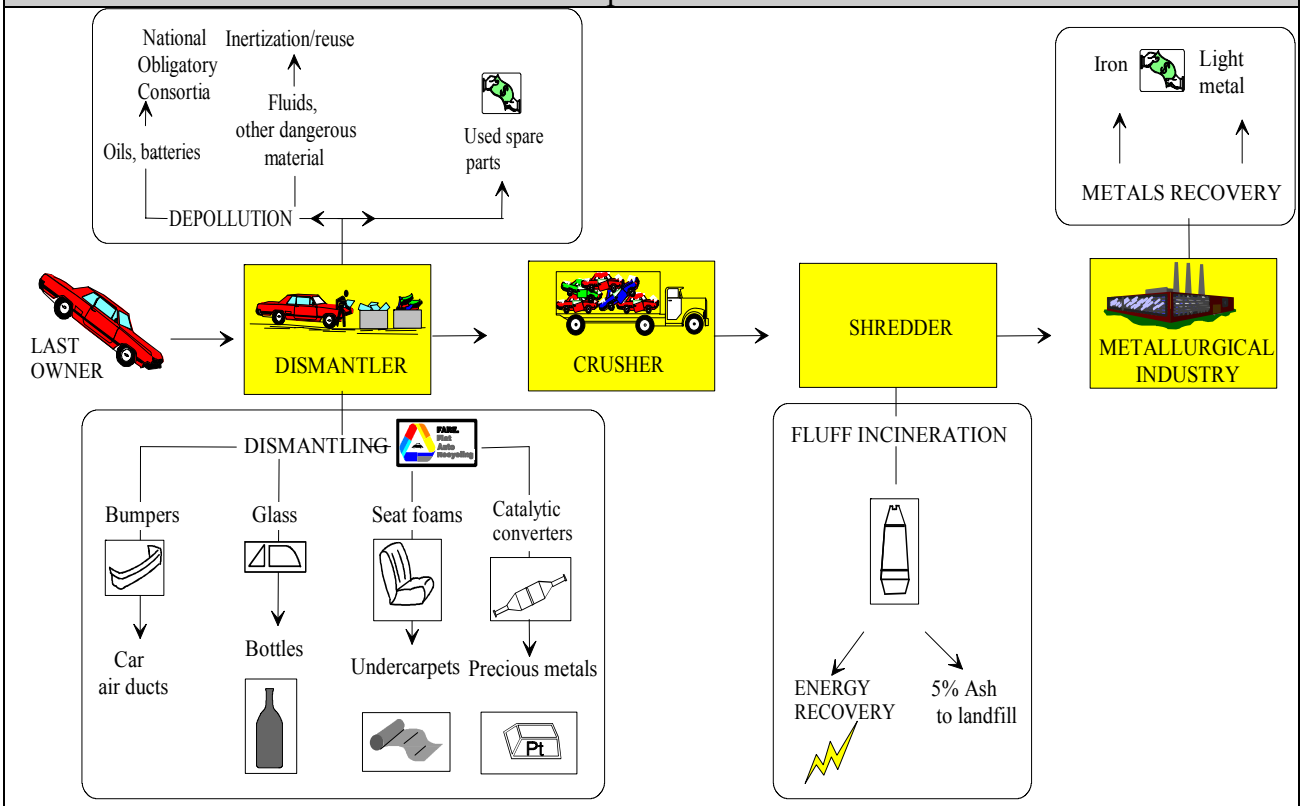

Illustration of the information flow (flowchart)

In order to identify informational requirements, illustrate the flow of information and clearly identify information/data flows by denoting this in the figure. Use rectangles, arrows, circles etc with text. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

Specific requirements needed in order to fulfil the objective (user requirements related to WP R1)

If there are some specific requirements that are needed to be fulfilled, please state them here.

Pain-points (problems/challenges) Identify the most important problems/challenges related to this scenario (e.g. technical, economical, ethical, environmental, customer related, partner related)
One should identify what parts/subsystems are potentially worth reusing/remanufacturing/recycling, which implies detaching in the first place. Then one should identify what information is needed to improve decision making (e.g. some material may have no use if the average humidity is higher than a give threshold). This specifies the information to be captured. Then one should study how to capture this information and where to store it. A good solution might be on the on-board computer. After dismantling the the information should be attached to the component PEID and follow the part. This read and write facility is an issue to be tackled by the project.

Other aspects related to the Application Scenario If some aspects are not are covered above, please use this field.

1.1 Technical issues A1

***Data&Information*: Product Information requirements**

List what sort of data is to be gathered from e.g. PEIDs. Show how the data is to be transformed into information. Use a tree diagram to illustrate the flow of data, starting with the data gathering from e.g. wheel, dampers etc to the right, and flowing into the PEID. From the PEID indicate output flows and show whether the data is sent by internet, radio, gathered by technician to e.g. a PDA

1. The incoming vehicle will be identified by a top-level PEID, which will indicate the type of vehicle, its ID, the owner, the assembly date, to mention the main information.
I am assuming that a number of global information will be collected and stored on the vehicle on-board computer:

- mission profiles statistics about the use of the vehicle and components (e.g. kilometres travelled);
- mission profiles statistics about other environmental conditions (e.g average humidity, external temperature, temperature in the engine area);
- history of all maintenance activity, and specifically the list of replaced parts and corresponding date.

Local information might be stored either on the on-board computer or on some local chip.

2. The components and subsystems worth reusing/remanufacturing will be identified (decision making!) and detached based on this information and following the work instructions downloaded from IDIS backend system. These information could be shown on a display to be used by the worker.

3. Detached parts will be identifiable thanks to the information stored on a local PEID (which may be attached at the moment). Besides the ID, the essential information which should travel with the component will be:

- the manufacturing date,
- installed date,
- material code
- summaries concerning the use (e.g. kilometres travelled);
- environmental conditions (e.g average humidity, external temperature, temperature in the engine area);
- history of all maintenance activity, and specifically the list of replaced parts and corresponding date.
- routing instructions (destination recycler/remanufacturer)
- processing instruction (mainly for recycling).

4. At its arrival at the dismantler the vehicle will be deregistered and its ownership will be transferred to the dismantler.

5. The vehicle will be tracked until the shredder. After reaching the shredder the vehicle will be cancelled, and statistics will be updated.

Data&Information: Input data Describe the input data going into the PEIDs (type of data, believed amount of data etc).
Data going into the PEID – apart the identifier, material code and work instructions – is the same collected for MoL applications. It will depend on the part type and material. An analysis is needed. My hunch is that fewer than 5-6 data are enough to characterize the use/environmental history. Some data (global) will apply to all vehicle components. Other (local) will apply to specific components (e.g. wipers work hours). The former can be stored on the on-board computer, the latter on local devices.

Data&Information: Output data Describe the output data going out from the PEIDs (type of data, believed amount of data etc).
Same data as in input, as far as downstream processing is concerned. I am not excluding that summaries (information) may be useful to Engineering, but I still have to make sure.

***Data&Information*: Amount of data** Describe the need for storage in the PEIDs (this in order to get a picture of how much storage is needed in e.g. the PEIDs)
One has to distinguish part for reuse and parts for recycle. Engines, gearbox, steering wheels, brakes, etc. which qualify for manufacturing, are more demanding than parts for recycle. In the former case a history of use, service interventions, environment may easily add value to the part to be reused. This information requires quite a few data. In the latter case material code and possibly a class code (depending on environmental condition) would be enough. As far as processing instruction, in the former case a routing instruction is all is needed. In the latter, processing instruction could be useful. Information such as processing or detailed engineering drawings could be downloaded from internet as needed.

***Hardware*: Hardware** Describe what sort of hardware technologies (PEID, sensors, GPS, networks etc) would be considered to be used or as needed to be developed.
1. For recording part information, work instructions and routing after dismantling RFID are warranted in a sufficiently automated environment – otherwise a paper slip and bar code could be enough. Assuming the use of RFIDs, then it must be investigated if RFIDs are attached at dismantling time or at vehicle assembly time (the latter solution would be needed to keep track if the vehicle configuration). In all cases a read/write capability is required, at least for recording work instructions. 2. The use of local devices to record local data may be warranted if the value of the reused component is adequate. 3. Read/write capability assumes a fairly short range. Information to be downloaded from backend via web does not require special channels.

***Hardware:* Life span of devices** What is the needed minimum life span of the devices?
The average vehicle life is 15 years, maximum 20. Devices mounted on the vehicles and to be read at EoL should last 20 years at least.

***Hardware:* Working conditions** Describe under what sort of working conditions the devices are believed to be working under (like impacts, heat, cold, moisture etc)
In the vehicle there are mainly 2 working environment: motor compartment: temp: -20 + 100 high vibrations elsewhere: temp –2 + 40 low vibrations

***Software:* Firmware (embedded software)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Existing sw technology is adequate

***Software:* Middleware (software that allows different software applications to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Existing sw technology is adequate

***Software:* D2D (software that allows devices to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
The only application I can this is if data collected by the on-board computer are written on the components RFIDs.

***Software:* D2B (software that allows devices to communicate with middleware and/or other software applications)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Read and write facilities shall be available.

***Software:* Backend software (software for data management, decision making etc)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
A PLKM is assumed where BoM, material, work instructions, decision rules will be stored. This information will be downloaded at dismantling time. An application sw will provide the deregistration of the vehicle.

***Software:* Decision support software (Local? Remote?)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
I am assuming that the operator will decide with the support of a PDA which will collect data from the RFID, and based on a program downloaded from the back end system will decide if the part is worth detaching and what sorting/processing has to undergo (write on RFID).

Other aspects related to the Technical issues

1.2 Business/economical issues A1

As-is, current solution/implementation of the scenario or similar tasks/situations Describe the As-is solution/implementation that are used today (either as your company or others uses). Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
Italy has implemented the EC directive only partially. Fiat has implemented the provisions which require the producers to "use components and material coding standards, in particular to facilitate the identification of those components and materials which are suitable for reuse and recovery". To that end Fiat has implemented norm ISO 22628, and supported IDIS systems with the proper dismantling and processing information. Fiat is by no means involved at the moment in any recycling activity. Remanufacturing and reuse of parts is limited to major assemblies collected in the warranty period.

To-be, Future scenario concept Describe in more detail the To-be solution/implementation. Describe it in such a way that it is related to the As-is description above. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
We still have to talk to Fiat Auto and therefore we cannot specify what the future business model will be. All we know is that the automakers operating in Italy (Fiat, Peugeot, DC, etc.) are defining a network of dismantlers, which will deal with the ELVs. In other words, the scenario makes technical assumptions, but at this moment we do not know what are the business interests of the stakeholders.

Business effects (own business) – negative aspects Describe the negative business effects the application scenario (described in section 1) will/could have on your business. (E.g. manpower needs, economy, new business areas, ethical, environmental etc.)
The implementation of the European directive will probably load the automakers with extracosts, especially if the target of 95% of recovery must be implemented. The use of valuable however could streamline and optimise the decision making and open some opportunities in the area of used parts. A detailed analysis is lacking.

Business effects (own business) – positive aspects Describe the business effects the application scenario will/could have on your business. (e.g. Improved business situation Business improvements opportunities (productivity, quality, environment, social issues) etc.
As said before, the minimum one can say is that the MoL information so gathered will reduce the costs of implementing the European directives.

Cost models What sort of cost models is viable for the application scenario? I.e. how much is the maximum price per PEID, support systems etc? It's important to identify the maximum price range that can be added to a product/vehicle etc as a consequence of the aspects described in this application scenario. Describe therefore aspects that will have a consequence for costs, and in what range the "hurting" price for the customer (or users etc) will be.
Again, a detailed analysis is still to be done.

Other aspects related to the Business/Economical issues If some aspects are not are covered above, please use this field.
A fundamental issue is to identify the business interests of the different stakeholders. There are clearly components/assemblies which may have a substantial value at EoL. What are they? What is the profit that one can make after remanufacturing, repairing and distribution? Who will take care of them? The manufacturers or special or remanufacturing enterprises? What is the worth of the information which can be attached to the part? To identify the sustainable cost of the device one has to address these key issues. Then there are parts which have no value except contributing to the 85% recovery target (95% by 2015). In this case the use of an RFID is to streamline the operations, to track the material, and nothing else. The advantage concerns more the efficiency than the potential profits.

1.3 Value-chain issues A1

Make an overview of the value-chain related to the application scenario Describe the partners/business associates/customers etc related to the application scenario. If this already has been covered by earlier illustrations/descriptions, please indicate this in the field below. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
The actors involved are: – The users – The producers – The state motor register – The dismantlers – The recyclers – The shredders – The workshops – The remanufacturers – The manufacturers – The transporters – The distributors (of new/used parts) The users deliver the vehicles to the dismantlers; the dismantlers will detach and sort the parts: the remanufacturers will refurbish the parts using new/used components; the distributors supply new/used parts to the workshops and remanufacturing plants; the recyclers transform the material into useable materials (plastics, rubber, etc.) and sell the material to the manufacturers; the shredder receives the compacted shell, it shreds the shell and sell the output to the steel mills and dump the residual. The transporters provide the transport and container facilities.

Describe possible downsides/upsides related to: Customers (categorized), Suppliers (categorized), Partners/cooperating companies (categorized) What kind of consequences will the application scenario have for the partners/business associates/customers etc in the value-chain (identified in 5.1). E.g. Dismantler: Dismantler must invest in new systems for reading/handling discarded products etc, but will have an upside regarding their operations of reuse/remfg etc as they more readily can… E.g. Customer: Customer will experience changes in their maintenance program this can be perceived as a positive or negative aspect (briefly describe why/how)
Legislative prescription, as well as the intensive use of smart tag in the EOL of the vehicle will will impact on the whole value chain described in 5.1. The principal changes will regard: ❑ The dismantlers, in terms of adoption of new technologies, partnership with the automotive industry, information sharing with the car maker. ❑ The reverse logistic process, i.e. from the dismantler back to the manufacturer via te recyclers

Other aspects related to the Value-chain issues If some aspects are not are covered above, please use this field.

1.4 Environmental issues A1

Savings of energy Based on today's As-is situation, try to guesstimate the savings of energy due to the new application scenario (if any). Justify the guesstimate.
This and the following questions assume a detailed analysis which is still to be done. Energy savings will derive from recovering part of the fluff and from the extended use of recovered parts. State of the art ELV recycling starts with the shredding of the entire vehicle and proceeds to separate different kinds of material (i.e. ferrous from non-ferrous metals). The residual material, up to 30% of the weight of the vehicle, is termed Auto Shredder Residue (ASR) or simply "Fluff". Fluff is composed of 50% polymers as well as rubber, glass and electronic components. The multi-material nature of ASR makes it economically impossible to segregate, recycle and reuse. Fluff is thus usually disposed of by means of incineration (thermal recycling). This practice has a considerable environmental impact in terms of CO_2 emissions and at the same time poses a serious health hazard resulting form toxic incineration residue disposed of in landfills.

Savings of material Based on today's As-is situation, try to guesstimate the savings of material due to the new application scenario (if any). Justify the guesstimate.
Recycled plastics will replace at least a share of virgin material. hile ferrous materials are already efficiently recycled, the challenge for the next future is to improve the recycling of polymer materials. In a modern vehicle a polymer percentage sums up up to 25%.

Reuse or extended product life Based on today's As-is situation, try to guesstimate the amount of reuse and/or extended product life due to the new application scenario (if any). Justify the guesstimate.
The business or reused parts is murky, at least in Italy. One can say that subject to an official warranty and lower price they will find a more widespread use in the workshops.

Other aspects related to the Environmental issues If some aspects are not are covered above, please use this field.

1.5 Social issues A1

Changed labour/work conditions Describe the implications of the application scenario regarding changed labour/work conditions

Social Impact on society Describe, if any, implications of the application scenario regarding Social Impact on society
n.a.

Ethical issues Is there ethical issues related to the application scenario? IF Yes explain
n.a.

Other aspects related to the Social issues If some aspects are not are covered above, please use this field.

Application Scenario Description
Caterpillar EOL

Written by:
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	1.0	See front page	The draft version submitted SINTEF
05.01.2005	1.1	Carl Christian Røstad, SINTEF	Updated v1.0 document – Chapter references below refers to the old chapter structure in v1.0 ♦ 3.14 Technical interfaces - DELETED (transferred to WP R1) ♦ 3.15 Facility and quality technical requirements – DELETED (transferred to WP R1) ♦ 3.16 Hardware and software platforms in use – DELETED (transferred to WP R1) ♦ 4.2 To-be, Future scenario concept - REMOVED ERRONUS DESCRIPTION TEXT ♦ 4.3 GAP analysis of As-is and To-be - REMOVED ♦ 4.6 Cost models - DESCRIPTION CHANGED ♦ 5.2 Describe possible downsides/upsides … - DESCRIPTION UPDATED ♦ 6.4 Improved LCA indications - REMOVED ♦ 6.5 Improved MOL/BOL/EOL options - REMOVED ♦ 7.1 Changed labour/work conditions - DESCRIPTION UPDATED ♦ 7.2 Social Impact on society - DESCRIPTION UPDATED ♦ 7.3 Ethical issues - DESCRIPTION CHANGED
	1.2	Keith Herman, Howard Ludewig, Jean Jacques Janosch, Pat Ludewig	
05.05.2005	1.3	Carl Christian Røstad	Prepared for inclusion in DR3.2

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2 Application scenario description A2 CATERPILLAR EOL

Where discrepancies, the Demonstrator-document overrides all aspects of this scenario.

Purpose and objective(s) of the scenario
Give a detailed description of the scenario objective – What is the purpose of the scenario

The purpose of this scenario is to identify the basic framework for implementing the PROMISE End of Life (EOL) methodology on construction and mining equipment. The application scenario focuses on information that is gained during EOL events and how rigorous management of the information can improve EOL responsive to the event as well as provide feedback to BOL and MOL functions and tracking of total life cycle information. The demo case for this scenario will be based on the Track Type Loader (TTL) or Track Type Tractor (TTT) as shown in Figures1 and 2, respectively.

Figure 1: Caterpillar Track Type Loader.

Figure 2: Caterpillar Track Type Tractor.

The primary objective of the proposed scenario is to manage the waste stream for MOL activities. In addition this information can provide feedback to the design and manufacturing sources as well as management to make the PLM processes more robust.

Scenario objective(s) rationale
Describe the rationale for the objective, i.e. why is the objective important and why the objective is important to fulfil

The scenario will be used to identify, test, and document the information requirements, component requirements, information flow, and business case relative to life cycle management. The focus of the scenario is EOL responsiveness to customers needs and commercial drivers. However, there is a requirement for a systematic approach for identifying the opportunities to convert the data that is gathered during the defined MOL process into useful knowledge to better manage the design, production, and waste management processes. In this context the waste management processes includes recycling, remanufacturing, and disposal. Standard systems must be developed where possible to facilitate data flow, material flow and data management with a end goal to maximize reuse and minimize disposal within a viable economic model.

Relations with PROMISE objectives Relate the application scenario to the PROMISE objectives as described in the Declaration of Work
PROMISE main objective #1: *To develop new closed-**loop life cycle information flow models** for BOL, MOL and EOL.* This scenario will use information relative to component life and failure modes gained during MOL to enhance the design process in BOL. It will use field population data and implied demand to enhance the logistics information for the component providers in the remanufacturing phase of BOL. It will also provide for the study of waste stream data to optimise EOL processes. PROMISE main objective #2: **To develop new PLM system and IT infrastructure exploiting the capabilities of smart product embedded information devices. Embedded devices will form the bases of the data and information tracking during the MOL event that triggers the process generating the waste stream for EOL management. These devices will continue to be used during EOL to track and document data relative to the logistics and validation through the supply chain.** PROMISE main objective #3: To develop new standards to allow the technologies and associated tools to be developed by the PROMISE project to be accepted by the market and allow it to expand quickly by creating an appropriate environment for the development of new innovative applications. **Standards will be required to convert the event data into a actionable information package. In addition the scenario will support the need for standards in device and information protocols. New standards must address the need for recycle and reuse parameters within an acceptable economic model.** PROMISE main objective #4: To develop new working and business models appropriate for the use and exploitation of the new technologies and tools to be developed by all actors involved in a product lifecycle. **The scenario will be used to identify, test, and document the information requirements, component requirements, information flow, and business case relative to life cycle management. This will include processes and information management that will facilitate EOL activities including quantification of recyclable content and processes to validate proper levels of recyclable content as well as socially acceptable disposal processes.**

Lifecycle phase relevance (BOL, MOL, EOL) Relate the scenario application to BOL, MOL, EOL, and clearly state the relevance to BOL, MOL and/or EOL
This scenario is primarily related to EOL activities. However, it impacts both BOL and MOL process as previously stated. Information will be collected from the machine during use. When onboard data processing determines that there is an "event", this event data will be transmitted to the appropriate source. For example, a major failure should transmit information directly to the service people (MOL). Logistics information would also be sent out so the replacement part(s) (BOL) could be put in route to the destination of the failure. Manufactures would also be contacted in the case that no parts are available or if the supply of the needed part(s) falls below a designated quantity (MOL). Other importance performance data could be transmitted to the service people and/or designers to help understand how to determine the source of the problem or improve the design. (BOL). As components , assemblies, and machines are replaced in the MOL phase a waste stream is generated that will transfer the focus to EOL processes. Information into EOL will be tagged by a RFID linked data base. This information will establish the bases for EOL decisions relative to reuse, recycle, and disposal. The first objective would be to reuse as much of the components , assemblies, or machines as possible. Often this will require some remanufacturing so information flow back to BOL will be critical to optimizing the process.

Product considered in scenario Describe the products in the scenario (e.g. car, truck). Include related functionality and life cycle issues.
The product to be used in this scenario will be either a track type tractor or a track type loader, depending on which fits better with the PROMISE scenario. (see Figure 1 and 2) These products are commonly used in construction and mining application with a large distribution of application requirements that significantly impact the life and performance of the product.

Interfaces between lifecycle phases Describe the interfaces between relevant BOL, MOL and/or EOL
An overall PLM concept drawing related to the scenario is shown in Figure 2 in ILLUSTRATION OF THE APPLICATION SCENARIO. The interfaces between the lifecycle phases are shown in Figure 4 in ILLUSTRATION OF THE INFORMATION FLOW 8. The primary interface point is between the MOL and EOL processes are illustrated. The interface includes recyclable content data as well as validation data for waste stream management. Application data will provide the basics for EOL decisions relative to reuse, recycle, or dispose. This information is both application specific and product specific. Therefore, it is very important that the interface information format and content is user configurable. There is also an interface point between the EOL and BOL for any parts that are reused. This interface involves both logistics relative to the supply chain and manufacturing relative to remanufacturing processing.

Illustration of the application scenario

Provide an illustration of the application scenario that can be used for communication purposes (e.g. in trade magazines, on the front of reports, slide shows etc). Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

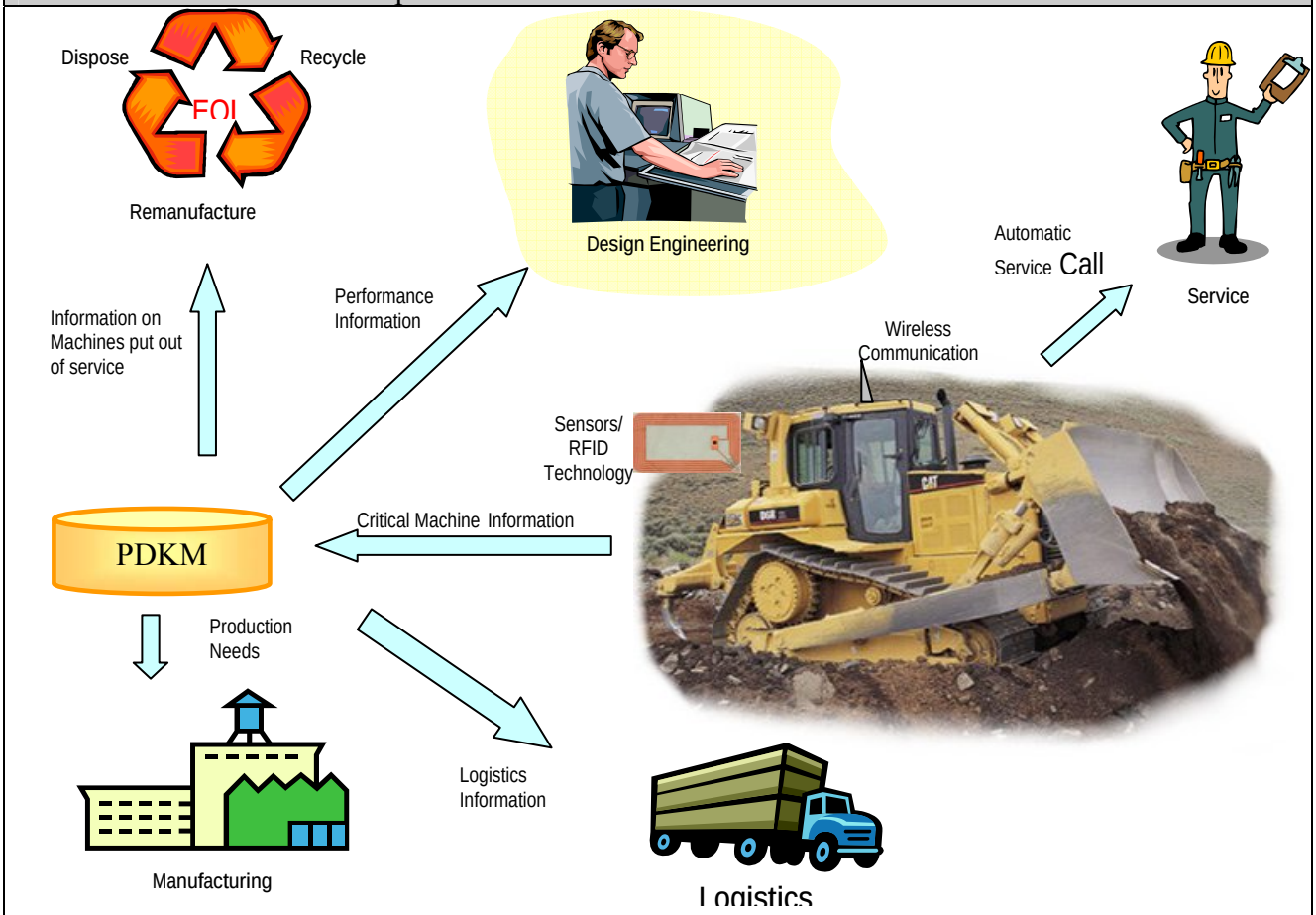

Figure 3: Life Cycle Management concept drawing.

Illustration of the information flow (flowchart)
In order to identify informational requirements, illustrate the flow of information and clearly identify information/data flows by denoting this in the figure. Use rectangles, arrows, circles etc with text. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

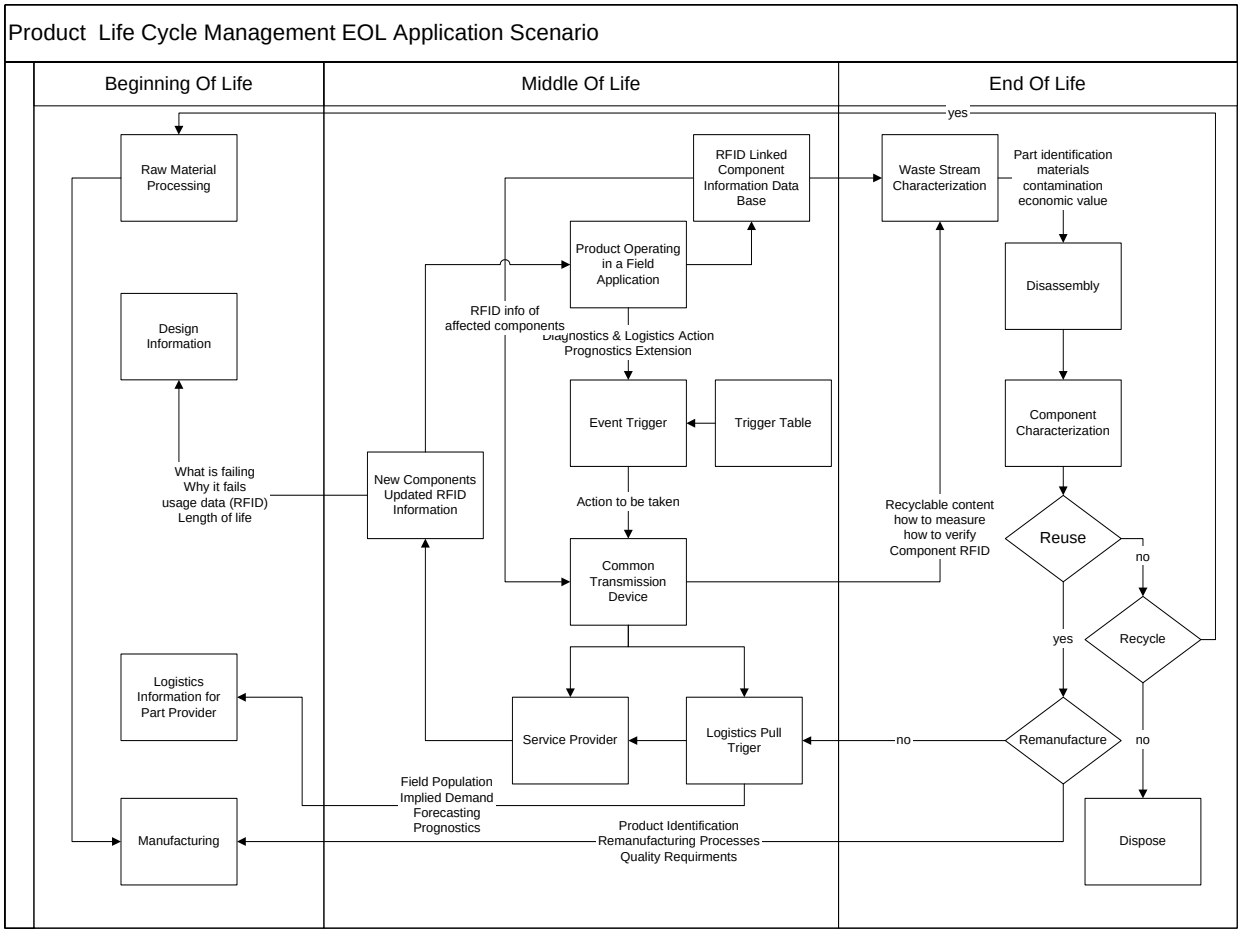

Figure 4: Flow chart of the EOL Application Scenario.

Specific requirements needed in order to fulfil the objective (user requirements related to WP R1) If there are some specific requirements that are needed to be fulfilled, please state them here.
Collection and documentation of User Requirements is not a straightforward process relative to a broad based implementation of this scenario. The best way to get this information is through a combination of interviews and brainstorming sessions. If the right people can be pulled together, a series of "focus group" brainstorming sessions may be the best tool to fully understand the process requirements. Some of the general requirements are: • Component information linked to a RFID. • User configurable data base structures for component information. • User configurable management systems for proprietary diagnostics and prognostics systems. • High level of system reliability in harsh remote environments. • Commercially available hardware interfaces.

Pain-points (problems/challenges) Identify the most important problems/challenges related to this scenario (e.g. technical, economical, ethical, environmental, customer related, partner related)
The single most important challenge will be getting consensus of standardization issues in both hardware and software protocol, communications, and data structures. Application requirements are going to vary significant within a industry segment as well between industry segments. Generic identification of information classifications will facilitate the development of a system that is user configurable.

Other aspects related to the Application Scenario If some aspects are not are covered above, please use this field.
There are several requirements for this scenario that must be fulfilled for it to be successful. The real challenge is to develop standard methods and protocols that can be used for a number of different applications. The process start point is defined as a TTL or TTT operating in the field as illustrated in the top of the MOL box in Figure 4. In fact this can be characterised as any machine with some diagnostic and prognostic capability operating in its designed application. There are a number of decision point in the EOL processes of reuse, recycle, and dispose depicted in Figure 4. The information requirements and processes definitions related to these decision points have to be identified. However, each application will be different and must be identified by the end user of the system. The final challenge will be to fully define the information flow between the MOL process and the BOL and EOL processes. Some high level concepts are included in Figure 4. However, these will have to be further defined and specified by the PROMISE team.

2.1 Technical issues A2

***Data&Information*: Product Information requirements** List what sort of data is to be gathered from e.g. PEIDs. Show how the data is to be transformed into information. Use a tree diagram to illustrate the flow of data, starting with the data gathering from e.g. wheel, dampers etc to the right, and flowing into the PEID. From the PEID indicate output flows and show whether the data is sent by internet, radio, gathered by technician to e.g. a PDA
Data will be collected from PEID sensors through out the life of the product, component, and piece part. Most of the data will be stored in data bases that are associatively connected to the PEID via an identification number. In some cases the data may be stored on the PEID itself. This will have to be determined on each individual product. This data or information will be used in EOL to characterize the components and/or piece parts. The data will be used to retrieve the most up to date processes and procedures for disassembly, remanufacturing, recycling, and disposal. The database will contain information such as part identification, material, contamination, duration of life, and service conditions.

Data&Information: Input data Describe the input data going into the PEIDs (type of data, believed amount of data etc).
• Sensor data from a range of sensors. • Manually entered data from servicemen. • RFID information identifying machine components

Data&Information: Output data Describe the output data going out from the PEIDs (type of data, believed amount of data etc).
• Time/Date stamp • Event type • Relevant Event data • Action Required • Product serial number (TTT or TTL) • Component serial number (Specific component in question) • Machine hours • Component hours • Relevant sensor information (condensed or raw data) • Maintenance information • Misc. user input - . . If there are large amounts of sensor data that cannot be transmitted, an event could be triggered which informs a service man to come and manually collected the needed data from the machine and clear the storage device.

***Data&Information*: Amount of data** Describe the need for storage in the PEIDs (this in order to get a picture of how much storage is needed in e.g. the PEIDs)
At this point, it is not clear where or what data will be stored. The application scenario needs a bit further refinement to come to that stage.

***Hardware*: Hardware** Describe what sort of hardware technologies (PEID, sensors, GPS, networks etc) would be considered to be used or as needed to be developed.
Unknown

***Hardware:* Life span of devices** What is the needed minimum life span of the devices?
Since Caterpillar machines live for decades (50+ years) in the field, the life should be quite long. This should, at a minimum, match the time to the first major overhaul of the machine where devices could possibly be replaced.

***Hardware:* Working conditions** Describe under what sort of working conditions the devices are believed to be working under (like impacts, heat, cold, moisture etc)
Caterpillar machines work in very rugged conditions. Both extreme heat (55 °C) and extreme cold (-30 °C) conditions are encountered. Vibration, impact, large amounts of dust, oil, rain, mud, etc are also part of the normal operating conditions. These machines work in all weather conditions.

***Software:* Firmware (embedded software)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Software should be user configurable and relatively open so that the user (Caterpillar or a dealer) can customise it to fit a specific customer's needs. It could then also be customised monitor multiple components on a machine (engine, critical structures, etc)

***Software:* Middleware (software that allows different software applications to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
See SOFTWARE: FIRMWARE (EMBEDDED SOFTWARE

***Software:* D2D (software that allows devices to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
See SOFTWARE: FIRMWARE (EMBEDDED SOFTWARE

***Software:* D2B (software that allows devices to communicate with middleware and/or other software applications)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
See SOFTWARE: FIRMWARE (EMBEDDED SOFTWARE

***Software:* Backend software (software for data management, decision making etc)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
In a final product, all decisions would be made by proprietary Caterpillar software, however we will need a solution for the PROMISE demonstration. Possibly a portable PC could be placed on board the product to perform data analysis and storage for the demo. The need for storage would most likely be needed only in the case that the volume is too great to transfer with the chosen communication device.

***Software:* Decision support software (Local? Remote?)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
See SOFTWARE: BACKEND SOFTWARE (SOFTWARE FOR DATA MANAGEMENT, DECISION MAKING ETC)

Other aspects related to the Technical issues If some aspects are not are covered above, please use this field.
N/A

2.2 Business/economical issues A2

As-is, current solution/implementation of the scenario or similar tasks/situations Describe the As-is solution/implementation that are used today (either as your company or others uses). Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
The as-is situation is that all information from the machines must be manually collected from a limited number of sensors. Because of this there is no PLM infrastructure in place to handle this real time data collection.

To-be, Future scenario concept Describe in more detail the To-be solution/implementation. Describe it in such a way that it is related to the As-is description in section 0 above. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
The to-be situation is the incorporation of more sensors on the machine as a "standard" with the PLM infrastructure to utilize the valuable data.

Business effects (own business) – negative aspects Describe the negative business effects the application scenario (described in section 1) will/could have on your business. (E.g. manpower needs, economy, new business areas, ethical, environmental etc.)
- Caterpillar is a large global organisation with products in use on every continent. This would require systems to be produced in many languages and the system would be required to handle very large amounts of data. - Caterpillar machines are serviced by independently owned dealers. Implementation and training of such a system will/would require a large investment with these dealers. - Some customers may perceive that Caterpillar is spying on them in order to avoid paying warranty claims.

Business effects (own business) – positive aspects Describe the business effects the application scenario will/could have on your business. (e.g. Improved business situation Business improvements opportunities (productivity, quality, environment, social issues) etc.
For EOL activities, the critical data for the machine could be obtained without the expense (of the customer) of stopping the machine. This could improve customer satisfaction. This could also allow dealers to better manage their resources and be more profitable. It would also allow them to better service their customer, giving Caterpillar an advantage over their competition.

Cost models What sort of cost models is viable for the application scenario? I.e. how much is the maximum price per PEID, support systems etc? It's important to identify the maximum price range that can be added to a product/vehicle etc as a consequence of the aspects described in this application scenario. Describe therefore aspects that will have a consequence for costs, and in what range the "hurting" price for the customer (or users etc) will be.
This would need to be determined on a cost-benefit basis. Caterpillar customers buy machines to make money. Considering this fact and the fact that the customer has spent a quite large sum of money on a machine, cost would not be the primary focus if the device would allow for lower owning and operating costs.

Other aspects related to the Business/Economical issues If some aspects are not are covered above, please use this field.
N/A

2.3 Value-chain issues A2

Make an overview of the value-chain related to the application scenario Describe the partners/business associates/customers etc related to the application scenario. If this already has been covered by earlier illustrations/descriptions, please indicate this in the field below. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
For EOL consideration the business relationships must be established primarily in the recycle and disposal arena. Any component or part of a component that has potential recycle value must be identified as such. The recycle process must be fully developed and documented. A business to take the part and convert it to a somewhat original form must be identified and the process has to be established to transport theses parts to the appropriate location. The same relationship may be required for reuse process. However, many organizations have internal remanufacturing facilities.

Describe possible downsides/upsides related to: Customers (categorized), Suppliers (categorized), Partners/cooperating companies (categorized) What kind of consequences will the application scenario have for the partners/business associates/customers etc in the value-chain (identified in 5.1). E.g. Dismantler: Dismantler must invest in new systems for reading/handling discarded products etc, but will have an upside regarding their operations of reuse/remfg etc as they more readily can… E.g. Customer: Customer will experience changes in their maintenance program this can be perceived as a positive or negative aspect (briefly describe why/how)
The business case for recycle and disposal is not well defined. In many cases it may be more expensive than doing nothing at all.

Other aspects related to the Value-chain issues If some aspects are not are covered above, please use this field.
N/A

2.4 Environmental issues A2

Savings of energy Based on today's As-is situation, try to guesstimate the savings of energy due to the new application scenario (if any). Justify the guesstimate.
Energy efficiencies will come primarily from remanufacturing of parts and components. Published data shows that remanufacturing requires only about 15% of the energy used to make the product from scratch. Current data shows a 120 trillion Btu's savings resulting from remanufacturing activities worldwide.

Savings of material Based on today's As-is situation, try to guesstimate the savings of material due to the new application scenario (if any). Justify the guesstimate.
Real-time predictive and real-time preventative measures during the life cycle of the product will prevent hard failures and promote the retention of value added from the original manufacturing.

Reuse or extended product life Based on today's As-is situation, try to guesstimate the amount of reuse and/or extended product life due to the new application scenario (if any). Justify the guesstimate.
Baseline data shows that annually the material savings resulting from worldwide remanufacturing activities is 14 million tons.

Other aspects related to the Environmental issues If some aspects are not are covered above, please use this field.
The primary advantage that is not covered above is the conservation of landfill space and the decrease in the use of virgin natural resources that will result from increased reuse and recycling..

2.5 Social issues A2

Changed labour/work conditions Describe the implications of the application scenario regarding changed labour/work conditions
• Improved training processes. • Proactive maintenance • Information feedback to the design and manufacturing process will produce user friendly products. . (operator comfort, safety, satisfaction of the product user …)

Social Impact on society Describe, if any, implications of the application scenario regarding Social Impact on society
Reduced pressure on natural resources. Reduced green house gas emissions

Ethical issues Is there ethical issues related to the application scenario? IF Yes explain
Privacy? Does Caterpillar have the right to monitor the use of a customer's machine?

Other aspects related to the Social issues If some aspects are not are covered above, please use this field.
NONE

Application Scenario Description
BIBA/INDYON EOL

Written by:
Andreas Plettner, INDYON
Martin Schnatmeyer, BIBA

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22/03/2005	2	Martin Schnatmeyer, BIBA	Example included (see annex)
05.05.2005	2.1	Carl Christian Røstad	Prepared for inclusion in DR3.2

Author(s)' contact information

In order to contact your company regarding the application scenario, please fill in the author(s) contact information.

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3 Application scenario description A3 BIBA/INDYON EOL

Where discrepancies, the Demonstrator-document overrides all aspects of this scenario.

Purpose and objective(s) of the scenario Give a detailed description of the scenario objective – What is the purpose of the scenario
The objective of this WP is to develop an application which supports the tracking and tracing of products for recycling by using the PROMISE PEID technology and PDKM system in combination with indoor and outdoor navigation systems.

Scenario objective(s) rationale Describe the rationale for the objective, i.e. why is the objective important and why the objective is important to fulfil
Related to the other 2 EOL scenarios (EOL information management for monitoring End of Life Vehicles and for heavy load vehicle decommissioning) this objective has a more generic approach and is open for other scenarios outside the EOL vehicle sector. Beside this the objective covers also logistic process steps, which have to be fulfilled after the monitoring and decommissioning of vehicles for closing the product life cycle loop.

Relations with PROMISE objectives Relate the application scenario to the PROMISE objectives as described in the Declaration of Work
This scenario is related to the EOL sector, which has to be covered by PROMISE, and will test the PROMISE PEID and PDKM system in the EOL environment.

Lifecycle phase relevance (BOL, MOL, EOL) Relate the scenario application to BOL, MOL, EOL, and clearly state the relevance to BOL, MOL and/or EOL
This scenario is focused on the EOL sector but is also applicable on the other sectors, especially on the production level (BOL). For improving the recycling rate, data coming from the BOL and MOL sector, shall be used for an optimised reverse logistic.

Product considered in scenario Describe the products in the scenario (e.g. car, truck). Include related functionality and life cycle issues.
The main material is plastic (production waste, e. g. from the automotive industry foreseen for a reuse in this sector or in other sectors needing a high plastic material quality).

Interfaces between lifecycle phases
Describe the interfaces between relevant BOL, MOL and/or EOL

The picture below describes the single process steps on a generic level, starting with the collecting of production waste and ending finally in the production again. Between each step there are normally interfaces based on paper documents, telephone calls, manually written fax documents or e-mail and an ERP (AMIC A1) / Microsoft office (mainly EXCEL and ACCESS) systems, all depending on commands coming from the PC key board (i. e. human interface or interaction).

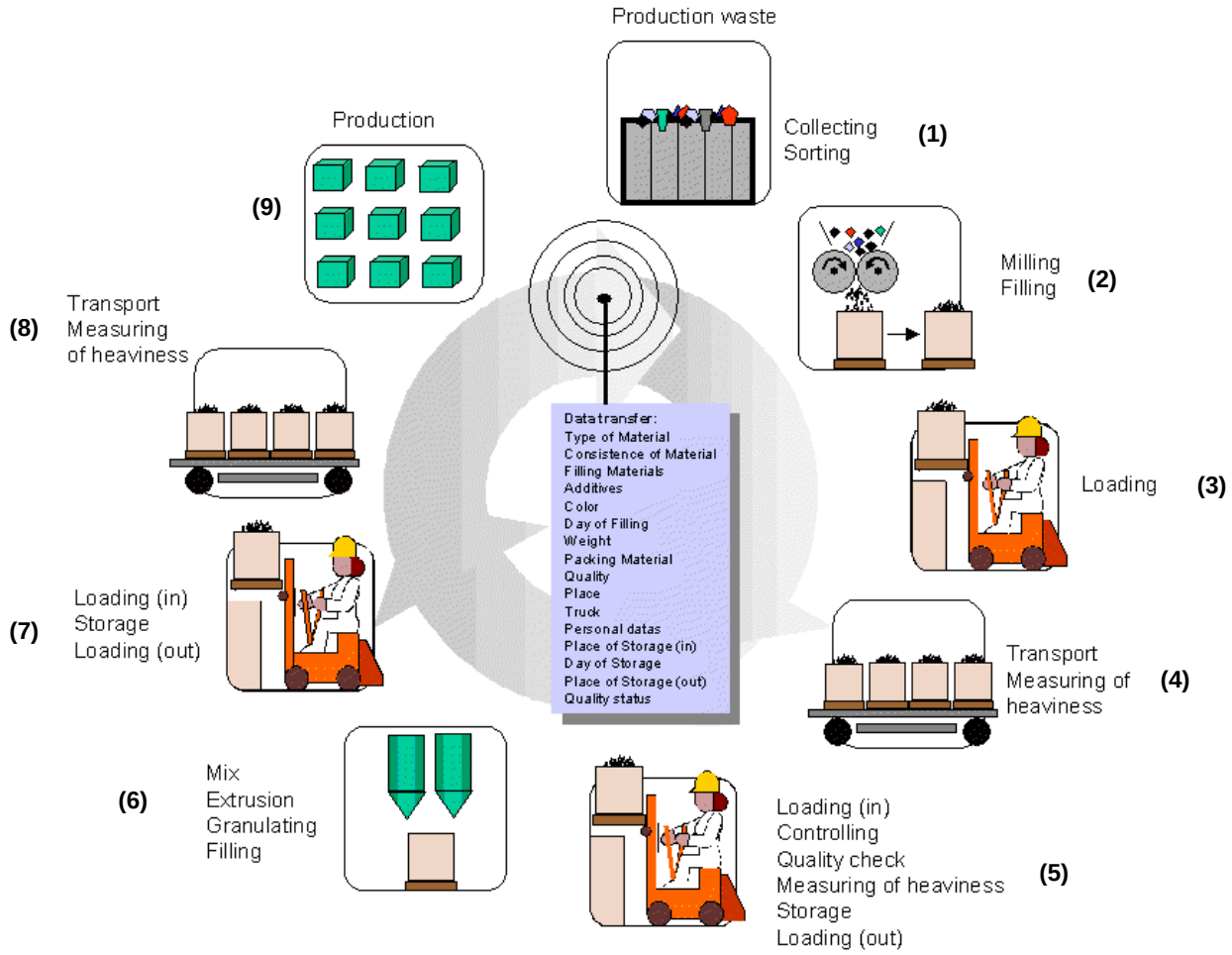

Figure 1: PEID based tracking and tracing of plastic material

Illustration of the application scenario

Provide an illustration of the application scenario that can be used for communication purposes (e.g. in trade magazines, on the front of reports, slide shows etc). Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

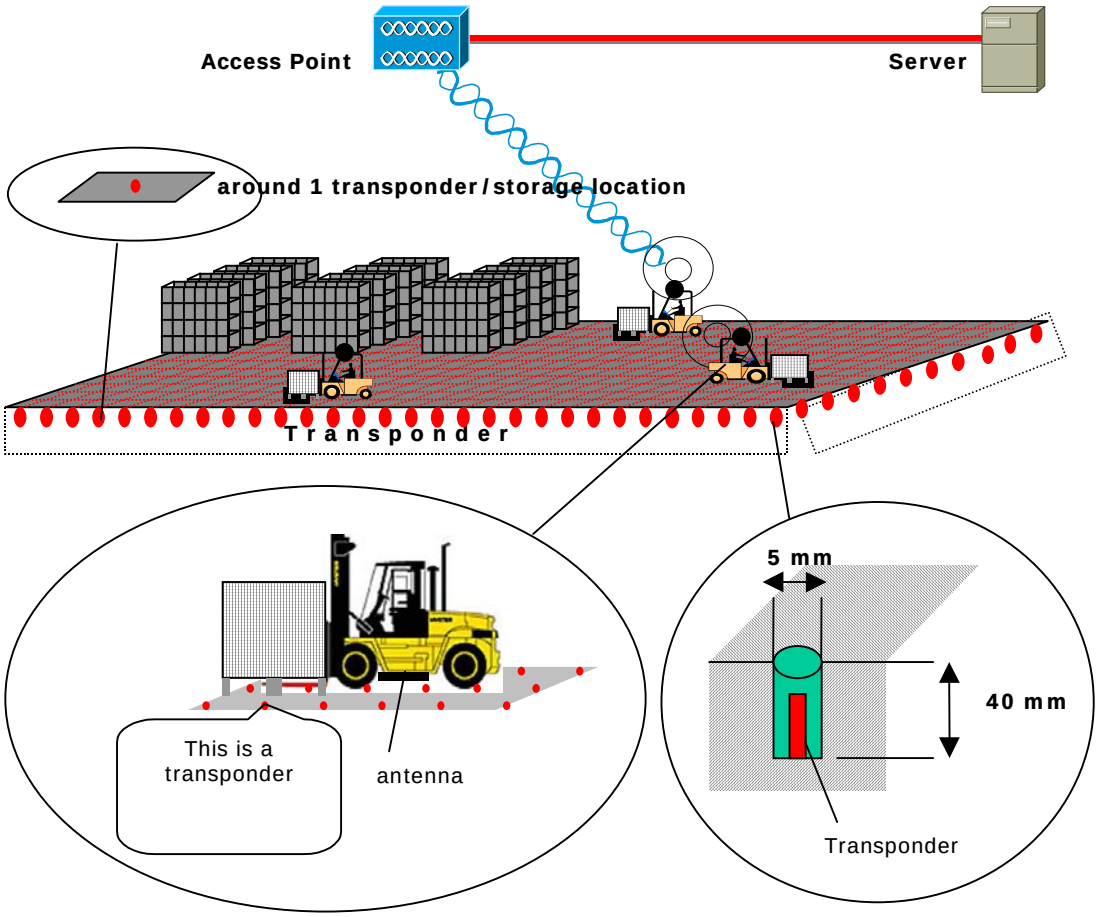

Figure 2: Illustration of application scenario

Illustration of the information flow (flowchart)
In order to identify informational requirements, illustrate the flow of information and clearly identify information/data flows by denoting this in the figure. Use rectangles, arrows, circles etc with text. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

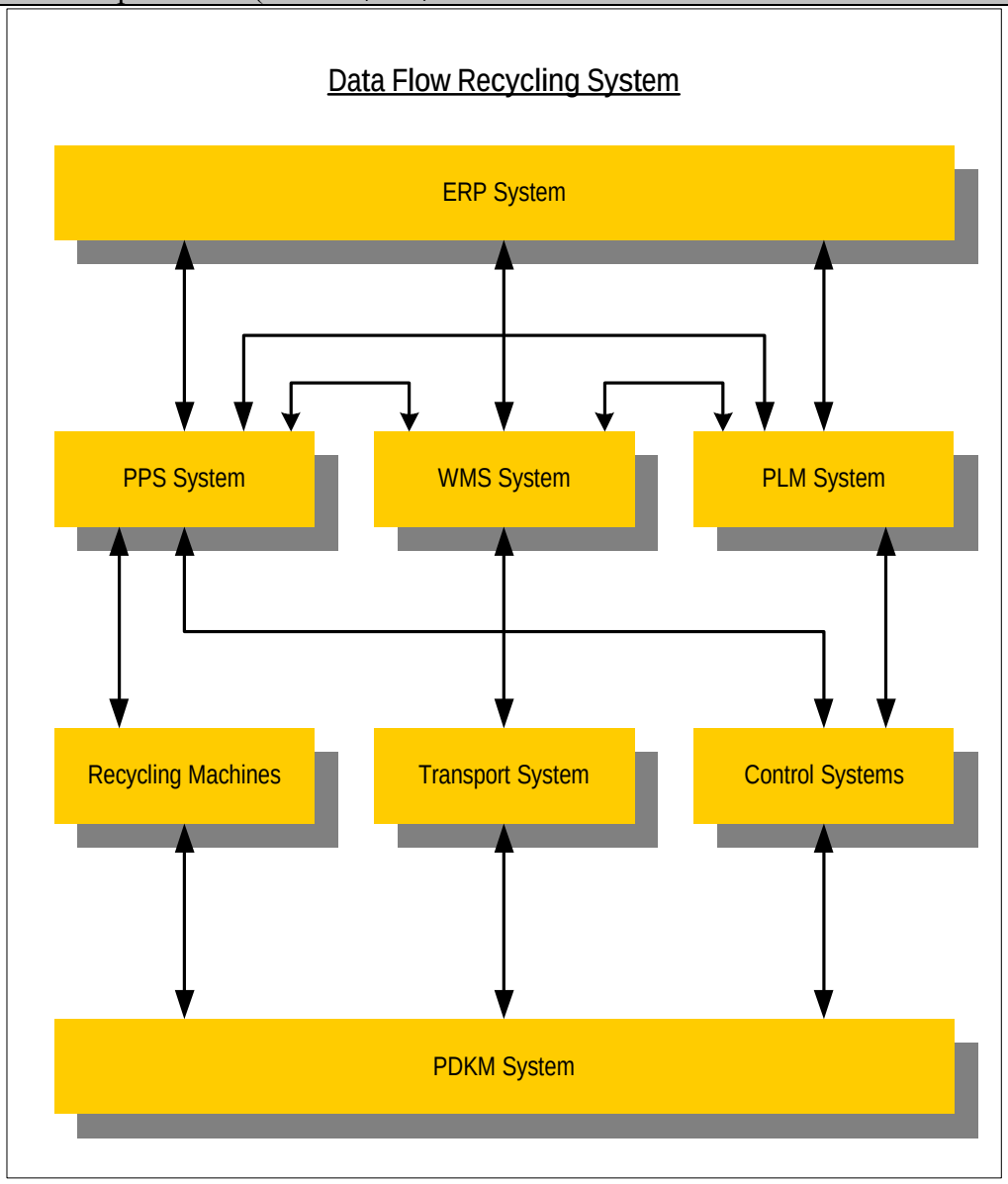

Figure 3: Data Flow

This is the general structure of the system. There are still some data flows to be defined during the project and these are the data flows between PPS and WMS and PLM. There more definition work is to be done in order to generate an appropriate system that uses the existing capabilities/interfaces between these main components.

Specific requirements needed in order to fulfil the objective (user requirements related to WP R1) If there are some specific requirements that are needed to be fulfilled, please state them here.
PDKM system inputs from research clusters are needed.

Pain-points (problems/challenges) Identify the most important problems/challenges related to this scenario (e.g. technical, economical, ethical, environmental, customer related, partner related)
The main challenges for this scenario are the interfaces to the PROMISE PDKM systems and the PROMISE PLM system. The questions to be answered are to define the level of intelligence of the PDKM system in order to make decisions about e.g. recycling process to be used, this means putting some PLM functionality into the PDKM system (controller). Economical: fast return on invest of these systems is essential Ethical: Too much control Customer: Too much control Environmental: Too much RF in the air (although the systems comply to the legal regulations).

Other aspects related to the Application Scenario If some aspects are not are covered above, please use this field.
Not applicable at the moment

3.1 Technical issues A3

***Data&Information*: Product Information requirements** List what sort of data is to be gathered from e.g. PEIDs. Show how the data is to be transformed into information. Use a tree diagram to illustrate the flow of data, starting with the data gathering from e.g. wheel, dampers etc to the right, and flowing into the PEID. From the PEID indicate output flows and show whether the data is sent by internet, radio, gathered by technician to e.g. a PDA
The sort of data is listed in the centre of Figure 1. The PEID is part of the packing material use for the transport of the milled plastic material. Data from the PEID will be collected via a reader antenna (distance antenna – tag 1 m maximum or less). Data will go via W-LAN into the internal IT network (step 5, 6, 7) or into the internet (step 1 – 4, 8,9)

Data&Information: Input data Describe the input data going into the PEIDs (type of data, believed amount of data etc).
At the moment its foreseen only to use the ID code on the tag, the rest will come from the database. Related to the PROMISE PEID normal ASCII code is sufficient and – if feasible – around 500 kBit storage capacity would be an alternative to the ID code solution. See also PAIN-POINTS (PROBLEMS/CHALLENGES) where the question arise whether to put more intelligence into PEID reader systems. If this is done more data than the ID will be needed on the PEID.

Data&Information: Output data Describe the output data going out from the PEIDs (type of data, believed amount of data etc).
See DATA&INFORMATION: INPUT DATA

***Data&Information*: Amount of data** Describe the need for storage in the PEIDs (this in order to get a picture of how much storage is needed in e.g. the PEIDs)
See DATA&INFORMATION: INPUT DATA

***Hardware*: Hardware** Describe what sort of hardware technologies (PEID, sensors, GPS, networks etc) would be considered to be used or as needed to be developed.
1. PEIDs 2. PEID Readers 3. WLAN equipment 4. Panel PC with WLAN 5. Server 6. LAN

***Hardware:* Life span of devices** What is the needed minimum life span of the devices?
All components should be suitable for industrial use and have common lifetime. Lifetime of PEIDs can vary between 1 year and 10 years depending on the specific use.

***Hardware:* Working conditions** Describe under what sort of working conditions the devices are believed to be working under (like impacts, heat, cold, moisture etc)
Industrial working conditions, partly outdoor application and therefore temperatures between -20°C and +60 °C.

***Software:* Firmware (embedded software)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
PEID Reader controller SW in order to enhance decision capabilities of the PDKM system.

***Software:* Middleware (software that allows different software applications to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Implementation of SW that allows in this specific case the data flows between recycling machines, transport systems and control systems. This layer of SW can be a part of the PDKM system.

***Software:* D2D (software that allows devices to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
A communication between the packing material (e. g. in a storage unit) is sensible. If the PEIDs are passive, an external radio field is necessary. If the PEIDs are active (with own energy supply) an autonomous communication between the packing material is useful for an process optimisation.

***Software:* D2B (software that allows devices to communicate with middleware and/or other software applications)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Depends on the future SW infrastructure.

***Software:* Backend software (software for data management, decision making etc)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Standard backend modules like ERP, WMS, PPS, Oracle DB, PLM. Related to decision making, agent technology is for the logistic sector a good basis (for operative business processes). For strategic decision making a logistic simulation system is perhaps the better solution.

***Software:* Decision support software (Local? Remote?)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
In autonomous logistic systems software should act local and has to be controlled by a remote system.

Technical interfaces Describe what sort of technical interfaces would be considered to be used or as needed to be developed.
?

Facility and quality technical requirements
4 or more storage racks, fork lift, packing material + plastic material storage area of round about 100 m^2, swap trailer.

Hardware and software platforms in use
100 Transponder (125 kHz), antenna (125 kHz) + controller, 4 or more PEIDs, PEID antenna + controller, display, Panel PC, backend server, Oracle database, W-LAN, keyboards, mouse, monitor.

Other aspects related to the Technical issues If some aspects are not are covered above, please use this field.
GPS system for outdoor navigation can be integrated if needed.

3.2 Business/economical issues A3

As-is, current solution/implementation of the scenario or similar tasks/situations Describe the As-is solution/implementation that are used today (either as your company or others uses). Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
See figure below describes the as-is situation (paper based / manual data input):

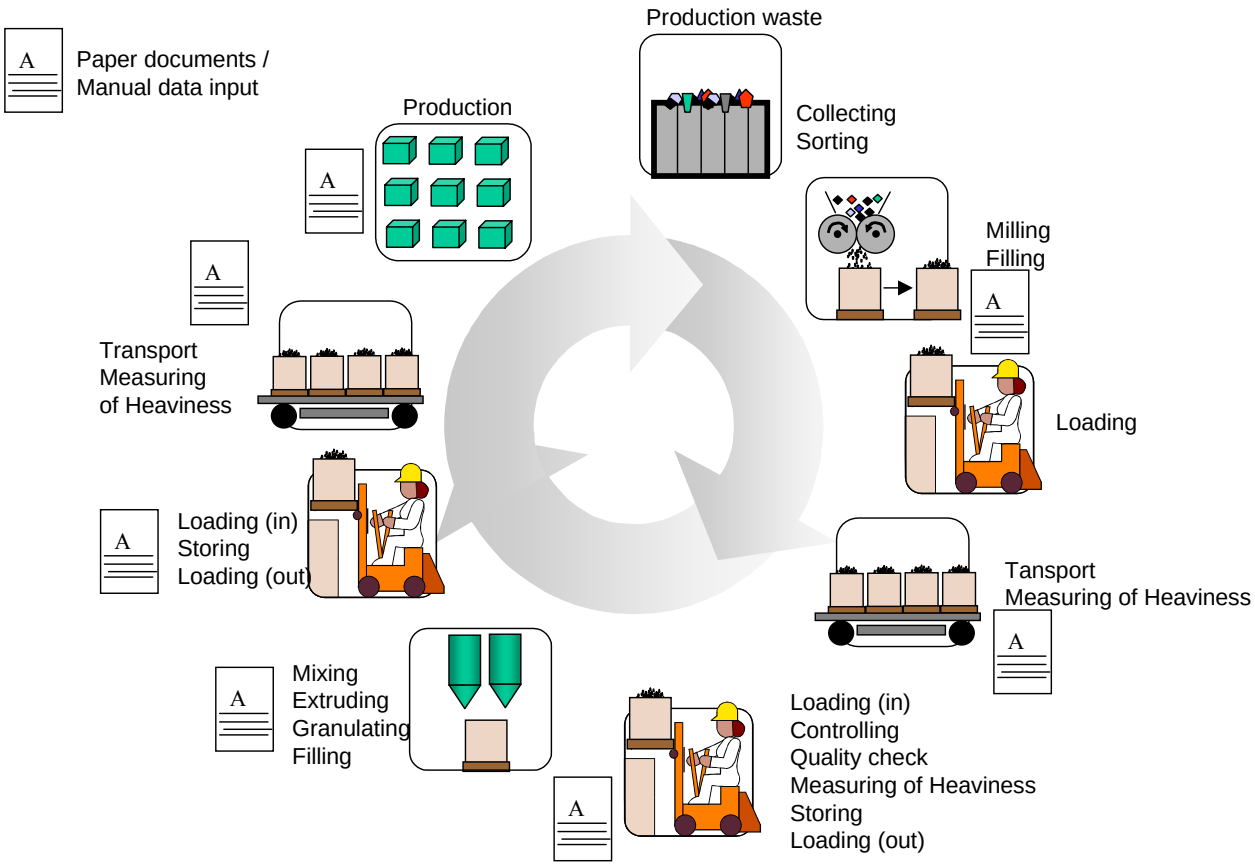

Figure 4: As-is situation in the plastic recycling loop

To-be, Future scenario concept Describe in more detail the To-be solution/implementation that are used today (either as your company or others uses). Describe it in such a way that it is related to the As-is description in above. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
The goal is to deny each kind of paper and human interacting related to the data transfer between the different steps in Figure 4.

GAP analysis of As-is and To-be Identify the gaps between the As-is and the To-be.
See TO-BE, FUTURE SCENARIO CONCEPT

Business effects (own business) – negative aspects Describe the negative business effects the application scenario (described in section 1) will/could have on your business. (E.g. manpower needs, economy, new business areas, ethical, environmental etc.)
Since we are not the users of such a system there are no effects to our business. For the user: - Investment to establish a system - Running costs of such a system

Business effects (own business) – positive aspects Describe the business effects the application scenario will/could have on your business. (e.g. Improved business situation Business improvements opportunities (productivity, quality, environment, social issues) etc.
Since we are not the users of such a system there are no effects to our business. For the user: - Less paper, less costs - Higher degree of transparency in all processes - Optimised decision making

Cost models What sort of cost models is viable for the application scenario? I.e. how much is the maximum price per device.
These data depend mainly on the coming results. From today's point of view the systems being developed in the project will generate a positive return on invest to the users in cases where many transactions (today flow of information on paper) take place. Cost per device depends on the use cycles. An active tag has and can be used many cycles and therefore a price of 10-100 € can still be economical. On the other hand single use tags have to prove themselves for single use. This is now still not viable, but in supply chains where the tag attached to a product is used by many participants of the supply chain the economical calculation can justify the use. The prices for these tags range between 0,3 and 2,0 €.

Other aspects related to the Business/Economical issues If some aspects are not are covered above, please use this field.
Not applicable, depends on results.

3.3 Value-chain issues A3

Make an overview of the value-chain related to the application scenario
Describe the partners/business associates/customers etc related to the application scenario. If this already has been covered by earlier illustrations/descriptions, please indicate this in the field below. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

Value Chain for A3

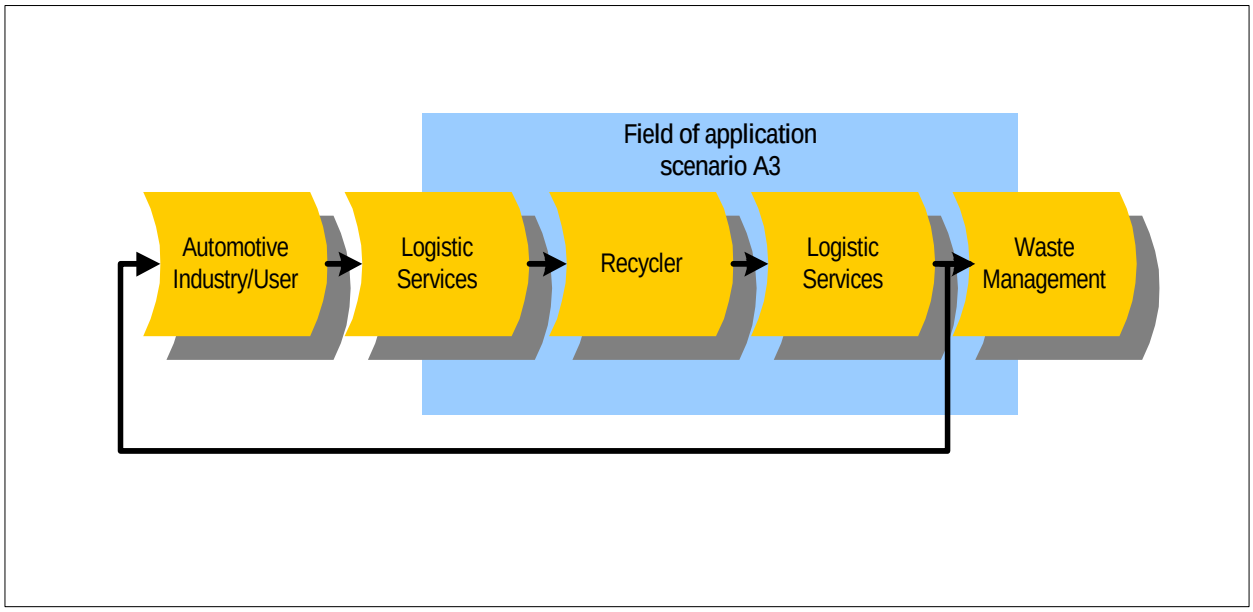

Figure 5: value chain

The value chain here is subdivided between the user of the material due for recycling, the logistics that transport or store the material, the recycler, logistics to store the recycled products and bring the recycled material back to a user or to waste management (e.g. incineration). It is also possible to find the logistics services attached to either the automotive industry or the recycler.
This value chain fits with other application scenarios where the automotive industry is involved.

Describe possible downsides/upsides related to: Customers (categorized), Suppliers (categorized), Partners/cooperating companies (categorized)
Customers downsides 1. The data security on the customer side 2. If the customer wants to use the technology advantages coming from the PEIDs, he has to install an suitable system environment. **Customer upsides** 1. Higher product availability 2. Transparent (logistic) processes **Supplier downsides** 1. The data security on the supplier side 2. The supplier has to invest in an suitable system environment. **Supplier upsides** 1. Fast delivery service 2. Transparent (logistic) processes **Partner downsides** 1. Data security 2. They have to invest in an suitable system environment. **Partner upsides** 1. Better co-operation 2. Process optimisation 3. Transparent (logistic) processes

Other aspects related to the Value-chain issues If some aspects are not are covered above, please use this field.
-

3.4 Environmental issues A3

Savings of energy Based on today's As-is situation, try to guesstimate the savings of energy due to the new application scenario (if any). Justify the guesstimate.
Due to the higher data transparency the logistic processes are more efficient. The guesstimate is 10% less energy consumption based on own experience in this sector.

Savings of material Based on today's As-is situation, try to guesstimate the savings of material due to the new application scenario (if any). Justify the guesstimate.
Based on more efficient logistic processes, the material recycling (also from smaller fractions) becomes more attractive than incineration or disposal on a garbage dump. The guesstimate is 10% less raw material consumption based on own experience in this sector.

Reuse or extended product life Based on today's As-is situation, try to guesstimate the amount of reuse and/or extended product life due to the new application scenario (if any). Justify the guesstimate.
See SOCIAL IMPACT ON SOCIETY

Improved LCA indications
If the PEID or the system behind the PEID is able to collect and interpret data, which are useful for an LCA, the results of LCA will have a better quality.

Improved MOL/BOL/EOL options
If the PEID or the system behind the PEID is able to collect and interpret data, which are useful for the MOL/BOL/EOL phases, the amount of feasible options will be higher in this phases.

Other aspects related to the Environmental issues If some aspects are not are covered above, please use this field.
Maybe the radio fields related to the PEID system are bad for human health and his nature environment (belongs also to section 7) but there are clear rules about frequencies and related emissions. Other aspect is also the recyclability of the PEIDs and the energy consumption of the PEID system in his whole product life cycle (BOL, MOL, EOL).

3.5 Social issues A3

Changed labour/work conditions Describe the implications of the application scenario regarding changed labour/work conditions
Maybe the radio fields related to the PEID system are bad for human health and his nature environment. Workers has to be educated in the PEID technology. Furthermore data security and possibility of the surveillance of workers will maybe prohibit that they accept the system.

Social Impact on society Describe the implications of the application scenario regarding Social Impact on society
Especially related to the reduced raw material consumption the social impact is positive.

Ethical issues Last, but not least, discuss the ethical issues related to the application scenario
Data security and data ownership is an important factor which has to be taken into account from all stake holders in the value chain.

Other aspects related to the Social issues If some aspects are not are covered above, please use this field.
Looking on the global market place, PROMISE has to take into account that all regions on the world can have access to the technology (especially reading and interpreting data from the PEID).

3.6 Annex A3

3.6.1 Recycling of Car Bumpers with RFID Technology as an Example for A3[1]

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 3 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 (see **Error! Reference source not found.**). This reader gate reads all data from the single bumper tag and writes data on the tag (see Table 1).

[1] Following Hans, C.; Schnatmeyer; M.; Schumacher, S.; Thoben, K.D.: Using Transponder Technology to Support the End-of-Life Phase in Product Life Cycle Management. Proceedings International IMS Forum 2004, S. 1448 – 1455. Biassono (Milano) 2004.

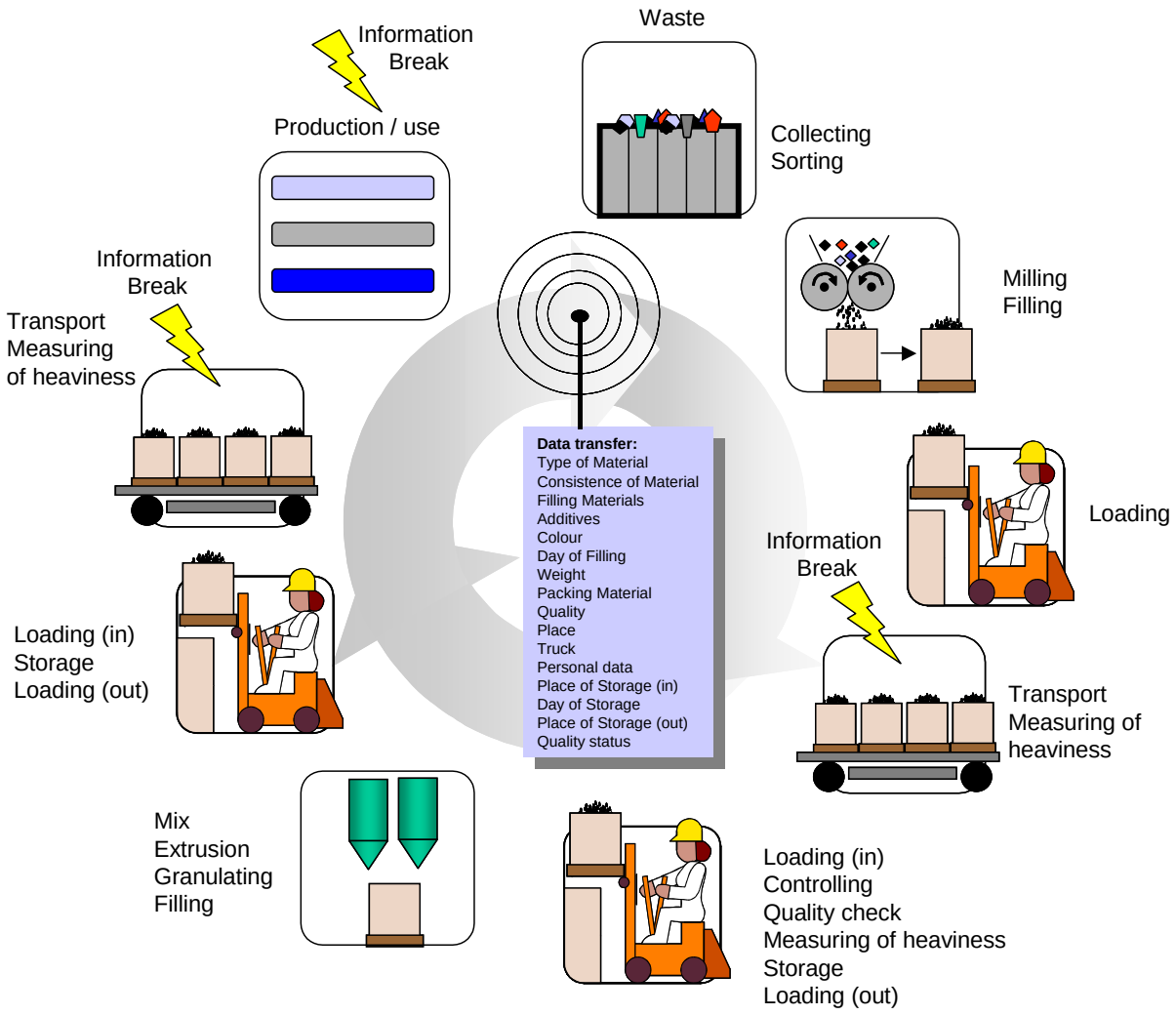

Figure 3: Use of RFID technology in the life cycle of bumpers

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 1 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 3) 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 1: Date exchange during the recycling process of bumpers (examples)

3.6.2 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.

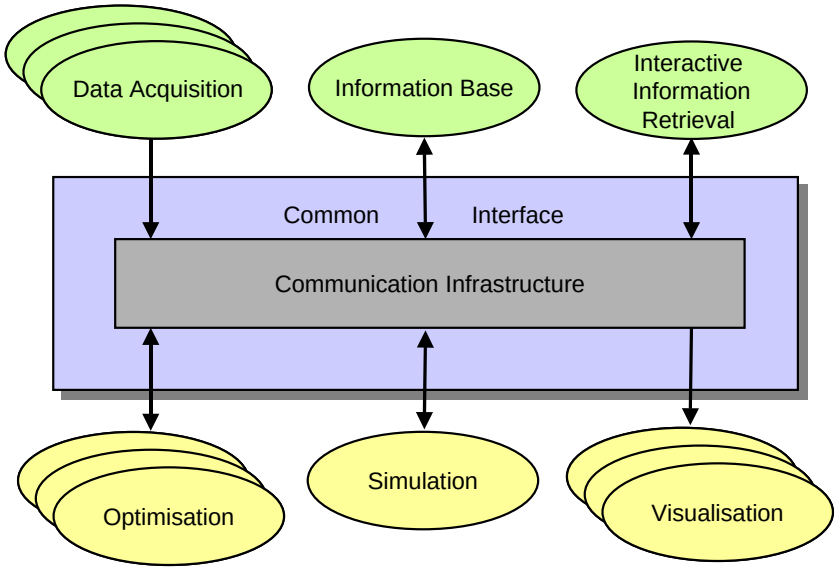

Figure 4: Architecture of a simulation-based decision support tool

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 4 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.

3.6.3 Conclusion and Outlook

It's obvious that the use of transponder technology in the whole product life cycle becomes a more important role. Traditional systems, like the barcode systems, will still exist especially in domains where the product price is on a relatively low level. Another possibility is e. g. the combination of both systems, barcode and transponder systems. This offers a high flexibility between both systems, which are depended on appropriate reader technology and safety information flows.

If the storage capacity of transponder chips is higher than 100 kB it will be possible to store complete documents (e. g. data sheets) or language based information on the chip. Additionally a data collection during the whole life cycle of the product will ease the information generation of the impact from the product on the environment and human being. This will be important for strategic stakeholder decisions and offers new business models (e. g. payment of the product use and not product ownership).

In future product embedded data storage systems might transform today's centralised approaches in data storage to more independent data storage systems. In consequence this leads to new concepts of product ownership, where the owner not only owns the product but also related information gathered during the various stages of the life cycle.

Application Scenario Description
CRF MOL

Written by:
Mario Gambera, CRF

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13.12.04	1.0	Mario Gambera	The draft version submitted SINTEF
05.01.2005	1.1	Carl Christian Røstad, SINTEF	Updated v1.0 document – Chapter references below refers to the old chapter structure in v1.0 ♦ 3.14 Technical interfaces - DELETED (transferred to WP R1) ♦ 3.15 Facility and quality technical requirements – DELETED (transferred to WP R1) ♦ 3.16 Hardware and software platforms in use – DELETED (transferred to WP R1) ♦ 4.2 To-be, Future scenario concept - REMOVED ERRONUS DESCRIPTION TEXT ♦ 4.3 GAP analysis of As-is and To-be - REMOVED ♦ 4.6 Cost models - DESCRIPTION CHANGED ♦ 5.2 Describe possible downsides/upsides … - DESCRIPTION UPDATED ♦ 6.4 Improved LCA indications - REMOVED ♦ 6.5 Improved MOL/BOL/EOL options - REMOVED ♦ 7.1 Changed labour/work conditions - DESCRIPTION UPDATED ♦ 7.2 Social Impact on society - DESCRIPTION UPDATED ♦ 7.3 Ethical issues - DESCRIPTION CHANGED
12.1.05	1.2	Mario Gambera	Updated from point 3.8 on
05.05.2005	1.3	Carl Christian Røstad	Prepared for inclusion in DR3.2

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4 Application scenario description A4 CRF MOL

Where discrepancies, the Demonstrator-document overrides all aspects of this scenario.

Purpose and objective(s) of the scenario
Give a detailed description of the scenario objective – What is the purpose of the scenario

- Assess usability of predictive maintenance strategies during usage of the vehicle in order to optimise maintenance policy in terms of
    - nr. of interventions
    - saving of spare parts
    - increase of vehicle availability

- Evaluate the use of PEID and wireless communication system in order to provide complete and real time feedback to the company (design, production, after sales and marketing) about the:
    - mission profile of the vehicle
    - mission profile and reliability of critical components and vehicle systems

Scenario objective(s) rationale
Describe the rationale for the objective, i.e. why is the objective important and why the objective is important to fulfil

In the short period, increasing vehicle availability is essential especially for commercial trucks. Predictive maintenance strategies can greatly increase the "productivity on the road" concept. IVECO is putting great emphasis on this aspect.

On a more long term view, the lack of information about vehicle and component mission profile is one of the major limits to the optimisation of product design. The collection of information made possible with the transmission of information to a ground station will allow to overcome this problem.

Relations with PROMISE objectives
Relate the application scenario to the PROMISE objectives as described in the Declaration of Work

The proposed scenario relates to all four objectives of PROMISE inasmuch:

- It develops a new closed loop life cycle information model;
- It contributes to the definition of a PLM and IT infrastructure;
- It will contribute to new standards concerning Predictive maintenance strategies
- It develops new business models appropriate to the MoL phase.

Specifically the objective more addressed by this applications are

- New standards concerning Predictive maintenance strategies
- Business models appropriate to the MoL phase.

Lifecycle phase relevance (BOL, MOL, EOL)
Relate the scenario application to BOL, MOL, EOL, and clearly state the relevance to BOL, MOL and/or EOL

MOL mainly

Product considered in scenario
Describe the products in the scenario (e.g. car, truck). Include related functionality and life cycle issues.

Trucks, ranking from light truck (IVECO Daily) to heavy lorry (IVECO Stralis).

The scenario is also applicable to Bus for public transport.

Interfaces between lifecycle phases
Describe the interfaces between relevant BOL, MOL and/or EOL

The definition of statistics summarising the mission profile of the vehicle / component can be used for:

- provide direct feedback to the company design and production department
- provide "forward" quantitative and certified feedback to:
  - second hand vehicle owners
  - EOL applications for the last vehicle owner

Illustration of the application scenario
Provide an illustration of the application scenario that can be used for communication purposes (e.g. in trade magazines, on the front of reports, slide shows etc). Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

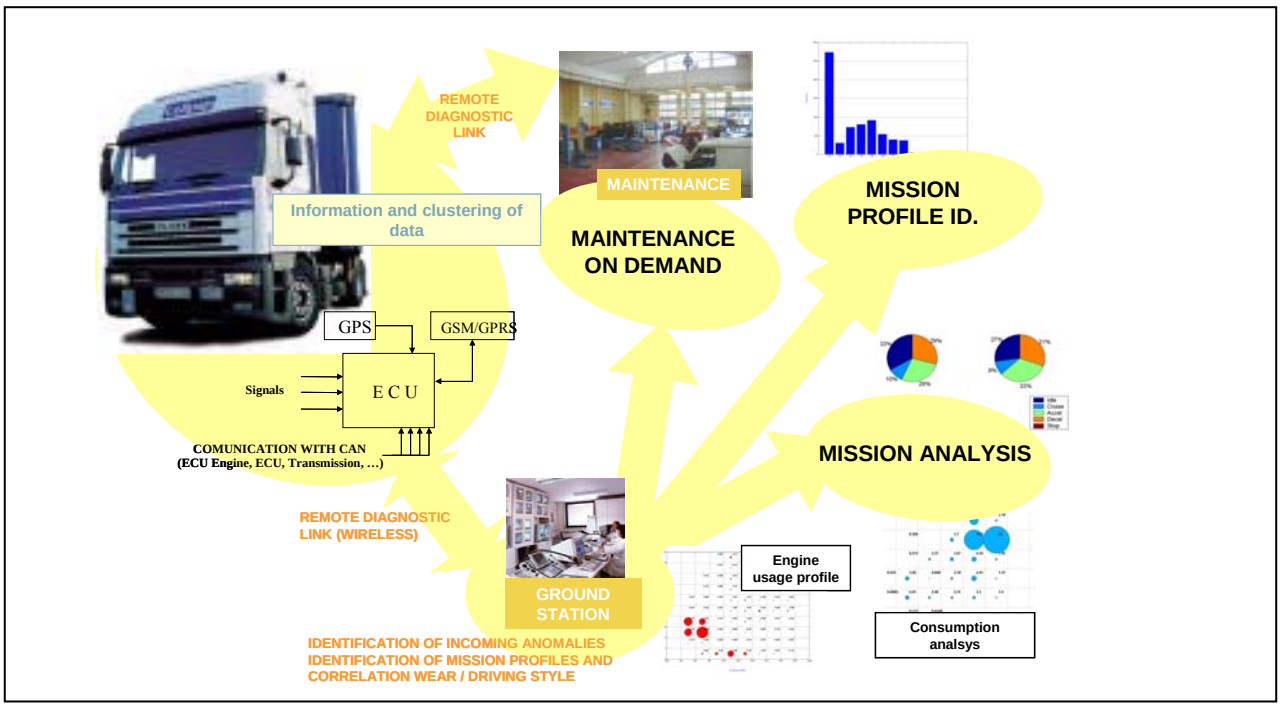
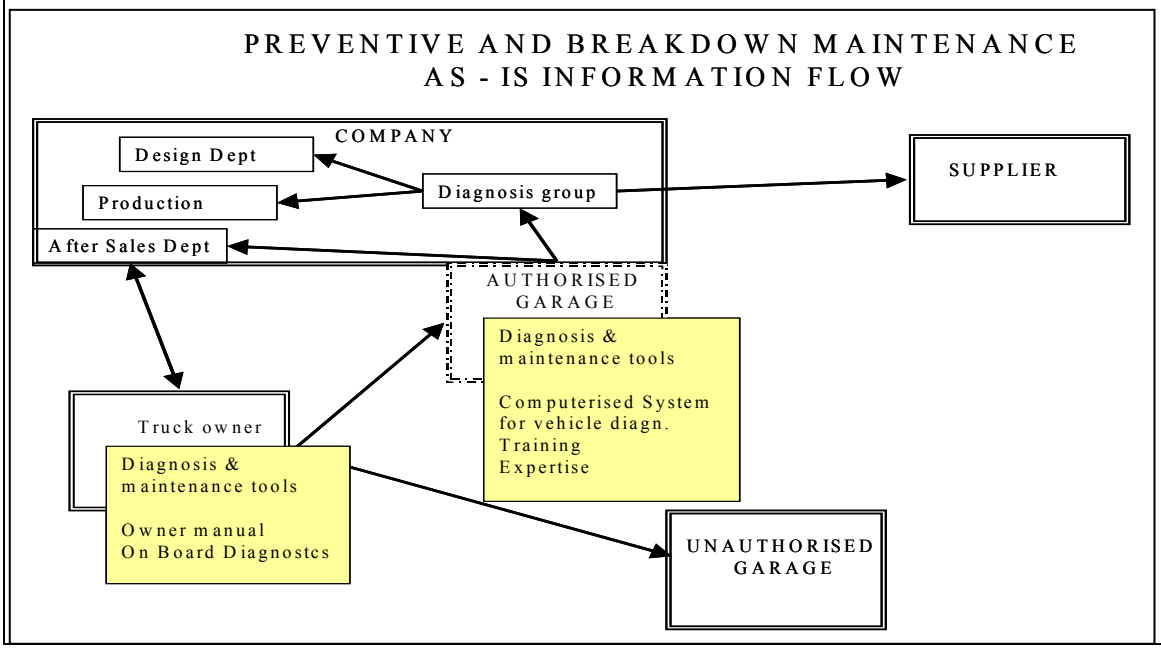
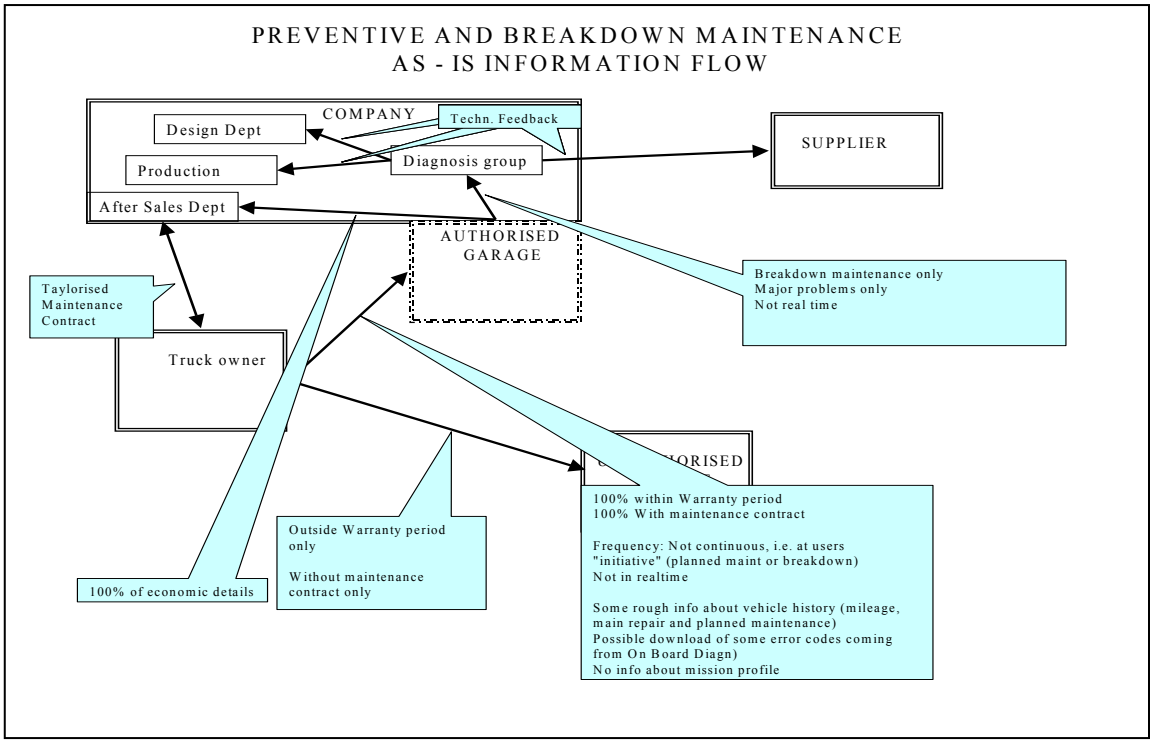


Illustration of the information flow (flowchart)
In order to identify informational requirements, illustrate the flow of information and clearly identify information/data flows by denoting this in the figure. Use rectangles, arrows, circles etc with text. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.





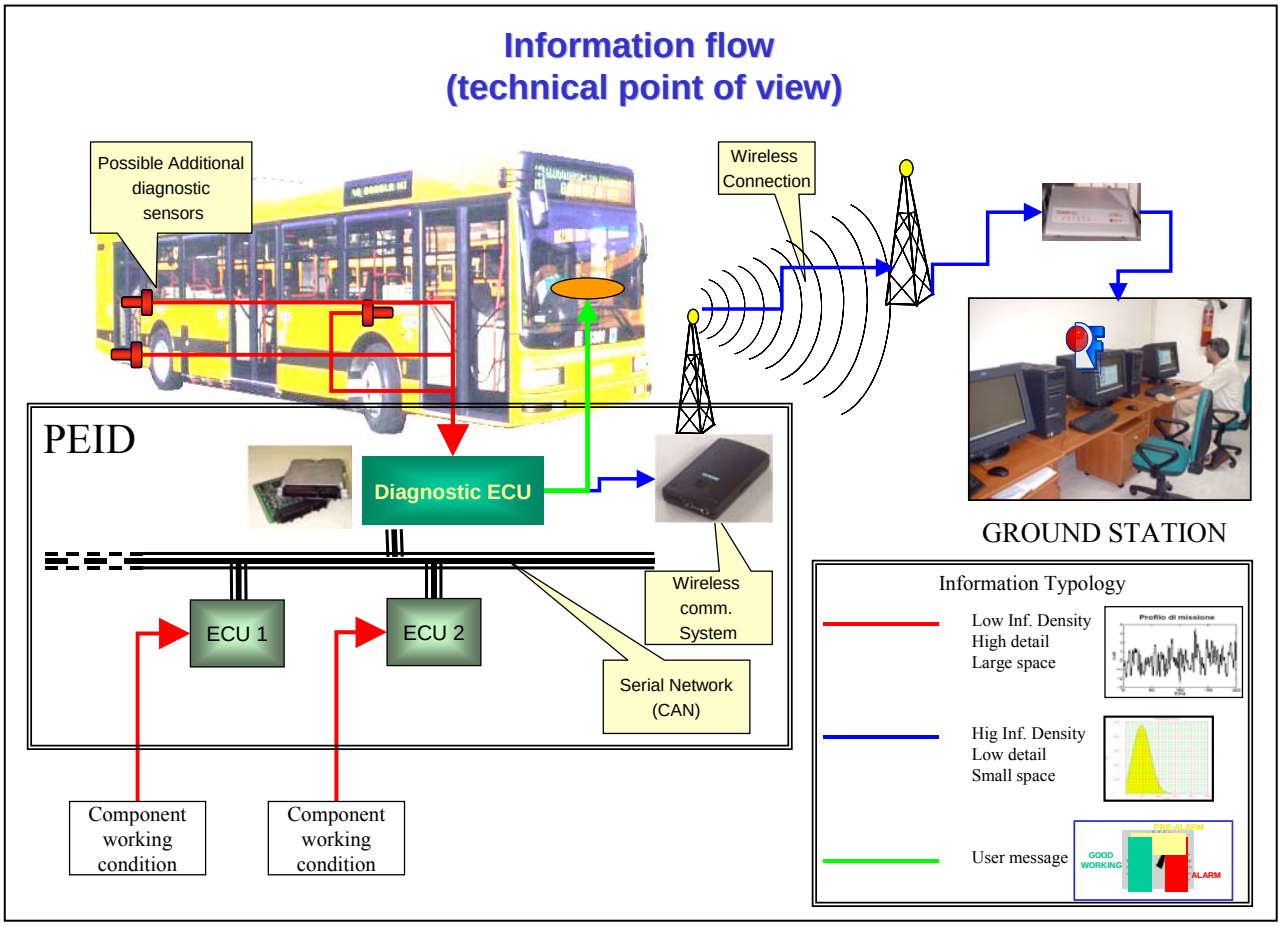
Specific requirements needed in order to fulfil the objective (user requirements related to WP R1) If there are some specific requirements that are needed to be fulfilled, please state them here.

Pain-points (problems/challenges) Identify the most important problems/challenges related to this scenario (e.g. technical, economical, ethical, environmental, customer related, partner related)
Technical: The definition of the wireless transmission solution should be found compromising among these aspects: - Amonunt of data - Transmission distance - Transmission frequency - Transmission cost - Cost of the wireless device Ethical (other): Privacy problems are possible when tracking / recording user habits

Other aspects related to the Application Scenario If some aspects are not are covered above, please use this field.

4.1 Technical issues A4

***Data&Information*: Product Information requirements**
List what sort of data is to be gathered from e.g. PEIDs. Show how the data is to be transformed into information. Use a tree diagram to illustrate the flow of data, starting with the data gathering from e.g. wheel, dampers etc to the right, and flowing into the PEID. From the PEID indicate output flows and show whether the data is sent by internet, radio, gathered by technician to e.g. a PDA



Data & Information: Input data Describe the input data going into the PEIDs (type of data, believed amount of data etc).
Referring to the illustration above, and having in mind a PEID as a "network" of board computer + transm. devices, a first hypothesis of data going into the PEID can be classified as "raw data", (mainly time histories), coming from: ❑ Normal production sensor ❑ Added sensors ❑ Vehicle computer network in general The amount of data and the typology of information that can flow into the PEID is, in principle, huge.

Data & Information: Output data Describe the output data going out from the PEIDs (type of data, believed amount of data etc).
Referring to the illustration above, there are 2 kind of "data" (information) going out from the PEID: ❑ User message to be displayed on the dashboard related to preventive maintenance strategies ❑ synthesis / statistics related to preventive maintenance strategies and vehicle / components mission profile description

Data & Information: Amount of data Describe the need for storage in the PEIDs (this in order to get a picture of how much storage is needed in e.g. the PEIDs)
Input data described above easily sum up to 100 different quantities

***Hardware*: Hardware** Describe what sort of hardware technologies (PEID, sensors, GPS, networks etc) would be considered to be used or as needed to be developed.
See data flow. A body computer system in a modern truck is a Multiplex system with Several Body Computers, output devices (or output doors). Most of the computational capacity of this system is dedicated to the real-time management of the vehicle; the aspects of data collection and synthesis for "promise" purpose are less exploited

***Hardware:* Life span of devices** What is the needed minimum life span of the devices?
15 years

***Hardware:* Working conditions** Describe under what sort of working conditions the devices are believed to be working under (like impacts, heat, cold, moisture etc)
In the vehicle there are mainly 2 working environment: motor compartment: temp: -20 + 100 high vibrations elsewhere: temp –2 + 40 low vibrations Some PEID for predictive maintenance won't necessarily stay in the motor compartment (apart from some sensor)

***Software:* Firmware (embedded software)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Existing sw technology today used for on-line control strategy should be adequate. Some attention should be paid to the storing capacity of the PEID.

***Software:* Middleware (software that allows different software applications to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Existing sw technology is adequate

***Software:* D2D (software that allows devices to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Existing sw technology is adequate

***Software:* D2B (software that allows devices to communicate with middleware and/or other software applications)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Existing sw technology is adequate

***Software:* Backend software (software for data management, decision making etc)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
A PLKM is assumed for management of information collected from the vehicles fleet during its entire life. Specific modules shall be provided with facilities for: ❑ data mining ❑ pattern recognition ❑ decision making (decision support modules) This software must be therefore able to perform advanced data analysis, statistical elaboration and provide adequate decision.

***Software:* Decision support software (Local? Remote?)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
There are at the moment 2 possibility to use synthesis / statistics related to preventive maintenance strategies and vehicle / components mission profile description information. The first solution foresee an architecture with a remote Backend software devoted to collect and analyse all the data collected from the vehicles. Decision support modules are described in section SOFTWARE: BACKEND SOFTWARE. The second solution foresee an architecture where data is processed locally (on the vehicle): no backend server is required. In this hypothesis, a “small” and “local” decision support module is foressen. In this case, the decision support module will obviously elaborate decision regarding the single vehicle only.

Other aspects related to the Technical issues If some aspects are not are covered above, please use this field.

4.2 Business/economical issues A4

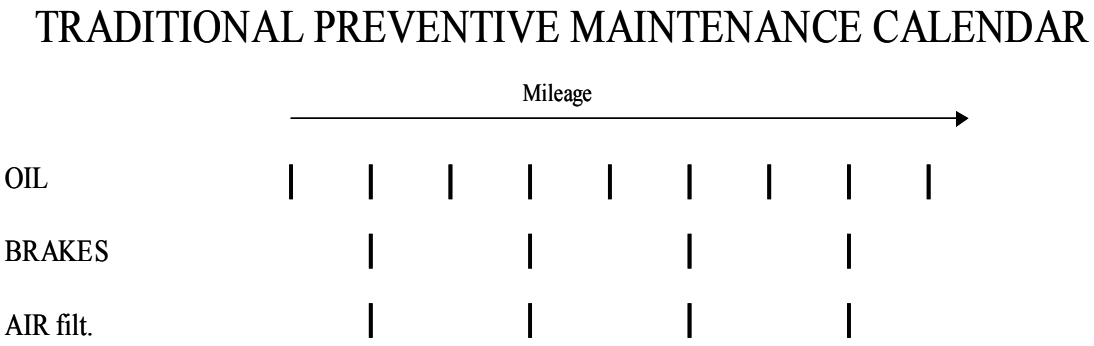
As-is, current solution/implementation of the scenario or similar tasks/situations

Describe the As-is solution/implementation that are used today (either as your company or others uses). Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

At present predictive maintenance is not yet an industrial application. As is situation described in Inf. Flow for MOL appl.ppt describes break down maintenance and preventive maintenance only.

Maintenance policy is organised as follows:
during the warranty period is performed by the company. Maintenance interventions can be preventive or due to a break down.
Preventive maintenance plan is organised in a predefined and rigid maintenance calendar, (See picture).

Maintenance policy outside the warranty period can be framed in personalised "maintenance contracts" or can be performed "at user request". Maintenance interventions can be preventive or due to a break down. There is scarce possibility to foresee a breakdown and consequently to plan an intervention of this kind in advance.

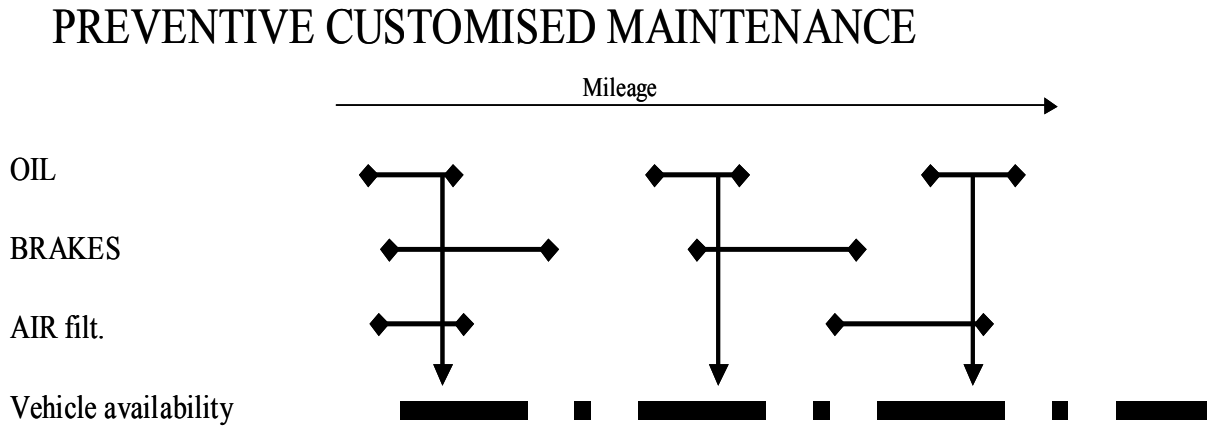


To-be, Future scenario concept
Describe in more detail the To-be solution/implementation. Describe it in such a way that it is related to the As-is description in above. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

Predictive maintenance strategies will act on 2 sides

Regarding the preventive maintenance, it will be possible to define a user defined preventive maintenance calendar. This calendar will be at the same time more flexible and will be based on the actual consumption of the components; it will therefore allow a considerable spare.
See figure illustrating customised maintenance calendar.

Regarding the break down maintenance, the definition of predictive strategies will allow to increase the foresee some major breakdown. This will avoid an increasing percentage of breakdown and will give the possibility to plan these intervention.



Business effects (own business) – negative aspects
Describe the negative business effects the application scenario (described in section 1) will/could have on your business. (E.g. manpower needs, economy, new business areas, ethical, environmental etc.)

Development of effective preventive maintenance strategy for each critical component. These strategy should be developed:

- for each component
- for each failure mode

They should be also enough general to be applied to several “alternatives” of the component.

Updating of the maintenance strategy with the evolution of the component technology is also an issue.

Business effects (own business) – positive aspects Describe the business effects the application scenario will/could have on your business. (e.g. Improved business situation Business improvements opportunities (productivity, quality, environment, social issues) etc.
Optimised maintenance with big economical impacts and environmental impacts. Referring to the “to be framework” par. TO-BE, FUTURE SCENARIO CONCEPT the following advantages can be foreseen: ❑ saving of material / spare parts ❑ increase of vehicle availability and reliability ❑ increase of flexibility in the maintenance plan ❑ prodct cost reduction (design cost and product cost)

Cost models What sort of cost models is viable for the application scenario? I.e. how much is the maximum price per PEID, support systems etc? It’s important to identify the maximum price range that can be added to a product/vehicle etc as a consequence of the aspects described in this application scenario. Describe therefore aspects that will have a consequence for costs, and in what range the “hurting” price for the customer (or users etc) will be.
n.a.

Other aspects related to the Business/Economical issues If some aspects are not are covered above, please use this field.

4.3 Value-chain issues A4

Make an overview of the value-chain related to the application scenario Describe the partners/business associates/customers etc related to the application scenario. If this already has been covered by earlier illustrations/descriptions, please indicate this in the field below. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
Actors considered in the scenario are (see also file"Inf flow for MOL pred. maint.ppt" and derived .pps): ▪ the company afters sales dept ▪ the company design dept. (and related diagnosis group) ▪ the company production dept. ▪ the truck owner ▪ the authorised garage network ▪ the (generic) unauthorised garage ▪ the company suppliers network

Describe possible downsides/upsides related to: Customers (categorized), Suppliers (categorized), Partners/cooperating companies (categorized) What kind of consequences will the application scenario have for the partners/business associates/customers etc in the value-chain (identified in 5.1). E.g. Dismantler: Dismantler must invest in new systems for reading/handling discarded products etc, but will have an upside regarding their operations of reuse/remfg etc as they more readily can… E.g. Customer: Customer will experience changes in their maintenance program this can be perceived as a positive or negative aspect (briefly describe why/how)
Predictive maintenance development will impact on the whole value chain. The principal changes will regard: ❑ after sales department. A data mining / dss unit must be foreseen for managing all the information. The natural host for this ground station is the after sales dept. New competencies should be acquired. ❑ maintenance policy. An increase in the "full proof" maintenance contracts is unavoidable. ❑ Authorised garage. They should be able to cope with prevdictive maintenance strategies and messages.

Other aspects related to the Value-chain issues If some aspects are not are covered above, please use this field.

4.4 Environmental issues A4

Savings of energy Based on today's As-is situation, try to guesstimate the savings of energy due to the new application scenario (if any). Justify the guesstimate.
Considering par BUSINESS EFFECTS (OWN BUSINESS) – POSITIVE ASPECTS and preliminary evaluations, up to 30% saving of energy for each topic / component equipped with predictive maintenance strategies can be foreseen.

Savings of material Based on today's As-is situation, try to guesstimate the savings of material due to the new application scenario (if any). Justify the guesstimate.
Considering par BUSINESS EFFECTS (OWN BUSINESS) – POSITIVE ASPECTS and preliminary evaluations, up to 30% saving of energy for each topic / component equipped with predictive maintenance strategies can be foreseen.

Reuse or extended product life Based on today's As-is situation, try to guesstimate the amount of reuse and/or extended product life due to the new application scenario (if any). Justify the guesstimate.
Considering par BUSINESS EFFECTS (OWN BUSINESS) – POSITIVE ASPECTS and preliminary evaluations, up to 30% saving of energy for each topic / component equipped with predictive maintenance strategies can be foreseen.

Other aspects related to the Environmental issues If some aspects are not are covered above, please use this field.

4.5 Social issues A4

Changed labour/work conditions Describe the implications of the application scenario regarding changed labour/work conditions
See VALUE-CHAIN ISSUES

Social Impact on society Describe, if any, implications of the application scenario regarding Social Impact on society
n.a.

Ethical issues Is there ethical issues related to the application scenario? IF Yes explain
n.a.

Other aspects related to the Social issues If some aspects are not are covered above, please use this field.

Application Scenario Description
Caterpillar MOL

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Date (dd.mm.yyyy)	Version	Author	Comments
	1.0	See front page	The draft version submitted SINTEF
05.01.2005	1.1	Carl Christian Røstad, SINTEF	Updated v1.0 document – Chapter references below refers to the old chapter structure in v1.0 ♦ 3.14 Technical interfaces - DELETED (transferred to WP R1) ♦ 3.15 Facility and quality technical requirements – DELETED (transferred to WP R1) ♦ 3.16 Hardware and software platforms in use – DELETED (transferred to WP R1) ♦ 4.2 To-be, Future scenario concept - REMOVED ERRONUS DESCRIPTION TEXT ♦ 4.3 GAP analysis of As-is and To-be - REMOVED ♦ 4.6 Cost models - DESCRIPTION CHANGED ♦ 5.2 Describe possible downsides/upsides … - DESCRIPTION UPDATED ♦ 6.4 Improved LCA indications - REMOVED ♦ 6.5 Improved MOL/BOL/EOL options - REMOVED ♦ 7.1 Changed labour/work conditions - DESCRIPTION UPDATED ♦ 7.2 Social Impact on society - DESCRIPTION UPDATED ♦ 7.3 Ethical issues - DESCRIPTION CHANGED
	1.2	Keith Herman, Howard Ludewig, Jean Jacques Janosch, Pat Ludewig	Many changes
05.05.2005	1.3	Carl Christian Røstad	Prepared for inclusion in DR3.2

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5 Application scenario description A5 CATERPILLAR MOL

Where discrepancies, the Demonstrator-document overrides all aspects of this scenario.

Purpose and objective(s) of the scenario Give a detailed description of the scenario objective – What is the purpose of the scenario
The purpose of this scenario is to identify the basic framework for implementing the PROMISE methodology on construction and mining equipment. The application scenario focuses on information that is gained during MOL events and how rigorous management of the information can improve MOL responsive to the event as well as provide feedback to BOL functions and tracking of EOL information. The demo case for this scenario will be based on the Track Type Loader (TTL) or Track Type Tractor (TTT) as shown in Figures1 and 2, respectively.

Figure 1: Caterpillar Track Type Loader.

Figure 2: Caterpillar Track Type Tractor.

The primary objective of the proposed scenario is to take available information on the vehicle and convert it into an action that improves responsiveness to customer requirements. In addition this information can provide feedback to the design and manufacturing sources as well as waste stream management to make these processes more robust.

Scenario objective(s) rationale Describe the rationale for the objective, i.e. why is the objective important and why the objective is important to fulfil
The scenario will be used to identify, test, and document the information requirements, component requirements, information flow, and business case relative to life cycle management. The focus of the scenario is MOL responsiveness to customers needs. However, there is a requirement for a systematic approach for identifying the opportunities to convert the data that is gathered during the defined MOL process into useful knowledge to better manage the design, production, and waste management processes. In this context the waste management processes includes recycling, remanufacturing, and disposal. Standard systems must be developed where possible to facilitate data flow and data management.

Relations with PROMISE objectives Relate the application scenario to the PROMISE objectives as described in the Declaration of Work
PROMISE main objective #1: *To develop new closed-**loop life cycle information flow models** for BOL, MOL and EOL.* This scenario will use information relative to component life and failure modes gained during MOL to enhance the design process in BOL. It will use field population data and implied demand to enhance the logistics information for the component providers in the production phase of BOL. It will also provide for the study of waste stream data to optimise EOL processes. PROMISE main objective #2: **To develop new PLM system and IT infrastructure exploiting the capabilities of smart product embedded information devices. Embedded devices will form the bases of the data and information tracking during the MOL event that triggers the process. These devices will continue to be used during MOL to track and document data relative to the product performance, service, and maintenance.** PROMISE main objective #3: To develop new standards to allow the technologies and associated tools to be developed by the PROMISE project to be accepted by the market and allow it to expand quickly by creating an appropriate environment for the development of new innovative applications. **Standards will be required to convert the event data into a actionable information package. In addition the scenario will support the need for standards in device and information protocols.** PROMISE main objective #4: To develop new working and business models appropriate for the use and exploitation of the new technologies and tools to be developed by all actors involved in a product lifecycle. **The scenario will be used to identify, test, and document the information requirements, component requirements, information flow, and business case relative to life cycle management. This will include processes and information management that will facilitate EOL activities including quantification of recyclable content and processes to validate proper levels of recyclable content as well as disposal processes. Opportunities for safety improvements will also be investigated.**

Lifecycle phase relevance (BOL, MOL, EOL) Relate the scenario application to BOL, MOL, EOL, and clearly state the relevance to BOL, MOL and/or EOL
This scenario is primarily related to MOL activities. However, it impacts both BOL and EOL process as previously stated. Information will be collected from the machine during use. When onboard data processing determines that there is an "event", this event data will be transmitted to the appropriate source. For example, a major failure should transmit information directly to the service people (MOL). Logistics information would also be sent out so the replacement part(s) (BOL) could be put in route to the destination of the failure. Manufactures would also be contacted in the case that no parts are available or if the supply of the needed part(s) falls below a designated quantity (MOL). Other importance performance data could be transmitted to the service people and/or designers to help understand how to determine the source of the problem or improve the design. (BOL).

Product considered in scenario Describe the products in the scenario (e.g. car, truck). Include related functionality and life cycle issues.
The product to be used in this scenario will be either a track type tractor or a track type loader, depending on which fits better with the Promise scenario.

Interfaces between lifecycle phases
Describe the interfaces between relevant BOL, MOL and/or EOL

The interfaces between the lifecycle phases are shown in ILLUSTRATION OF THE INFORMATION FLOW. There are two feedback points from MOL to BOL. The first is where part information is feed back to the design process. This includes but is not limited to cause of failure, usage data, and length of life. The second point is information feedback to the production process. This includes logistics information relative to field population, implied demand, and forecasting. The last interface point is between MOL and EOL processes. This includes recyclable content data as well as validation data for waste stream management.

Illustration of the application scenario
Provide an illustration of the application scenario that can be used for communication purposes (e.g. in trade magazines, on the front of reports, slide shows etc). Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

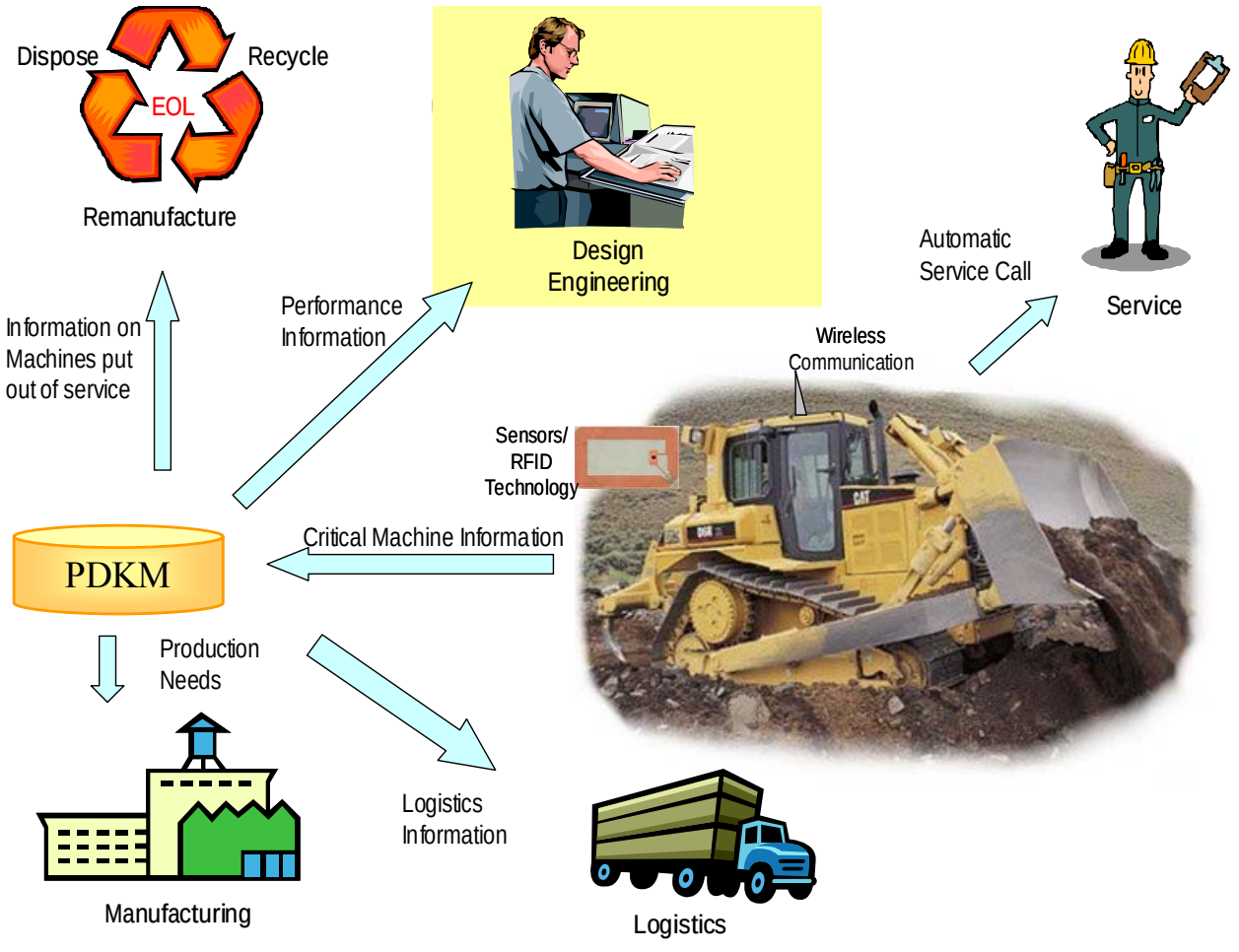


Illustration of the information flow (flowchart)
In order to identify informational requirements, illustrate the flow of information and clearly identify information/data flows by denoting this in the figure. Use rectangles, arrows, circles etc with text. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

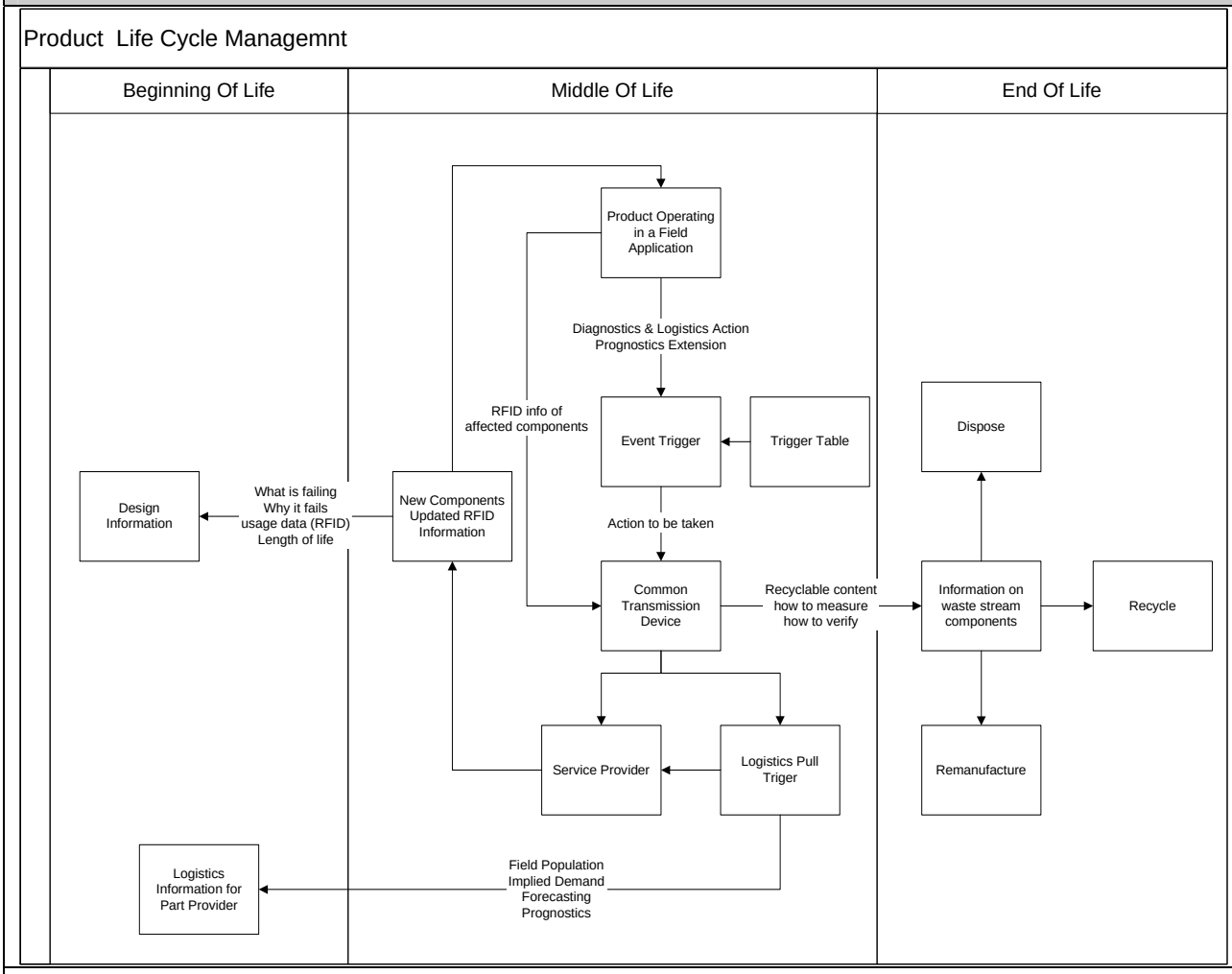


Figure 3: Flow chart of the TTL Application Scenario.

Specific requirements needed in order to fulfil the objective (user requirements related to WP R1)
If there are some specific requirements that are needed to be fulfilled, please state them here.

Collection and documentation of User Requirements is not a straightforward process relative to a broad based implementation of this scenario. The best way to get this information is through a combination of interviews and brainstorming sessions. If the right people can be pulled together, a series of "focus group" brainstorming sessions may be the best tool to fully understand the process requirements.

Pain-points (problems/challenges)
Identify the most important problems/challenges related to this scenario (e.g. technical, economical, ethical, environmental, customer related, partner related)

The single most important challenge will be getting consensus of standardization issues in both hardware and software protocol, communications, and data structures.

Other aspects related to the Application Scenario
If some aspects are not are covered above, please use this field.

There are several requirements for this scenario that must be fulfilled for it to be successful. The real challenge is to develop standard methods and protocols that can be used for a number of different applications. The process start point is defined as a TTL or TTT operating in the field as illustrated in the top of the MOL box in figure 3. In fact this can be characterised as any machine with some diagnostic and prognostic capability operating in its designed application. The diagnostic and prognostic capability is unique to the machine and out of scope for the PROMISE scenario. What is in scope and needed to facilitate the implementation of this scenario is the trigger table that converts the diagnostic and/or prognostic output into an actionable item. An example of what a trigger table might look like is presented in Figure 4.

MOL Event	Action to be taken
Level 1	Maintenance Required Contact Field Service (low Priority)
Level 2	Service Required Contact Field Service (medium Priority)
Level 3	Service Required Part Failure (high Priority)
Level 4	Machine Down Major part failure (immediate action required)

Figure 4: Example of a trigger table.

Figure 4 is a very simple example to illustrate the structure of the trigger table. The PROMISE team will have to better develop the table in detail for it to be useful across multiple applications.

The next major issue is selection a common transmission device that can appropriately communicate action requirements. This has to include the integration of the RFID of affected components. The challenge will be in developing standard protocols and data structures.

The final challenge will be to fully define the information flow between the MOL process and the BOL and EOL processes. Some high level concepts are included in Figure 2. However, these will have to be further defined and specified by the PROMISE team.

If RFID readers are to be installed on machines, a safety opportunity could be available. Dangerous items (electricity, fuel), other machines, and people could carry “warning” RFID’s. When the machine gets in proximity of one of these “dangers”, the operator could be notified.

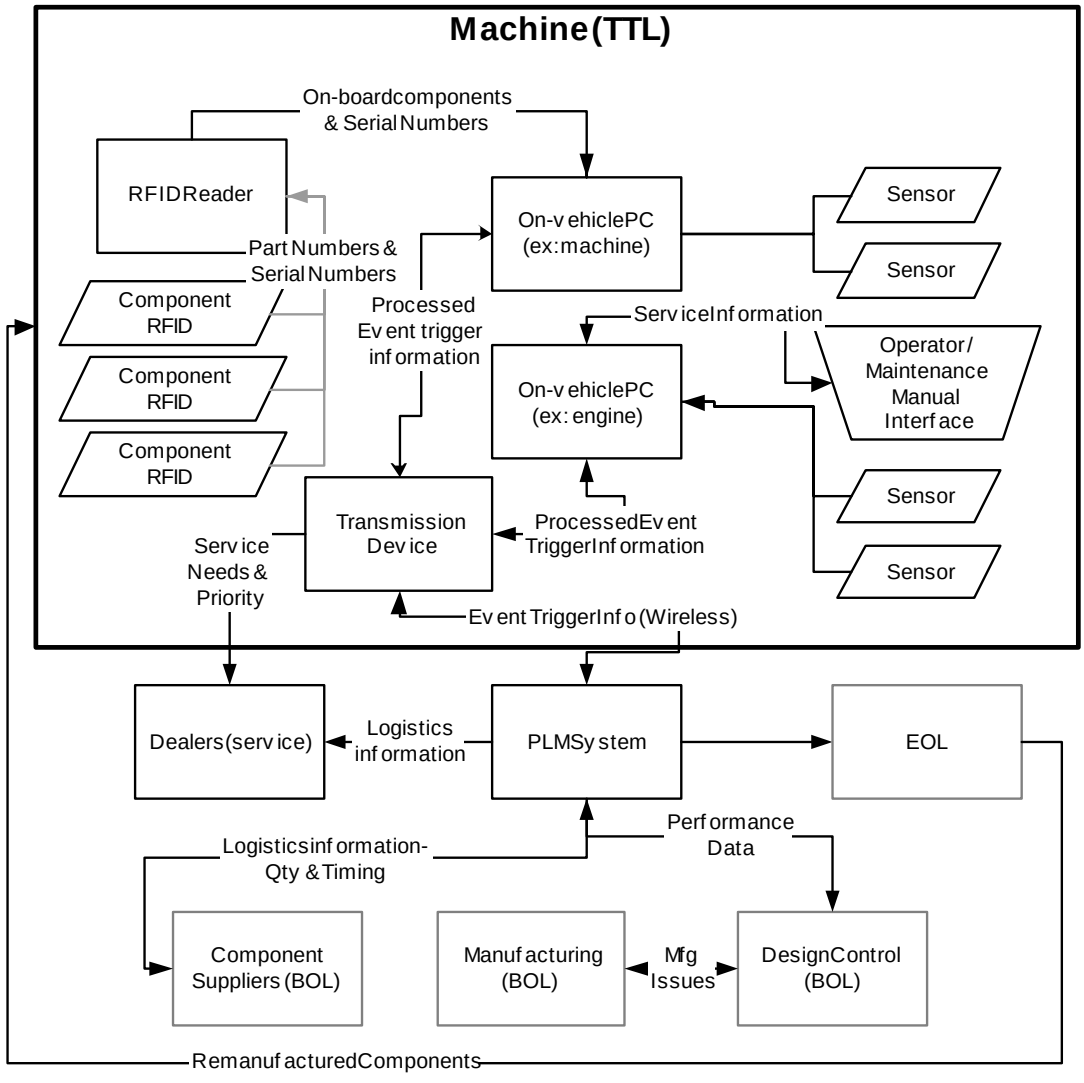
Other safety scenarios could be developed by considering that catastrophic failures could be sensed before they occur letting the operator know to shut down the machine.

5.1 Technical issues A5

***Data&Information*: Product Information requirements**

List what sort of data is to be gathered from e.g. PEIDs. Show how the data is to be transformed into information. Use a tree diagram to illustrate the flow of data, starting with the data gathering from e.g. wheel, dampers etc to the right, and flowing into the PEID. From the PEID indicate output flows and show whether the data is sent by internet, radio, gathered by technician to e.g. a PDA.

Data will be collected from sensors. In a finished product, this sensor data would be processed by an on-vehicle PC. For the Promise demonstration an alternative solution will need to be established to simulate this PC. It is in the on-board PC that the decision will be made to trigger an event and what information must be transferred. There should also be an interface for service man and/or operators to enter information about service, performance, etc.



Data&Information: Input data

Describe the input data going into the PEIDs (type of data, believed amount of data etc).

- Sensor data from a range of sensors.
- Manually entered data from servicemen
- RFID information identifying machine components

Data&Information: Output data Describe the output data going out from the PEIDs (type of data, believed amount of data etc).
• Time/Date stamp • Event type • Relevant Event data • Action Required • Product serial number (TTT or TTL) • Component serial number (Specific component in question) • Machine hours • Component hours • Relevant sensor information (condensed or raw data) • Maintenance information • Misc. user input - . . If there are large amounts of sensor data that cannot be transmitted, an event could be triggered which informs a service man to come and manually collected the needed data from the machine and clear the storage device.

***Data&Information*: Amount of data** Describe the need for storage in the PEIDs (this in order to get a picture of how much storage is needed in e.g. the PEIDs)
At this point, it is not clear where or what data will be stored. The application scenario needs a bit further refinement to come to that stage.

***Hardware*: Hardware** Describe what sort of hardware technologies (PEID, sensors, GPS, networks etc) would be considered to be used or as needed to be developed.
Unknown

***Hardware:* Life span of devices** What is the needed minimum life span of the devices?
Since Caterpillar machines live for decades (50+ years) in the field, the life should be quite long. This should, at a minimum, match the time to the first major overhaul of the machine where devices could possibly be replaced.

***Hardware:* Working conditions** Describe under what sort of working conditions the devices are believed to be working under (like impacts, heat, cold, moisture etc)
Caterpillar machines work in very rugged conditions. Both extreme heat (55 °C) and extreme cold (-30 °C) conditions are encountered. Vibration, impact, large amounts of dust, oil, rain, mud, etc are also part of the normal operating conditions. These machines work in all weather conditions.

***Software:* Firmware (embedded software)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Software should be user configurable and relatively open so that the user (Caterpillar or a dealer) can customise it to fit a specific customer's needs. It could then also be customised monitor multiple components on a machine (engine, critical structures, etc)

***Software:* Middleware (software that allows different software applications to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
See SOFTWARE: FIRMWARE (EMBEDDED SOFTWARE)

***Software:* D2D (software that allows devices to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
See SOFTWARE: FIRMWARE (EMBEDDED SOFTWARE)

***Software:* D2B (software that allows devices to communicate with middleware and/or other software applications)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
See SOFTWARE: FIRMWARE (EMBEDDED SOFTWARE)

***Software:* Backend software (software for data management, decision making etc)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
In a final product, all decisions would be made by proprietary Caterpillar software, however we will need a solution for the Promise demonstration. Possibly a portable PC could be placed on board the product to perform data analysis and storage for the demo. The need for storage would most likely be needed only in the case that the volume is too great to transfer with the chosen communication device.

***Software:* Decision support software (Local? Remote?)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
See SOFTWARE: BACKEND SOFTWARE

Other aspects related to the Technical issues If some aspects are not are covered above, please use this field.
N/A

5.2 Business/economical issues A5

As-is, current solution/implementation of the scenario or similar tasks/situations Describe the As-is solution/implementation that are used today (either as your company or others uses). Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
The as-is situation is that all information from the machines must be manually collected from a limited number of sensors. Because of this there is no PLM infrastructure in place to handle this real time data collection.

To-be, Future scenario concept Describe in more detail the To-be solution/implementation. Describe it in such a way that it is related to the As-is description in section 0 above. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
The to-be situation is the incorporation of more sensors on the machine as a "standard" with the PLM infrastructure to utilize the valuable data.

Business effects (own business) – negative aspects Describe the negative business effects the application scenario (described in section 1) will/could have on your business. (E.g. manpower needs, economy, new business areas, ethical, environmental etc.)
- Caterpillar is a large global organisation with products in use on every continent. This would require systems to be produced in many languages and the system would be required to handle very large amounts of data. - Caterpillar machines are serviced by independently owned dealers. Implementation and training of such a system will/would require a large investment with these dealers. - Some customers may perceive that Caterpillar is spying on them in order to avoid paying warranty claims.

Business effects (own business) – positive aspects Describe the business effects the application scenario will/could have on your business. (e.g. Improved business situation Business improvements opportunities (productivity, quality, environment, social issues) etc.
For MOL activities, the critical data for the machine could be obtained without the expense (of the customer) of stopping the machine. This could improve customer satisfaction. This could also allow dealers to better manage their resources and be more profitable. It would also allow them to better service their customer, giving Caterpillar an advantage over their competition.

Cost models What sort of cost models is viable for the application scenario? I.e. how much is the maximum price per PEID, support systems etc? It's important to identify the maximum price range that can be added to a product/vehicle etc as a consequence of the aspects described in this application scenario. Describe therefore aspects that will have a consequence for costs, and in what range the "hurting" price for the customer (or users etc) will be.
This would need to be determined on a cost-benefit basis. Caterpillar customers buy machines to make money. Considering this fact and the fact that the customer has spent a quite large sum of money on a machine, cost would not be the primary focus if the device would allow for lower owning and operating costs.

Other aspects related to the Business/Economical issues If some aspects are not are covered above, please use this field.
N/A

5.3 Value-chain issues A5

Make an overview of the value-chain related to the application scenario Describe the partners/business associates/customers etc related to the application scenario. If this already has been covered by earlier illustrations/descriptions, please indicate this in the field below. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
For replaceable or "consumable" parts of a machine, the supplier/manufacturer of a specific component could automatically be contacted in advance of the need of a new component as sensed by the machine. This would allow for the new component to be produced and delivered to the appropriate location just before it is actually needed. In many cases, this replacement could occur during the normal maintenance schedule of the machine. See diagram in section ILLUSTRATION OF THE APPLICATION SCENARIO.

Describe possible downsides/upsides related to: Customers (categorized), Suppliers (categorized), Partners/cooperating companies (categorized) What kind of consequences will the application scenario have for the partners/business associates/customers etc in the value-chain. E.g. Dismantler: Dismantler must invest in new systems for reading/handling discarded products etc, but will have an upside regarding their operations of reuse/remfg etc as they more readily can… E.g. Customer: Customer will experience changes in their maintenance program this can be perceived as a positive or negative aspect (briefly describe why/how)
• At a high level, a large investment will be needed to implement the needed infrastructure and supporting processes. If the customer will accept such a system. • Customers may not agree to have Caterpillar monitoring their machines. For example, if Caterpillar could prove that the customer was abusing their machine (regularly exceeding established capacity), they would be denied • In some countries, there could be legal issues with Caterpillar monitoring a customer's machine.

Other aspects related to the Value-chain issues If some aspects are not are covered above, please use this field.
N/A

5.4 Environmental issues A5

Savings of energy Based on today's As-is situation, try to guesstimate the savings of energy due to the new application scenario (if any). Justify the guesstimate.
We do not fully know the level of scope for this application at this time. However, the utilization of a predictive and preventative maintenance tool will optimise energy efficiency of the product. Thus, energy will be realized in reduced fuel consumption.

Savings of material Based on today's As-is situation, try to guesstimate the savings of material due to the new application scenario (if any). Justify the guesstimate.
Real-time predictive and preventative measures during the life cycle of the product will prevent hard failures and promote the retention of value added from the original manufacturing.

Reuse or extended product life Based on today's As-is situation, try to guesstimate the amount of reuse and/or extended product life due to the new application scenario (if any). Justify the guesstimate.
Baseline data shows that annual worldwide material savings resulting from remanufacturing activities is 14 million tons, according to the "National Center for Remanufacturing and Resource Recovery". Other sources indicate that this represents less than 20% of the total opportunity.

Other aspects related to the Environmental issues If some aspects are not are covered above, please use this field.
The primary advantage that is not covered above is the conservation of landfill space and the decrease in the use of virgin natural resources that will result from improved proactive fleet management.

5.5 Social issues A5

Changed labour/work conditions Describe the implications of the application scenario regarding changed labour/work conditions
• Improved training processes. • Proactive maintenance Information feedback to the design and manufacturing process will produce user-friendly products. (Operator comfort, safety, satisfaction of the product user …)

Social Impact on society Describe, if any, implications of the application scenario regarding Social Impact on society
• Reduced pressure on natural resources. • Reduced green house gas emissions

Ethical issues Is there ethical issues related to the application scenario? IF Yes explain
Privacy? Does Caterpillar have the right to monitor the use of a customer's machine? This is an issue that probably varies from country to country.

Other aspects related to the Social issues If some aspects are not are covered above, please use this field.
N/A

Application Scenario Description
FIDIA

Written by:
Daniele PANARESE, FIDIA
Michele SURICO, FIDIA

DELIVERABLE NO	Input to DR 3.1, **relates to WP A6**
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Revision History

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10.12.2004	1.0	Fabrizio MEO	The draft version submitted SINTEF
05.01.2005	1.1	Carl Christian Røstad, SINTEF	Updated v1.0 document – Chapter references below refers to the old chapter structure in v1.0 ♦ 3.14 Technical interfaces - DELETED (transferred to WP R1) ♦ 3.15 Facility and quality technical requirements – DELETED (transferred to WP R1) ♦ 3.16 Hardware and software platforms in use – DELETED (transferred to WP R1) ♦ 4.2 To-be, Future scenario concept - REMOVED ERRONUS DESCRIPTION TEXT ♦ 4.3 GAP analysis of As-is and To-be - REMOVED ♦ 4.6 Cost models - DESCRIPTION CHANGED ♦ 5.2 Describe possible downsides/upsides … - DESCRIPTION UPDATED ♦ 6.4 Improved LCA indications - REMOVED ♦ 6.5 Improved MOL/BOL/EOL options - REMOVED ♦ 7.1 Changed labour/work conditions - DESCRIPTION UPDATED ♦ 7.2 Social Impact on society - DESCRIPTION UPDATED ♦ 7.3 Ethical issues - DESCRIPTION CHANGED
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05.05.2005	1.4	Carl Christian Røstad	Prepared for inclusion in DR3.2

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6 Application scenario description A6 FIDIA

Purpose and objective(s) of the scenario Give a detailed description of the scenario objective – What is the purpose of the scenario
Fidia is a world leader in the design, construction and marketing of integrated systems for the machining of complex forms for the moulds and dies industry. Moulds and dies are used in the manufacturing of mass-produced products. Consequently, they find application in a very wide and increasing range of production sectors owing to the cost-effective pressing and moulding production process. Fidia manages all the technological areas, allowing for complete management of the milling process, from the post-design phase to the finished product. In particular, Fidia produces and markets: Numerical controls for milling systems; High-speed milling systems; Servo drives for milling systems. Fidia technology is focused on the production of more complex moulds and dies (i.e. where the form to be produced involves extremely sophisticated machining of the material). It finds application largely in the automotive industry (style models, tools, dies and moulds), aeronautical industry (undercarriage, turbines), footwear sector (style models, prototypes, dies and moulds) and for the manufacturing of various complex items. Fidia machines are often customised according to the needs of each individual customer, and high costs are usually incurred in production losses due to machinery breakdown, customers 'on-site' assistance during the set-up stages, as well as during the later stages of the life cycle of the machine, whenever maintenance work is needed, especially in the frequent case where the user site is several hundreds or thousands of kilometres from the supplier site. Modern Information Technologies offer the opportunity of dramatically reducing machine unavailability through the enhancing of their diagnostic performances. According to these issues the scenario objectives are: • diagnosis of the machine (prediction of interventions for substitution of mechanical parts, self tuning); • traceability of components.

Scenario objective(s) rationale Describe the rationale for the objective, i.e. why is the objective important and why the objective is important to fulfil
Prediction of interventions for substitution of mechanical parts is important because it allows to optimize the management of production. It is very important to prevent faults and to minimize machine unavailability. Traceability is important because allows the machine builder to know at any time in which machine a component is installed. Some eletrical or mechanical components once repaired could be installed on other machines, but the machine builder could ignore on which system that component was installed. At the next fault or reparation, it could be desiderable to know the provenience and the 'history' of that element for two reasons: statistical analysis of working conditions; feedback to the engineering team.

Relations with PROMISE objectives Relate the application scenario to the PROMISE objectives as described in the Declaration of Work
Diagnosis of the machine and Traceability of its parts and components, have as goal the use of smart embedded IT systems monitoring product information during its lifecycle at any moment and at any place in the world fully according to PROMISE objectives.

Lifecycle phase relevance (BOL, MOL, EOL) Relate the scenario application to BOL, MOL, EOL, and clearly state the relevance to BOL, MOL and/or EOL
Machine diagnosis in the sense of a preventive maintenance is related to the MOL because it monitors how the machine is working day by day and how it is going to work in the next future, related to the degradation of components. Traceability is related mainly to the MOL, but it involves relation with BOL and EOL because it allows to know the whole life of a component of a machine.

Product considered in scenario Describe the products in the scenario (e.g. car, truck). Include related functionality and life cycle issues.
Product considered in PROMISE scenario is milling machine. Milling is the process of cutting away material by a rotating cutter. 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. Fidia milling systems are small-medium working range high-speed systems, that offer substantial advantages compared to traditional milling machines. Fidia high-speed technology has improved quality and reduced manifacturing times significantly. The milling systems are controlled by a numerical control. Fidia numerical controls are designed to control milling systems for the machining of complex forms. Accuracy and the quality of the finished product are their most important characteristics. Numerical controls are electronic devices which, by means of specific data processing software programs, automate the operation of machine tools and production plants. The software incorporated in the numerical control "reads" the static mathematical data and transforms this data into dynamic electrical data, i.e. into commands for making the tool execute the sequence of movements required in order to produce the desired shape by milling the part.

Interfaces between lifecycle phases Describe the interfaces between relevant BOL, MOL and/or EOL
RFIDs could be useful in order to store data of each component of a milling system from the beginning of its life to the end. In fact in BOL could be stored data like dimension, weight, material, etc… in MOL could be added data reflecting how the component is working (scenario objectives), and at the EOL it could be possible to understand reading the huge amount of information stored in the RFIDs the behavior of the component for a feedback to the manifacturing designers. The application scenario even offers an interface to BOL and design. One of the results is the continuous improvement of products: the diagnostic module will be able to identify the most critical parts in the system, and to substitute them, through a change in the design of the product.

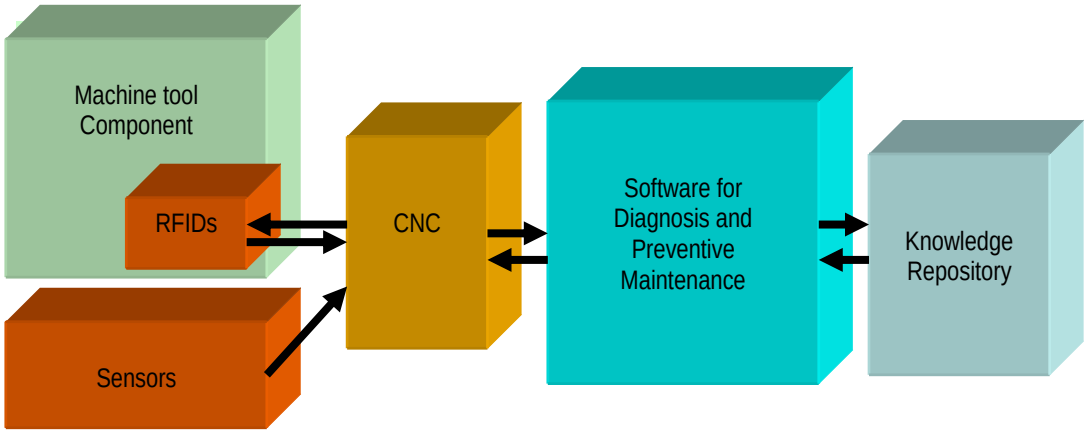
Illustration of the application scenario Provide an illustration of the application scenario that can be used for communication purposes (e.g. in trade magazines, on the front of reports, slide shows etc). Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.


Illustration of the information flow (flowchart) In order to identify informational requirements, illustrate the flow of information and clearly identify information/data flows by denoting this in the figure. Use rectangles, arrows, circles etc with text. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
See Illustration of Application scenario

Specific requirements needed in order to fulfil the objective (user requirements related to WP R1) If there are some specific requirements that are needed to be fulfilled, please state them here.
In order to be integrated in a milling machine RFIDs are needed to be small few millimeters, cheap less than 10 euros, capacious at least 200 kByte. More accurate estimate will be provided during the project.

Pain-points (problems/challenges) Identify the most important problems/challenges related to this scenario (e.g. technical, economical, ethical, environmental, customer related, partner related)
None

Other aspects related to the Application Scenario If some aspects are not are covered above, please use this field.
None

6.1 Technical issues A6

***Data&Information*: Product Information requirements** List what sort of data is to be gathered from e.g. PEIDs. Show how the data is to be transformed into information. Use a tree diagram to illustrate the flow of data, starting with the data gathering from e.g. wheel, dampers etc to the right, and flowing into the PEID. From the PEID indicate output flows and show whether the data is sent by internet, radio, gathered by technician to e.g. a PDA
In order to allow diagnosis applications and traceability features on Fidia Machines , RFIDs should gather information like: who built the component and when; when the component was installed on a machine, disinstalled and installed on another machine…; information to be used as a term for comparison for detection of degradation, condition diagnosis. This information flow should be realized by radio transmission between RFIDs and the Computerized Numerical Control (CNC).

Data&Information: Input data Describe the input data going into the PEIDs (type of data, believed amount of data etc).
Data related to the design of component; Data related to the life of component. The life of component is represented by a set of suitable parameters that take a picture of the state of the component.

Data&Information: Output data Describe the output data going out from the PEIDs (type of data, believed amount of data etc).
Same as input data

***Data&Information*: Amount of data** Describe the need for storage in the PEIDs (this in order to get a picture of how much storage is needed in e.g. the PEIDs)
Due to monitoring and traceability purposes it is required a huge amount of data to be stored during the life of the component. Memory required could be exstimated in kbytes

***Hardware*: Hardware** Describe what sort of hardware technologies (PEID, sensors, GPS, networks etc) would be considered to be used or as needed to be developed.
Sensors (position, temperature) are currently used in a milling machine and they have a wire connection. RFID wireless technology will be developed in order to integrate data and information gathered by sensors and to develop new knowledge and decision making features.

***Hardware:* Life span of devices** What is the needed minimum life span of the devices?
RFIDs in order to be applicable to the components of a milling machine, should have life span not less than life span of the components that should be monitored (about 30 years).

***Hardware:* Working conditions** Describe under what sort of working conditions the devices are believed to be working under (like impacts, heat, cold, moisture etc)
Fidia would apply RFID on its milling systems that have hostile working conditions. Milling centres are characterized by smokes, metal shavings, heat. It would be desirable to install RFIDs on mechanical components which translate or rotate in their working conditions.

***Software:* Firmware (embedded software)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
None

***Software:* Middleware (software that allows different software applications to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Middleware is FIDIA user interface running on Windows or Linux operating system.

***Software:* D2D (software that allows devices to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
None

***Software:* D2B (software that allows devices to communicate with middleware and/or other software applications)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
D2B software should allow devices (RFIDs) to communicate with the CNC. CNC should be able to read data from and write data on RFIDs. This could be achieved using software tecnologies like “dll” or “ocx” .

***Software:* Backend software (software for data management, decision making etc)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Backend software should manage a database containing data of all the components of a machine, and should be able to do statistical analysis, in order to evaluate “health state” of each single component, and its estimated end of life. This would allow a more efficient production management. Backend software would run on the CNC of each machine or on a Central PC dedicated to the management of several machines.

***Software:* Decision support software (Local? Remote?)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Decision support software, gathering data from RFIDs, will run locally on the PC of the Numerical Control. This software should do: suitable tests on the machine; elaboration of data and extraction of relevant parameters; making decision, starting from these parameters, trough A.I. algorithms (neural networks, kalmann filters, etc…). Data and parameters need to be read/written in RFIDs using libraries mentioned in 3.11 .

Other aspects related to the Technical issues If some aspects are not are covered above, please use this field.
Hardware and software platforms in use CNC is a computer with several boards integrated on bus PCI. The PC of the CNC is based on Windows operating system that allows several Windows software applications to be runned. The User Interface is a Visual C++ application that allows the user to manage overall the machine.

6.2 Business/economical issues A6

As-is, current solution/implementation of the scenario or similar tasks/situations Describe the As-is solution/implementation that are used today (either as your company or others uses). Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
Today a failure on a milling machine implies: ♦ the sudden interruption of a manufacturing process (loss of production); ♦ the intervention of a technician to repair the machine (travelling and manpower costs). These costs weigh on the Builder Machine and on the End User.

To-be, Future scenario concept Describe in more detail the To-be solution/implementation. Describe it in such a way that it is related to the As-is description above. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
In the future the diagnostic module could: ♦ minimize the unavailability of the machine because it could prevent sudden interruption; ♦ reduce the maintenance costs because the technician would intervene only when a component substitution is required.

GAP analysis of As-is and To-be Identify the gaps between the As-is and the To-be.
Reduction of costs for both the Builder Machine and the End User.

Business effects (own business) – negative aspects Describe the negative business effects the application scenario (described in section 1) will/could have on your business. (E.g. manpower needs, economy, new business areas, ethical, environmental etc.)
None

Business effects (own business) – positive aspects What sort of cost models is viable for the application scenario? I.e. how much is the maximum price per PEID, support systems etc? It's important to identify the maximum price range that can be added to a product/vehicle etc as a consequence of the aspects described in this application scenario. Describe therefore aspects that will have a consequence for costs, and in what range the "hurting" price for the customer (or users etc) will be.
Increase of production; and Increase of quality of technical assistance to the End User.
Cost models What sort of cost models is viable for the application scenario? I.e. how much is the maximum price per device.
Because of RFIDs would be installed on several components and several RFIDs could be installed per component, the device should cost less than € 10.
Other aspects related to the Business/Economical issues If some aspects are not are covered above, please use this field.
None

6.3 Value-chain issues A6

Make an overview of the value-chain related to the application scenario Describe the partners/business associates/customers etc related to the application scenario. If this already has been covered by earlier illustrations/descriptions, please indicate this in the field below. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
Customers: Higher quality of technical assistance to the End User. Fewer production stoppages. Lower technical assistence fares. Technical Assistence: Lower travelling and manpower costs for each intervention. Facilitations in their work. Design department: Better comprehension of malfunctions and breaks. Improvement of design (reliability, technical quality,etc…)

Describe possible downsides/upsides related to: Customers (categorized), Suppliers (categorized), Partners/cooperating companies (categorized) What kind of consequences will the application scenario have for the partners/business associates/customers etc in the value-chain. E.g. Dismantler: Dismantler must invest in new systems for reading/handling discarded products etc, but will have an upside regarding their operations of reuse/remfg etc as they more readily can… E.g. Customer: Customer will experience changes in their maintenance program this can be perceived as a positive or negative aspect (briefly describe why/how)
None

Other aspects related to the Value-chain issues If some aspects are not are covered above, please use this field.
None

6.4 Environmental issues A6

Savings of energy Based on today's As-is situation, try to guesstimate the savings of energy due to the new application scenario (if any). Justify the guesstimate.
None

Savings of material Based on today's As-is situation, try to guesstimate the savings of material due to the new application scenario (if any). Justify the guesstimate.
None

Reuse or extended product life Based on today's As-is situation, try to guesstimate the amount of reuse and/or extended product life due to the new application scenario (if any). Justify the guesstimate.
The integrated use of RFIDs in a diagnosis module, clearly extends product life because to intervene at the beginning of a failure can avoid serious consequencies to the machine. The use of RFIDs for traceability issues can allow the reuse of a substituted component being sure of its "quality" due to the history written on itself.

Other aspects related to the Environmental issues If some aspects are not are covered above, please use this field.
None

6.5 Social issues A6

Changed labour/work conditions Describe the implications of the application scenario regarding changed labour/work conditions
None

Social Impact on society Describe, if any, implications of the application scenario regarding Social Impact on society
None

Ethical issues Is there ethical issues related to the application scenario? IF Yes explain
None

Other aspects related to the Social issues If some aspects are not are covered above, please use this field.
None

Application Scenario Description A7
MTS MOL

Written by:
Marra Lorenzo: Teleassistance Manager, MTS

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Revision History

Date (dd.mm.yyyy)	Version	Author	Comments
20.12.2004	01	Lorenzo Marra	First draft of MTS gas boiler application scenario
05.01.2005	1.1	Carl Christian Røstad, SINTEF	Updated v1.0 document – Chapter references below refers to the old chapter structure in v1.0 ♦ 3.14 Technical interfaces - DELETED (transferred to WP R1) ♦ 3.15 Facility and quality technical requirements – DELETED (transferred to WP R1) ♦ 3.16 Hardware and software platforms in use – DELETED (transferred to WP R1) ♦ 4.2 To-be, Future scenario concept - REMOVED ERRONUS DESCRIPTION TEXT ♦ 4.3 GAP analysis of As-is and To-be - REMOVED ♦ 4.6 Cost models - DESCRIPTION CHANGED ♦ 5.2 Describe possible downsides/upsides … - DESCRIPTION UPDATED ♦ 6.4 Improved LCA indications - REMOVED ♦ 6.5 Improved MOL/BOL/EOL options - REMOVED ♦ 7.1 Changed labour/work conditions - DESCRIPTION UPDATED ♦ 7.2 Social Impact on society - DESCRIPTION UPDATED ♦ 7.3 Ethical issues - DESCRIPTION CHANGED
14.01.2005	1.2	Lorenzo Marra	• 2.11 Added security issue; • 6.3 extended lifetime of boiler control board is mentioned;
05.05.2005	1.3	Carl Christian Røstad	Prepared for inclusion in DR3.2

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7 Application scenario description A7 MTS MOL

Purpose and objective(s) of the scenario Give a detailed description of the scenario objective – What is the purpose of the scenario
The goal is to systematically collect and store the data relevant to the application and to apply evolutionary diagnostic and prognostic algorithms over the product lifespan (MOL). Gas boilers will be installed in the field and data collected will be handled by PLM developed in PROMISE. The goal of this application cluster is to validate on a real application what developed on RC2, RC3 and RC4 by other partners. The purpose of the scenario is to give to after sale service a tool to improve the maintenance and repairing operations of wall hung gas boilers during MOL. Prognostics algorithms are very relevant in this application scenario because they allow service people to replace a component before it has a failure, thus allowing higher availability of the gas boiler (the user will not have a cool house because the boiler is in lock-out).

Scenario objective(s) rationale Describe the rationale for the objective, i.e. why is the objective important and why the objective is important to fulfil
The objective is important because the maintenance and repairing operations during MOL are responsible of keeping gas boilers working with high efficiency, low polluting emissions and always available. The objective is important to fulfil because it will improve environment and customer satisfaction.

Relations with PROMISE objectives Relate the application scenario to the PROMISE objectives as described in the Declaration of Work
MTS application scenario is related to following PROMISE objectives: • PROMISE intents to realise the seamless e-Transformation of Product Lifecycle data and Information to Knowledge; • PROMISE will develop new tools and interfaces to allow human beings to seamlessly communicate with products; • PROMISE invests on smart Product Embedded Information Devices (tags) as a basis of the proposed technology.

Lifecycle phase relevance (BOL, MOL, EOL) Relate the scenario application to BOL, MOL, EOL, and clearly state the relevance to BOL, MOL and/or EOL
MTS application scenario is related to MOL. The relevance of MOL is explained by the interest of MTS to efficient operation of Service Companies working on maintenance and repair of MTS' boilers.

Product considered in scenario Describe the products in the scenario (e.g. car, truck). Include related functionality and life cycle issues.
MTS will make available a certain number of wall hung gas boilers, that have to be supplied by Natural Gas and installed in domestic houses. They are suitable for both istantaneous Domestic Hot Water production and Central Heating. The output power can be modulated between 8KW and 24KW.

Interfaces between lifecycle phases
Describe the interfaces between relevant BOL, MOL and/or EOL

At the time being in MTS structure there is not an interface between BOL/MOL to EOL; so MTS doesn't receive back from the field information on EOL of its boilers. On the contrary there is an information flow from MOL (boiler repairing) to BOL (boiler developing and production). MTS receives from After Sale Service companies informs MTS Call Centre or Quality department of malfunctions, installation problems, frequent failures of components. These information are used to correct project error or improve quality, e.g. acting on internal production process or on production processes of MTS' suppliers.

Illustration of the application scenario
Provide an illustration of the application scenario that can be used for communication purposes (e.g. in trade magazines, on the front of reports, slide shows etc). Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

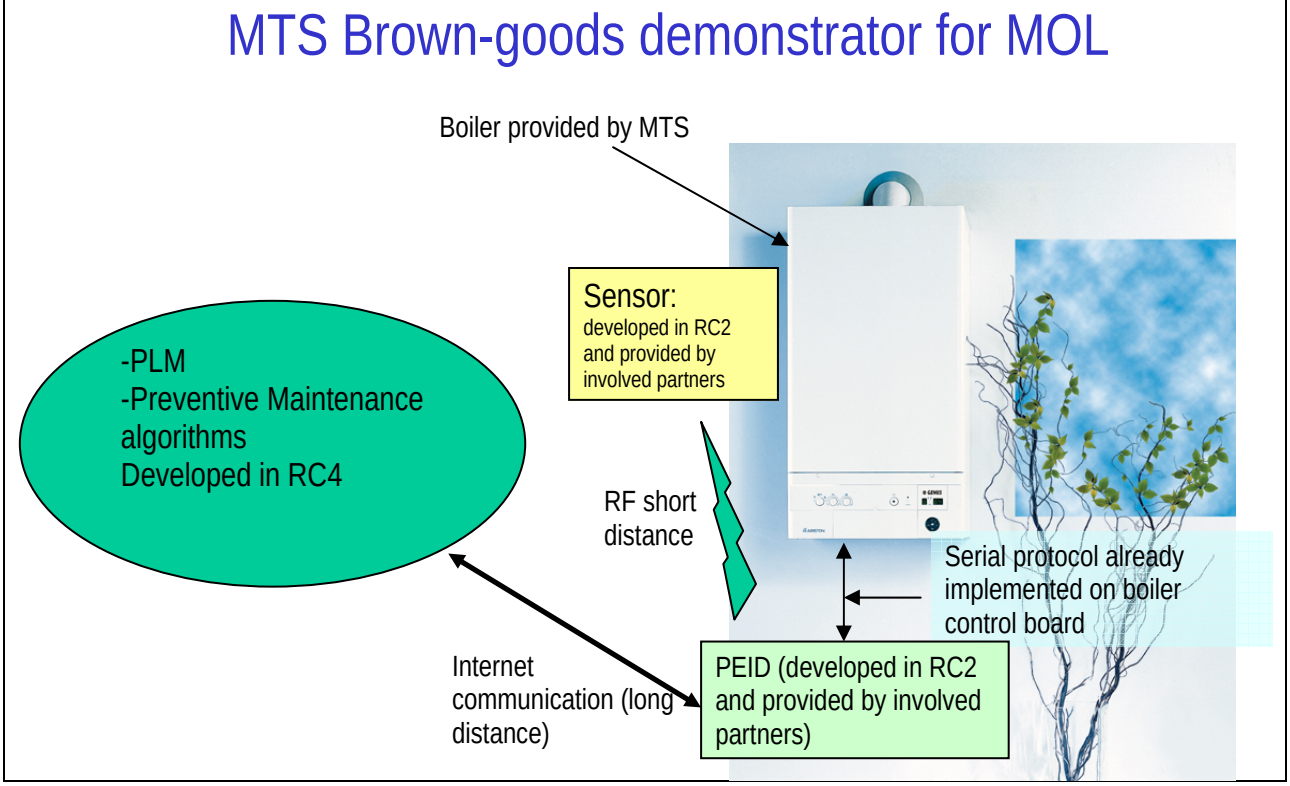
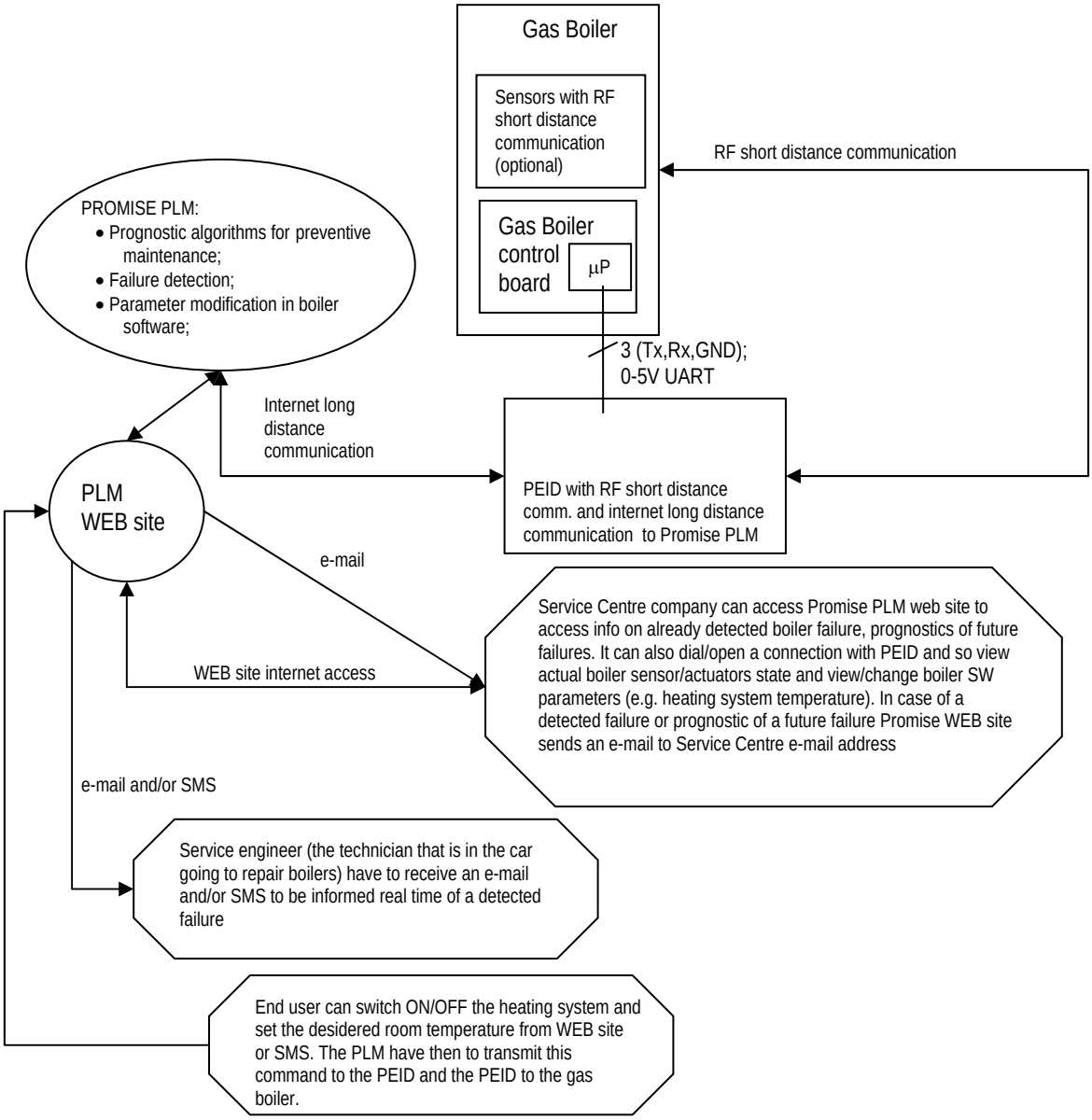


Illustration of the information flow (flowchart)
In order to identify informational requirements, illustrate the flow of information and clearly identify information/data flows by denoting this in the figure. Use rectangles, arrows, circles etc with text. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.



- **Gas boiler control board**:
  - it manages both safety and regulation functions of the boiler;
  - it is provided by MTS and certified with the boiler itself. The gas boiler control board has a certain number of digital (central heating pressure switch, air pressure switch,…) and analog input (central heating flow temperature, central heating return temperature, Domestic Hot Water temperature) and also a certain number of digital (220VAC for fan/pump/diverter valve driving) and analog output (for gas valve modulator);
  - it is provided with a serial protocol through a 3 wires connection (RX-TX-GND) directly connected to the UART of gas boiler control board's microprocessor; through this protocol the PEID can retrieve from the gas boiler control board all info on input/output status and can also read/modify functional software parameters of control board;
  - the specification of this serial protocol will be provided under NDA by MTS to the Promise partner which will develop the PEID for long distance communication over the internet to Promise PLM; this partner will implement MTS protocol and MTS will support this partner in testing and debugging it;

- in order to guarantee the gas boiler safety, the RX-TX-GND of PEID must be compliant to SELV (Safety Low Voltage Directive); EMC testing on Gas Boiler equipped with PEID + Sensors with RF communication must be performed in order to achieve the CE approval and so to be allowed to install these boilers in the field;

Specific requirements needed in order to fulfil the objective (user requirements related to WP R1)
If there are some specific requirements that are needed to be fulfilled, please state them here.

- It must be possible to have bi-directional communication to Gas boiler control board through Gas boiler control board serial protocol (MTS protocol);
- It must be possible to access data related to gas boiler through a WEB site;
- Service Centres and Service engineers must be advised through WEB site, e-mail and SMS of an already happened failure or of failures that are going to happen.
- It must be possible to get an information that a failure is going to happen through prognostic algorithms (PREVENTIVE MAINTENANCE);

Pain-points (problems/challenges)
Identify the most important problems/challenges related to this scenario (e.g. technical, economical, ethical, environmental, customer related, partner related)

The most important challenge is related to the reliability of a prognostic algorithm to estimate the probability that a failure on a specific component can happen in a certain time period. This reliability depends on the statistics technique used to analyze data, on mathematical models used to describe the gas boiler on the DOE technique used to gather data from the boiler through limited amount of experiments. MTS has not the expertise and know-how on DOW, statistics technique and mathematical models; this expertise is expected from other partners, like CRF. MTS has the expertise on the product, on the failures which are more important to detect before they happen, has the laboratory facility to carry out experiments and has products on which apply what developed in PROMISE in order to evaluate in the field the performance of the project.

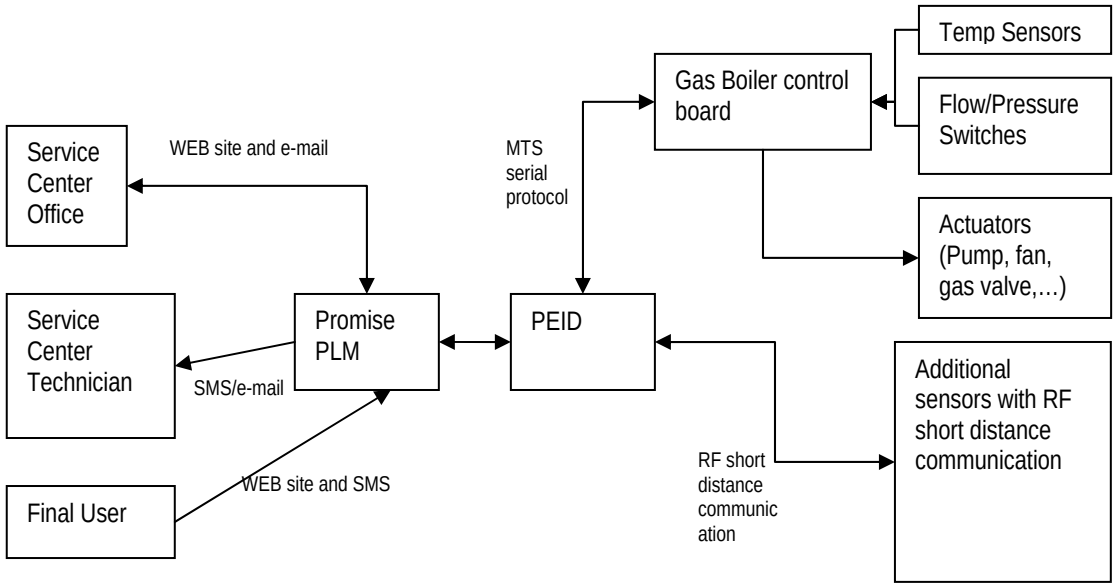
Other aspects related to the Application Scenario
If some aspects are not are covered above, please use this field.

Security issue must be considered, not only regarding possibility that an hacker takes control of household appliances but also regarding privacy and security of all information flowing and stored in PLM. Passwords and Usernames must be treated with highest level of security and also the communication over short distance and long distance must be protected.
In any case, we have already implemented in boiler control board microprocessor a protocol with checksum that ensures again corrupted data wrong handling.
I would like to point out very clearly that any wrong communication or hacker cannot drive the gas boiler into a not safe condition (e.g. an hacker could switch on the boiler but cannot let the valve be opened even if there is not flame detected, thus generating a flow of unburned gas that can cause explosion). This is not possible because the safety of the boiler in ensured by its control board against any kind of disturbances or/and errors.

7.1 Technical issues A7

***Data&Information*: Product Information requirements**

List what sort of data is to be gathered from e.g. PEIDs. Show how the data is to be transformed into information. Use a tree diagram to illustrate the flow of data, starting with the data gathering from e.g. wheel, dampers etc to the right, and flowing into the PEID. From the PEID indicate output flows and show whether the data is sent by internet, radio, gathered by technician to e.g. a PDA



Data&Information: Input data

Describe the input data going into the PEIDs (type of data, believed amount of data etc).

Temperatures, switches status, actuator status (both digital/analog), historical data, parameters value, boiler status (Central heating, Domestic hot water), command to modify parameters (e.g. Central heating temperature). Few megabytes/year max should be transmitted.

Data&Information: Output data

Describe the output data going out from the PEIDs (type of data, believed amount of data etc).

The same data retrieved by PEID from Gas boiler control board, through MTS serial protocol, and from eventually present other sensors, through RF short distance communication, must be locally logged and sent to PLM in case of:

- A failure is detected by PEID;
- Other diagnostic events are detected by PEID;
- Timer of X days expired (this timer must be implemented in PEID software);
- Request sent by PLM to PEID to retrieve data present in log memory;
- Counter of Y nr of cycles expired (this counter must be implemented in PEID software);
- Counter of Z nr of burning hours expired (this counter must be implemented in PEID software);
- Other events to be specified;

***Data&Information*: Amount of data** Describe the need for storage in the PEIDs (this in order to get a picture of how much storage is needed in e.g. the PEIDs)
1 Mybte of data flash should be enough

***Hardware*: Hardware** Describe what sort of hardware technologies (PEID, sensors, GPS, networks etc) would be considered to be used or as needed to be developed.
MTS has not specific technology to require.

***Hardware:* Life span of devices** What is the needed minimum life span of the devices?
20 years

***Hardware:* Working conditions** Describe under what sort of working conditions the devices are believed to be working under (like impacts, heat, cold, moisture etc)
-10°C; +75°C

***Software:* Firmware (embedded software)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
MTS has not specific technology to require.

***Software:* Middleware (software that allows different software applications to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
MTS has not specific technology to require.

***Software:* D2D (software that allows devices to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
PEID must implement the MTS protocol to communicate to gas boiler control board.

***Software:* D2B (software that allows devices to communicate with middleware and/or other software applications)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
MTS has not specific technology to require.

***Software:* Backend software (software for data management, decision making etc)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
MTS has not specific technology to require.

***Software:* Decision support software (Local? Remote?)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
MTS has not specific technology to require.

Other aspects related to the Technical issues If some aspects are not are covered above, please use this field.
MTS has not specific aspects to require

7.2 Business/economical issues A7

As-is, current solution/implementation of the scenario or similar tasks/situations Describe the As-is solution/implementation that are used today (either as your company or others uses). Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
At the moment MTS has developed a GSM/GPRS modem to be connected to gas boiler control board. This modem retrieves info from the MTS protocol and sends it to a WEB site. From the WEB site it is also possible to dial the boiler and see sensors/actuators status. It is also possible to see/modify functional parameters. When an error occurs, service center can see on the WEB site all info related to the failure and the service engineers is advised of the failure by SMS.

To-be, Future scenario concept Describe in more detail the To-be solution/implementation. Describe it in such a way that it is related to the As-is description in section 0 above. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
In the future scenario, not only must be possible to inform Service organization of an already happened failure, but must also be possible to advise the service organization of a failure that is going to happened in the next future (PREVENTIVE MAINTENANCE). It must be possible to detect also in which component is the failure going to happen. In this way the service engineer can plan in advance to visit the customer and bring with him the right spare parts. This will allow to reduce double visits, being the service engineer informed exactly of what is the problem, improve the service efficiency, avoiding that the service engineer replaces a component that is not responsible for the malfunction, and offering to the end user 100% availability of the boiler because a failure will never happen thank to prognostic algorithm. The gap between the AS-IS and the TO-BE, is mainly due to the absence of prognostics algorithms, decision support software that are able to inform service engineers of a failure that is going to happen and to the action to be done (replace a component, clean the exchanger,…) to avoid it.

Business effects (own business) – negative aspects Describe the negative business effects the application scenario (described in section 1) will/could have on your business. (E.g. manpower needs, economy, new business areas, ethical, environmental etc.)
Such application scenario will reduce the amount of manpower needed to service organizations, thus creating potential conflicts with service engineers. In addition the final user can feel as observed from a ‘Big brother’ that can intrude in appliances installed in his house.

Business effects (own business) – positive aspects Describe the business effects the application scenario will/could have on your business. (e.g. Improved business situation Business improvements opportunities (productivity, quality, environment, social issues) etc.
Service organizations can be more efficient, thus improving their profitability. Also the user can than get cheaper service contracts. The amount of component replaced will be reduced (not always the service engineer is able to find the real problem and so it can happen that he changes s component that is working fine) and so the waste of materials too. With possibility to adjust parameters from remote it is possible to let the boiler working in the most suitable condition, thus increasing the life cycle. If it is possible, through additional sensors, to measure the air/gas ratio the temperature of exhausts and inlet air, it is also possible to measure indirect efficiency of a boiler, so knowing when it is necessary to clean the heat exchanger to bring the efficiency back to its nominal value.

Cost models What sort of cost models is viable for the application scenario? I.e. how much is the maximum price per PEID, support systems etc? It's important to identify the maximum price range that can be added to a product/vehicle etc as a consequence of the aspects described in this application scenario. Describe therefore aspects that will have a consequence for costs, and in what range the "hurting" price for the customer (or users etc) will be.
The maximum cost per device must be around 10% of the industrial cost of the appliance and so around 20€. The communication cost per year must not exceed 4€.

Other aspects related to the Business/Economical issues If some aspects are not are covered above, please use this field.
MTS has not other aspects to describe.

7.3 Value-chain issues A7

Make an overview of the value-chain related to the application scenario Describe the partners/business associates/customers etc related to the application scenario. If this already has been covered by earlier illustrations/descriptions, please indicate this in the field below. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
The value chain depends on the country: • **Italy, France, UK, Spain**: MTS has not its own service organization, but there is a big number of service organizations that are trained and authorized by MTS to repair and maintain MTS boilers. These service organization will benefit of the possibility to have info on gas boiler failures, thus improving their profitability and service level. MTS will ask to these Service organization to pay a fee to MTS for each boiler where a PEID is installed. MTS have to give to service organization password and user name to access the PLM web site, and MTS have to pay the data center where the PLM servers are hosted. • **Switzerland, Germany, Austria and Holland**: MTS has its own service organization (under the brand ELCO). So in this case MTS will benefit directly of the possibility to have info on gas boiler failure, thank to improvement of its service efficiency.

Describe possible downsides/upsides related to: Customers (categorized), Suppliers (categorized), Partners/cooperating companies (categorized) What kind of consequences will the application scenario have for the partners/business associates/customers etc in the value-chain E.g. Dismantler: Dismantler must invest in new systems for reading/handling discarded products etc, but will have an upside regarding their operations of reuse/remfg etc as they more readily can… E.g. Customer: Customer will experience changes in their maintenance program this can be perceived as a positive or negative aspect (briefly describe why/how)
Please refer to OVERVIEW OF THE VALUE-CHAIN

Other aspects related to the Value-chain issues If some aspects are not are covered above, please use this field.
MTS has not other aspects to describe.

7.4 Environmental issues A7

Savings of energy Based on today's As-is situation, try to guesstimate the savings of energy due to the new application scenario (if any). Justify the guesstimate.
10%. It is obtainable in particular in condensing boilers, where the weather compensator parameter setting is very difficult to be done. By remote and by intelligent algorithm it will be possible to do it better, letting boiler compensate more.

Savings of material Based on today's As-is situation, try to guesstimate the savings of material due to the new application scenario (if any). Justify the guesstimate.
10%. It is obtainable for reduction of component replaced as defect but in reality perfectly working.

Reuse or extended product life Based on today's As-is situation, try to guesstimate the amount of reuse and/or extended product life due to the new application scenario (if any). Justify the guesstimate.
MTS is not able to give indication on this point because at the time being MTS has not any experience on this field. In gas boiler market there is no kind of reuse of components or extended product lifetime estimation thanks to a PLM. What can be said is that 50% of control board MTS receives back from the field as broken component replaced on a boiler are in reality perfectly working. The problem is that service people are not always able to find the real problem occurred and so replace the control board. This means that, through a smart system which can improve the diagnostic, it will possible to reduce the amount of component replaced because believed not working while they are. This will not extend the product lifetime but will extend the lifetime of control board, because they will not be replaced by error. I guessestimate that the percentage of replaced 'well working' control board can be reduced by 20%.

Other aspects related to the Environmental issues If some aspects are not are covered above, please use this field.
MTS is not able to give indication on this point.

7.5 Social issues A7

Changed labour/work conditions Describe the implications of the application scenario regarding changed labour/work conditions
Lower number of service engineers is needed. Some of them less skilled (they have just to go to the customer and simply replace a component the PLM told him to change because it is probable that it will break down), some other much more skilled (they have to access a web site and have the capability of plan visit, and deal with informatics issues, while today they are a little bit more than a plumber)

Social Impact on society Describe, if any, implications of the application scenario regarding Social Impact on society
Service engineers can be trained to be more skilled or be unemployed

Ethical issues Is there ethical issues related to the application scenario? IF Yes explain
Final user has to accept that information can be shipped from an appliance in his house to somewhere and someone who can see them. A problem with privacy respect is possible.

Other aspects related to the Social issues If some aspects are not are covered above, please use this field.
MTS has not other aspects to describe.

Application Scenario Description
WRAP MOL

Written by:
Pier Andrea Pracchi, Business Development, Wrap SpA

DELIVERABLE NO	Input to DR 3.1, **relates to WP A8**
WORK PACKAGE NO	WP R3, TR 3.1
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ELECTRONIC FILE CODE	*dr3_2 appendix b application scenarios~1.doc*
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Dec 2004	1.0	Pier Andrea Pracchi	The draft version submitted SINTEF
05.01.2005	1.1	Carl Christian Røstad, SINTEF	Updated v1.0 document – Chapter references below refers to the old chapter structure in v1.0 ♦ 3.14 Technical interfaces - DELETED (transferred to WP R1) ♦ 3.15 Facility and quality technical requirements – DELETED (transferred to WP R1) ♦ 3.16 Hardware and software platforms in use – DELETED (transferred to WP R1) ♦ 4.2 To-be, Future scenario concept - REMOVED ERRONUS DESCRIPTION TEXT ♦ 4.3 GAP analysis of As-is and To-be - REMOVED ♦ 4.6 Cost models - DESCRIPTION CHANGED ♦ 5.2 Describe possible downsides/upsides … - DESCRIPTION UPDATED ♦ 6.4 Improved LCA indications - REMOVED ♦ 6.5 Improved MOL/BOL/EOL options - REMOVED ♦ 7.1 Changed labour/work conditions - DESCRIPTION UPDATED ♦ 7.2 Social Impact on society - DESCRIPTION UPDATED ♦ 7.3 Ethical issues - DESCRIPTION CHANGED
13.01.2005	1.2	Pier Andrea Pracchi	
14.02.2005	1.3	Maurizio Tomasella, Andrea Matta	The final version submitted SINTEF. Updated v1.2 document.

Author(s)' contact information

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8 Application scenario description A8 WRAP MOL

Where discrepancies, the Demonstrator-document overrides all aspects of this scenario.

Purpose and objective(s) of the scenario Give a detailed description of the scenario objective – What is the purpose of the scenario
The purpose is to offer to white goods manufacturer the opportunity to reduce both production and maintenance cost.

Scenario objective(s) rationale Describe the rationale for the objective, i.e. why is the objective important and why the objective is important to fulfil
The objective is to be capable of showing a white good ready to be connected to a network at a minimal added cost and without the need to choose a home network protocol and yet reducing time and cost for inline testing and for maintenance. The importance of having a connected appliance capable of generating, transmitting and receiving data is threefold: 1) the manufacturer wil generate useful information on the appliance behaviour by acquiring consumption/usage data and that can either grant the possibility to deliver service to the consumer (preventive maintenance like) as well as doing appliance better that last longer 2) the user will benefit from the service delivered and yet from the "Peace of Mind" for having the appliance constantly monitored 3) The appliance itself is free from any communication protocol (EHS, LonTalk, Zigbee) and NO communication cost need to be installed within it, thus to create a standard for appliance connectivity (by using the Wrap Ultra Low cost Power Line) to a proxy device. The proxy device is free to adopt whatever protocol and node is needed acting as a bridge to connect the appliance to a chosen Network.

Relations with PROMISE objectives Relate the application scenario to the PROMISE objectives as described in the Declaration of Work
Basically, it will be easily shown how such an innovative technology can speed up testing time and monitoring the behaviour of a WG appliance at the same time which becomes easier to maintain through a more specific and punctual service delivery.

Lifecycle phase relevance (BOL, MOL, EOL) Relate the scenario application to BOL, MOL, EOL, and clearly state the relevance to BOL, MOL and/or EOL
BOL/MOL: by enabling bidirectional communication with the Appliance it is given the chance to TEST it in a quicker (when compared to the current method) and more effective way. MOL: communication will allow the collection of relevant information stored within the appliance itself thus providing a powerful tool for maintenance throughout the product life cycle. EOL: it is given the possibility (i.e.: for a Refrigerator) to see how many cycles the compressor had completed to understand the remaining cooling gas and find the best way either to recycle or to waste it.

Product considered in scenario Describe the products in the scenario (e.g. car, truck). Include related functionality and life cycle issues.
The product chosen is a modified Refrigerator (Ariston branded, Merloni Elettrodomestici SpA).

Interfaces between lifecycle phases Describe the interfaces between relevant BOL, MOL and/or EOL

MOL: the monitoring of the appliance for each of its critical component will possibly give valuable information to the manufacturer (which will be in charge of the Dismantling/recycling) in the EOL phase.
From the generated (during the MOL) knowledge repository, which would have collected periodically the data from the Appliance Main Board, information like COOLING circuit STATUS and COOLING GAS Level can possibly be found or at least estimated.

Illustration of the application scenario
Provide an illustration of the application scenario that can be used for communication purposes (e.g. in trade magazines, on the front of reports, slide shows etc). Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

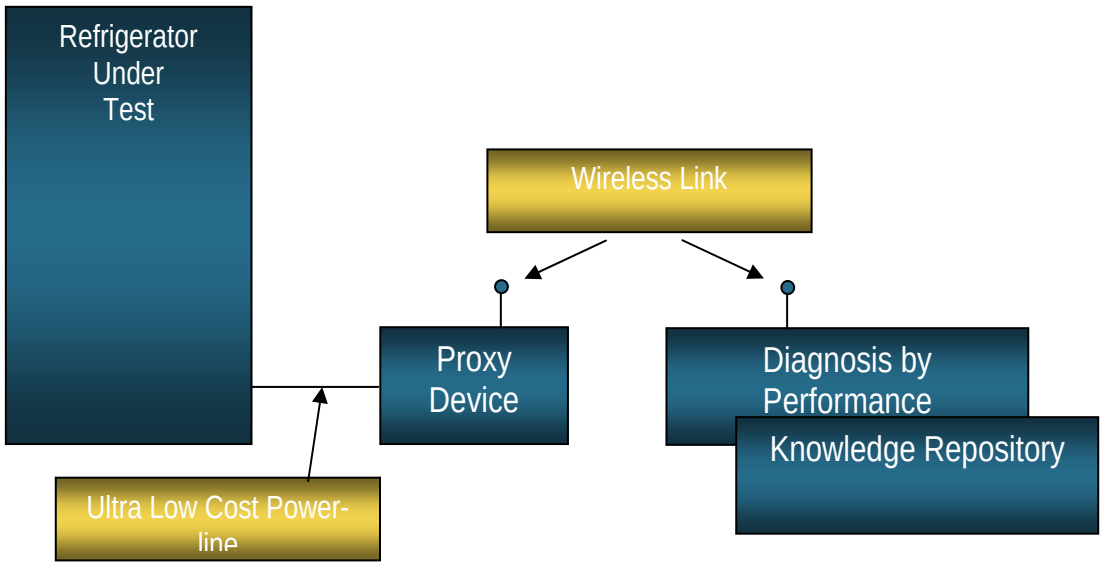
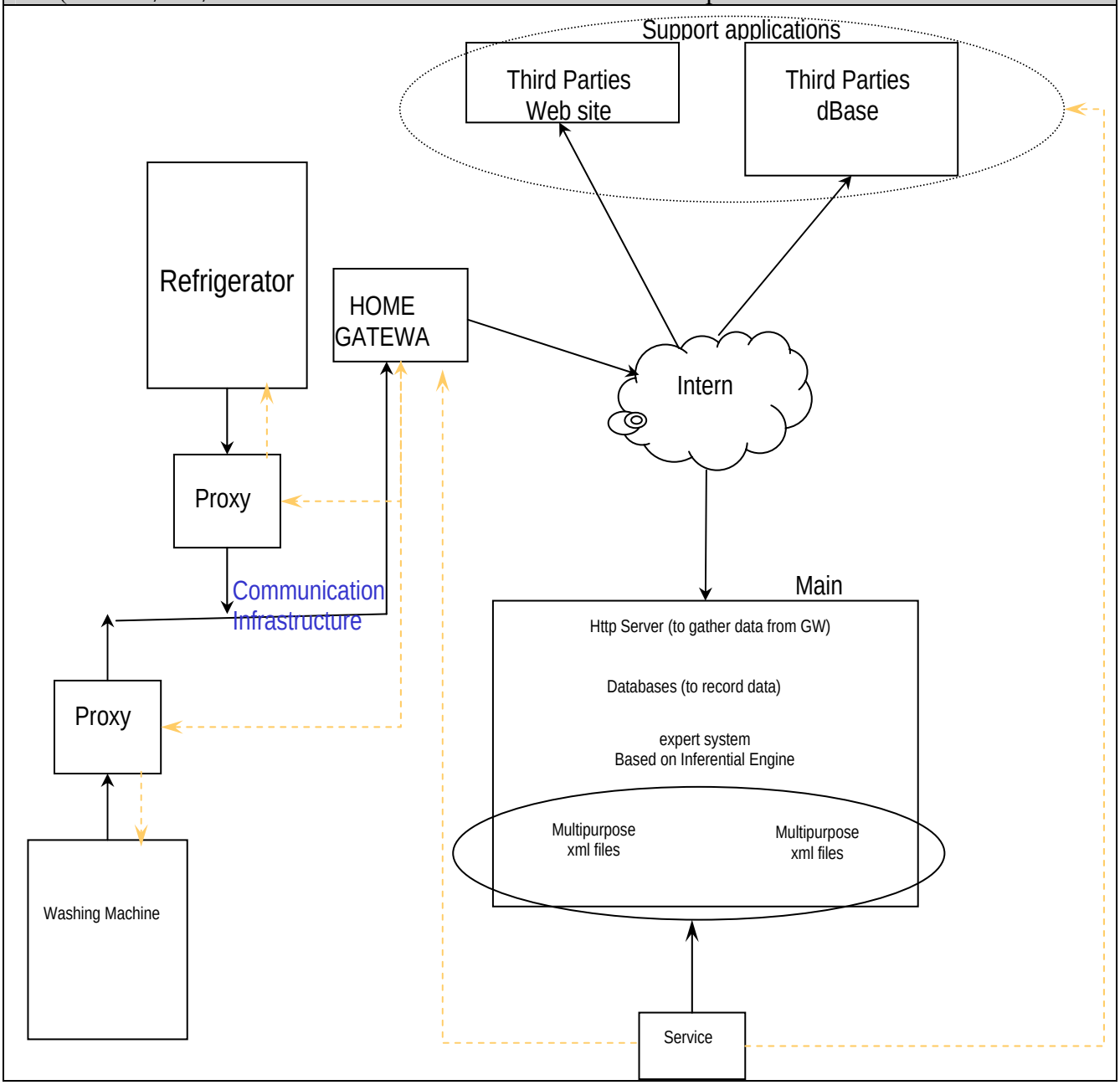


Illustration of the information flow (flowchart)
In order to identify informational requirements, illustrate the flow of information and clearly identify

information/data flows by denoting this in the figure. Use rectangles, arrows, circles etc with text. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.



Specific requirements needed in order to fulfil the objective (user requirements related to WP R1)

If there are some specific requirements that are needed to be fulfilled, please state them here.

.....

Pain-points (problems/challenges) Identify the most important problems/challenges related to this scenario (e.g. technical, economical, ethical, environmental, customer related, partner related)
1. each appliance has to store locally the history of the appliance usage; 2. each appliance has to be able to communicate with the external world, at the lowest possible cost (WRAP plans to use a technology developed in another EU project (TEAHA), named Ultra LowCost Powerline Technology); 3. a number of parameters has to be measured using an external Proxy Device, such as power, powerfactor (COSφ), time.

Other aspects related to the Application Scenario If some aspects are not are covered above, please use this field.

8.1 Technical issues A8

***Data&Information*: Product Information requirements** List what sort of data is to be gathered from e.g. PEIDs. Show how the data is to be transformed into information. Use a tree diagram to illustrate the flow of data, starting with the data gathering from e.g. wheel, dampers etc to the right, and flowing into the PEID. From the PEID indicate output flows and show whether the data is sent by internet, radio, gathered by technician to e.g. a PDA
The refrigerator used for this specific purpose, a NO-FROST double door with one compressor only, is/will be capable of electronically collecting: • Internal temperature • External temperature • Compressor time on • Compressor time off • Compressor ratio T(on/off+off) • Fan cosφ The refrigerator is/will be also capable of storing all the above information in the internal flash memeory (properly sized) with the aim reconfiguring it to create a statistic set of rules for PREVENTIVE/PROGNOSTIC MAINTENANCE.

Data&Information: Input data Describe the input data going into the PEIDs (type of data, believed amount of data etc).
The amount of data going into the appliance can be drafted down in a range from 1 to 16 bytes

Data&Information: Output data Describe the output data going out from the PEIDs (type of data, believed amount of data etc).
The amount of data going outbound can be drafted down in a range from 1 to 256 bytes

***Data&Information*: Amount of data** Describe the need for storage in the PEIDs (this in order to get a picture of how much storage is needed in e.g. the PEIDs)
We foresee that 1kbyte can store 1 week of monitoring data plus relevant historical information as needed (assuming that we never download this data from the Memory of the appliance this would generate a total of 260Kbyte per lifecycle – 5 years.).

***Hardware*: Hardware** Describe what sort of hardware technologies (PEID, sensors, GPS, networks etc) would be considered to be used or as needed to be developed.
By taking the electronic mainboard as a given within the appliances a number of component must be added to enable communication. These list of components can be summarised as : • Passive components • Triac • Internal Lamp (10W) • Ad hoc Software routines (either on board or in a custom microchip)

***Hardware:* Life span of devices** What is the needed minimum life span of the devices?
5 years

***Hardware:* Working conditions** Describe under what sort of working conditions the devices are believed to be working under (like impacts, heat, cold, moisture etc)
Regular indoor climate conditions (dry, 10-50 °c)

***Software:* Firmware (embedded software)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Few routines need to added to the regular Appliance Firmware

***Software:* Middleware (software that allows different software applications to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
tbd

***Software:* D2D (software that allows devices to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
tbd

***Software:* D2B (software that allows devices to communicate with middleware and/or other software applications)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
tbd

***Software:* Backend software (software for data management, decision making etc)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
The development of a remote Inferential Engine rules based is required to understand : • Compressor fails to start • Refrigerator Unplugged • Compressor On for too long • Defrost not Starting • Door left open

***Software:* Decision support software (Local? Remote?)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
The backend software remotely receives from the Appliance. The Software consists in an inferential engine that elaborates diagnostic information and is also able to reprogram the local device in order to access their diagnostic basic functions.

Other aspects related to the Technical issues If some aspects are not are covered above, please use this field.

8.2 Business/economical issues A8

As-is, current solution/implementation of the scenario or similar tasks/situations Describe the As-is solution/implementation that are used today (either as your company or others uses). Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
As of today we are not ware of any Remote monitoring system for White Goods Appliances

To-be, Future scenario concept Describe in more detail the To-be solution/implementation that are used today (either as your company or others uses). Describe it in such a way that it is related to the As-is description above. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
tbd

Business effects (own business) – negative aspects Describe the negative business effects the application scenario will/could have on your business. (E.g. manpower needs, economy, new business areas, ethical, environmental etc.)
The negative aspect that can be foreseen is the added cost of a communication node either within the appliance or as a retrofit. Again, the WG appliance market is mature and price competition is fierce, the consumer do not recognise a premium unless the benefit for him are worth it.

Business effects (own business) – positive aspects Describe the business effects the application scenario will/could have on your business. (e.g. Improved business situation Business improvements opportunities (productivity, quality, environment, social issues) etc.
By monitoring WG the manufacturer can: • Prevent any fault or malfunctioning • Extend warranty and service (say 5 years) • Understand how to better make appliances • Environmental respect • Dismantling options

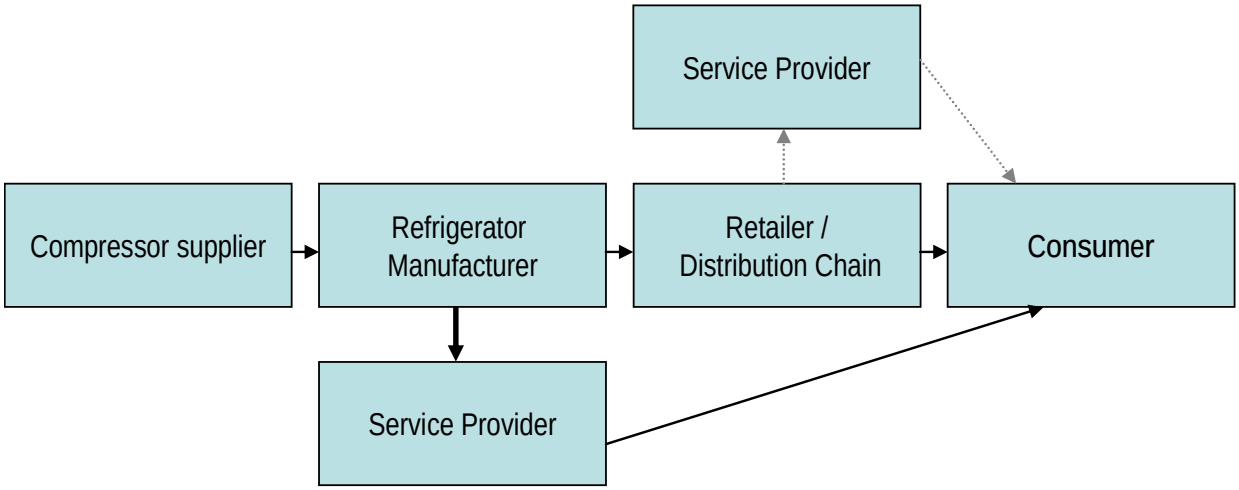
Cost models What sort of cost models is viable for the application scenario? I.e. how much is the maximum price per PEID, support systems etc? It's important to identify the maximum price range that can be added to a product/vehicle etc as a consequence of the aspects described in this application scenario. Describe therefore aspects that will have a consequence for costs, and in what range the "hurting" price for the customer (or users etc) will be.
Refrigerator (€400) / Proxy Device Prototype (€150) / Residential Gateway (€200)

Other aspects related to the Business/Economical issues If some aspects are not are covered above, please use this field.

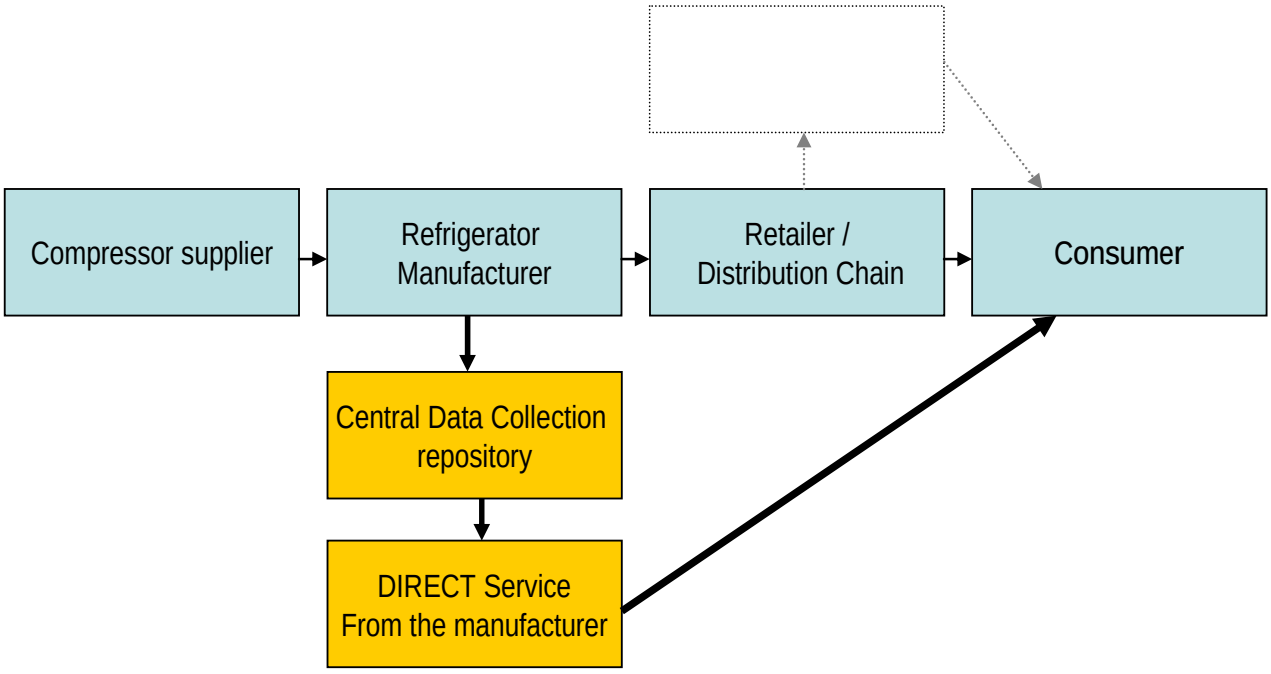
8.3 Value-chain issues A8

Make an overview of the value-chain related to the application scenario
Describe the partners/business associates/customers etc related to the application scenario. If this already has been covered by earlier illustrations/descriptions, please indicate this in the field below. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

Today Value Chain



Monitoring Added Value Chain



Describe possible downsides/upsides related to: Customers (categorized), Suppliers (categorized), Partners/cooperating companies (categorized) What kind of consequences will the application scenario have for the partners/business associates/customers etc in the value-chain E.g. Dismantler: Dismantler must invest in new systems for reading/handling discarded products etc, but will have an upside regarding their operations of reuse/remfg etc as they more readily can… E.g. Customer: Customer will experience changes in their maintenance program this can be perceived as a positive or negative aspect (briefly describe why/how)
Customer downside: Privacy related issue / Upside: technology enthusiast will see it as a gadget (value) Supplier Downside: competition and in depth analysis might scare them/ upside: data comparison to better understand their product Partners (Home Service Provider) downside: they can be substitute with a DIRECT customer service (Manufacturer to Consumer) / Upside: they might be given a service tool to better assist consumer

Other aspects related to the Value-chain issues If some aspects are not are covered above, please use this field.
NA

8.4 Environmental issues A8

Savings of energy Based on today's As-is situation, try to guesstimate the savings of energy due to the new application scenario (if any). Justify the guesstimate.
 Frost Building up → Compressor Time On too long→ Tremendous Energy Waste Energy consumption can rise up to 10% on annual operations, from 603KWh to 670KWh; assuming a product lifetime of 14 years and a Net cost for KWh of 8.5 cents we can estimate a lifetime operating cost $797.3 → the waste for single inefficient refrigerator will be $79.7  67KWh X 300ML = 20,1Bl KWh Solution → Diagnosys by Part

Savings of material Based on today's As-is situation, try to guesstimate the savings of material due to the new application scenario (if any). Justify the guesstimate.
NA

Reuse or extended product life Based on today's As-is situation, try to guesstimate the amount of reuse and/or extended product life due to the new application scenario (if any). Justify the guesstimate.
NA

Other aspects related to the Environmental issues If some aspects are not are covered above, please use this field.
NA

8.5 Social issues A8

Changed labour/work conditions Describe the implications of the application scenario regarding changed labour/work conditions
NA

Social Impact on society Describe, if any, implications of the application scenario regarding Social Impact on society
NA

Ethical issues Is there ethical issues related to the application scenario? IF Yes explain
NA

Other aspects related to the Social issues If some aspects are not are covered above, please use this field.
NA

Application Scenario Description
INTRACOM MOL

Written by:
Dimitra Pli
Maria Anastasiou

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WORK PACKAGE NO	WP R3, TR 3.1
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ELECTRONIC FILE CODE	*dr3_2 appendix b application scenarios~1.doc*
CONTRACT NO	507100 PROMISE A Project of the 6th Framework Programme Information Society Technologies (IST)

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Dec 2004	1.0	See front page	The draft version submitted SINTEF
05.01.2005	1.1	Carl Christian Røstad, SINTEF	Updated v1.0 document – Chapter references below refers to the old chapter structure in v1.0 ♦ 3.14 Technical interfaces - DELETED (transferred to WP R1) ♦ 3.15 Facility and quality technical requirements – DELETED (transferred to WP R1) ♦ 3.16 Hardware and software platforms in use – DELETED (transferred to WP R1) ♦ 4.2 To-be, Future scenario concept - REMOVED ERRONUS DESCRIPTION TEXT ♦ 4.3 GAP analysis of As-is and To-be - REMOVED ♦ 4.6 Cost models - DESCRIPTION CHANGED ♦ 5.2 Describe possible downsides/upsides … - DESCRIPTION UPDATED ♦ 6.4 Improved LCA indications - REMOVED ♦ 6.5 Improved MOL/BOL/EOL options - REMOVED ♦ 7.1 Changed labour/work conditions - DESCRIPTION UPDATED ♦ 7.2 Social Impact on society - DESCRIPTION UPDATED ♦ 7.3 Ethical issues - DESCRIPTION CHANGED
28.04.2005	1.2	Dimitra Pli	Updated application scenario
05.05.2005	1.3	Carl Christian Røstad	Prepared for inclusion in DR3.2

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9 Application scenario description A9 INTRACOM MOL

Where discrepancies, the Demonstrator-document overrides all aspects of this scenario.

Purpose and objective(s) of the scenario Give a detailed description of the scenario objective – What is the purpose of the scenario
The objectives of the scenario are: 1. To enable registering information related to the hardware and software combination used in a specific deployment scenario. Selecting statistical information related to product performance will enable in advance undertaking of reparative actions in the cases of similar scenarios, thus improving product's reliability. 2. To facilitate and improve the communication of product misbehaviour from technical support (maintenance) to engineering team. 3. To support the maintenance team in diagnosis and solution identification with knowledge gained from similar previous problems.

Scenario objective(s) rationale Describe the rationale for the objective, i.e. why is the objective important and why the objective is important to fulfil
These objectives are important in order to improve the quality of the product, the services provided to the customer and support the maintenance team in their every day work. Although, some data can be gathered from the field related to product function and malfunction, there is not a systematic approach to convert the data that is gathered into useful knowledge. In addition, there is not a standard procedure to provide the engineering team with this knowledge.

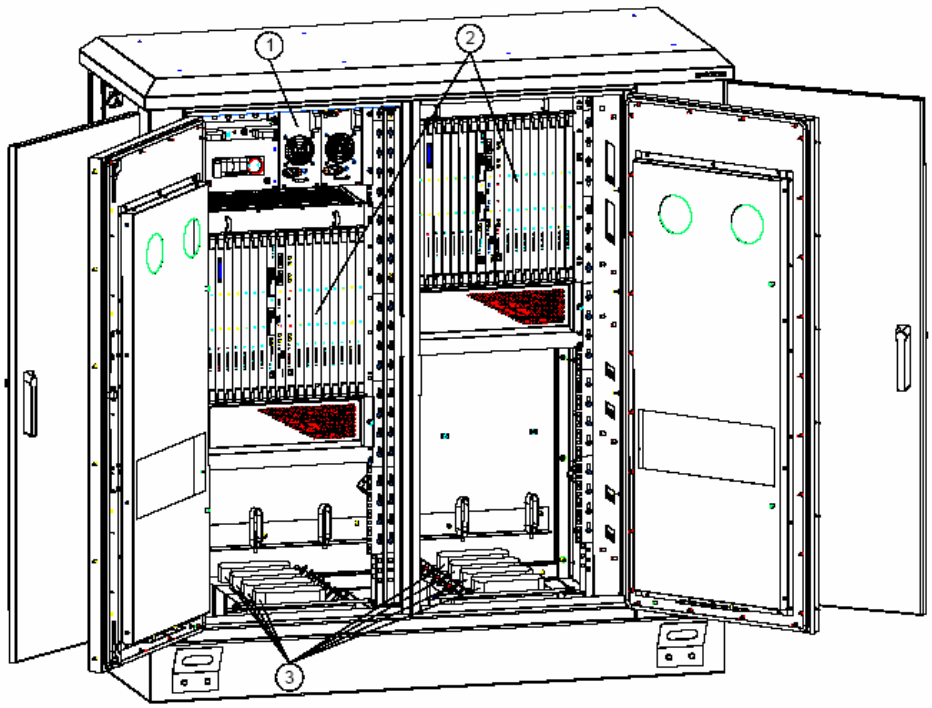
Relations with PROMISE objectives Relate the application scenario to the PROMISE objectives as described in the Declaration of Work
The scenario provided by INTRACOM corresponds to PROMISE objective to close the loop of information flow from customer site back to product development. In addition, the scenario is related to the project objective to convert product data that is gathered into useful knowledge. Finally, the goal is the above to be supported by appropriate functionalities and IT infrastructure that are to be developed within PROMISE, as well as by new process and business models.

Lifecycle phase relevance (BOL, MOL, EOL) Relate the scenario application to BOL, MOL, EOL, and clearly state the relevance to BOL, MOL and/or EOL
The scenario concerns MOL including service and maintenance but also EOL as the implementation of PROMISE concept is expected to facilitate product repairability, as well as product's parts reusability. In addition, the collection and management of information coming from the deployment sites can be exploited and used back at the BOL to realise improvements of the product.

Product considered in scenario

Describe the products in the scenario (e.g. car, truck). Include related functionality and life cycle issues.

The product in the scenario is called IBAS, INTRACOM Broadband Access System, and 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.



Central (Rack) compartment

IBAS product includes software and hardware components (line cards). Line cards hold their serial number and type hard coded on a special tag, as well as on their flash memory. IBAS keeps alarms in the form of log files to report on its performance, malfunction, and throughput degradation. The alarms are classified into Real, Active and Historical. Alarms maybe critical warning about a failure or simple ones that warn about throughput degradation or indicating that a problem may occur.

Periodically, the IBAS alarms are reported to and processed by the Element Management System (EMS) that resides at the Network Operation Centre (NOC).

It should be highlighted that the IBAS product is distinguished using its IP address on the Network.

Interfaces between lifecycle phases

Describe the interfaces between relevant BOL, MOL and/or EOL

The interface between MOL and BOL depends heavily on the role of the company and the agreement with the customer. Full access to IBAS operation information is possible when INTRACOM is also responsible for the operation of the customer's network. Otherwise, depending on the Service Level Agreement (SLA), INTRACOM may have remote access to the EMS.

Currently, there are no standard procedures to support information gathering from the technicians during support services provided in the field.

In addition, there is no standard procedure facilitated by the appropriate tools to transfer the knowledge gained in the field to the development team.

Illustration of the application scenario

Provide an illustration of the application scenario that can be used for communication purposes (e.g. in trade magazines, on the front of reports, slide shows etc). Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

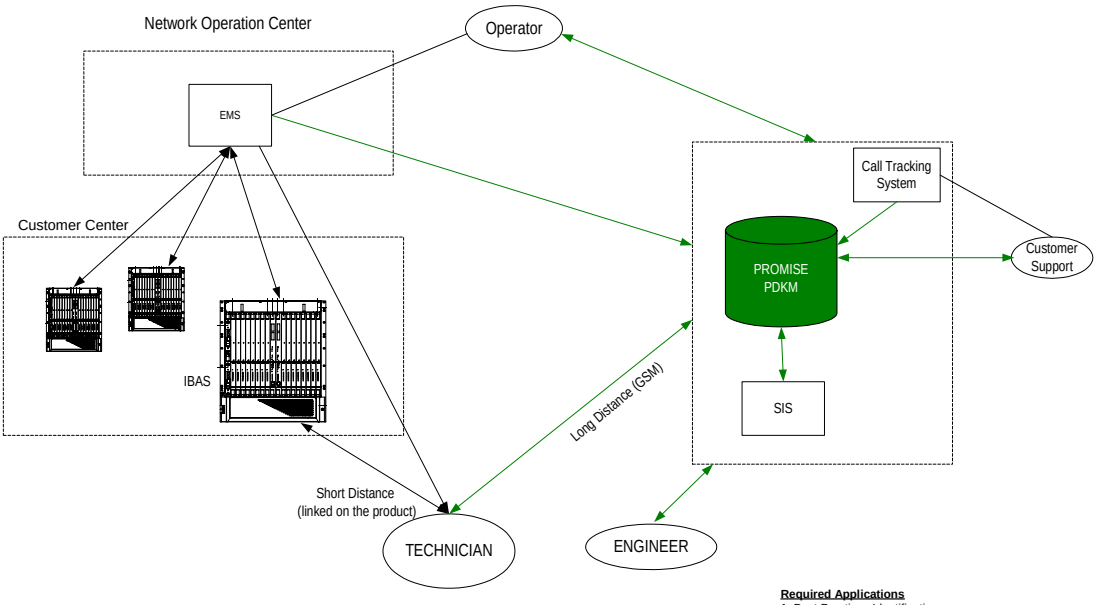
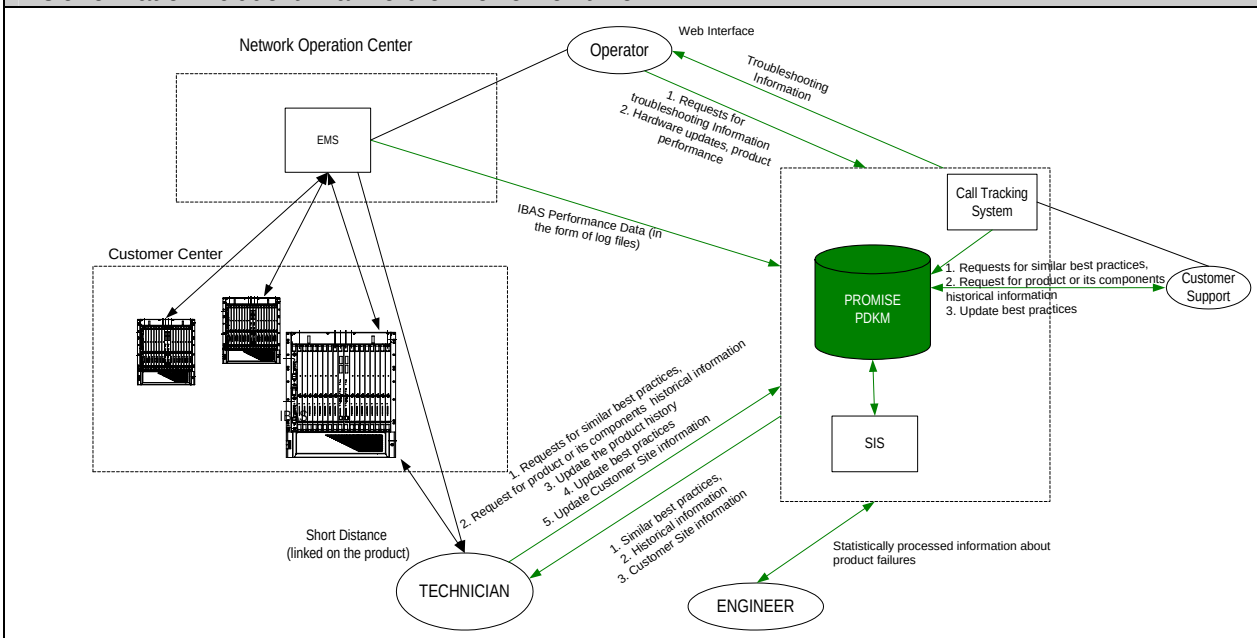


Illustration of the information flow (flowchart)

In order to identify informational requirements, illustrate the flow of information and clearly identify information/data flows by denoting this in the figure. Use rectangles, arrows, circles etc with text. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or PowerPoint-file.



Specific requirements needed in order to fulfil the objective (user requirements related to WP R1)

If there are some specific requirements that are needed to be fulfilled, please state them here.

Pain-points (problems/challenges)

Identify the most important problems/challenges related to this scenario (e.g. technical, economical, ethical, environmental, customer related, partner related)

As it is described in Section PRODUCT CONSIDERED IN SCENARIO, by IBAS nature, data on product performance and failures are already kept and reported to network operation management. The issue is that INTRACOM has not always access to this information. This depends on the role of the company and the agreement with the customer.

The main problem / challenge in the application scenario could be realised when INTRACOM is not responsible for the operation of the network on which the product is deployed. In that case, the company has no access to the EMS and consequently no access to the data related to product performance and failures, with the exception of some cases. The same applies to the information that resides on the product itself. INTRACOM can have access to these data with the supervision of the customer, when a technician visits the customer site to solve a reported problem.

In addition, there are cases that product components (e.g. line cards) are replaced by the customer without informing INTRACOM. The replaced line cards are sent to INTRACOM maintenance lab in a batch mode. In this case, useful information about the card as well as about IBAS is being lost.

Customers should be motivated and facilitated to provide the company with this information.

Other aspects related to the Application Scenario If some aspects are not covered above, please use this field.

9.1 Technical issues A9

***Data&Information*: Product Information requirements** List what sort of data is to be gathered from e.g. PEIDs. Show how the data is to be transformed into information. Use a tree diagram to illustrate the flow of data, starting with the data gathering from e.g. wheel, dampers etc to the right, and flowing into the PEID. From the PEID indicate output flows and show whether the data is sent by internet, radio, gathered by technician to e.g. a PDA
As it is mentioned in section PRODUCT CONSIDERED IN SCENARIO, IBAS product by its nature uses appropriate technology (software, hardware, sensors etc) for recording information about its performance and producing alarms indicating malfunction or throughput degradation. The Element Management System (EMS) uses this information and allows efficient operation management of the element (IBAS). In addition, the serial number and the type of each line card is hard coded on a special tag, as well as, on the flash memory of the card. However, it is under further investigation to use an RFID tag on the cabinet of IBAS, in order IBAS and its components to be efficiently allocated.

***Data&Information:* Input data** Describe the input data going into the PEIDs (type of data, believed amount of data etc).
It will be specified in detail later in the project

***Data&Information:* Output data** Describe the output data going out from the PEIDs (type of data, believed amount of data etc).
It will be specified in detail later in the project

***Data&Information*: Amount of data** Describe the need for storage in the PEIDs (this in order to get a picture of how much storage is needed in e.g. the PEIDs)
It will be specified in detail later in the project

***Hardware*: Hardware** Describe what sort of hardware technologies (PEID, sensors, GPS, networks etc) would be considered to be used or as needed to be developed.
It will be specified in detail later in the project

***Hardware:* Life span of devices** What is the needed minimum life span of the devices?
It will be specified in detail later in the project

***Hardware:* Working conditions** Describe under what sort of working conditions the devices are believed to be working under (like impacts, heat, cold, moisture etc)
It will be specified in detail later in the project

***Software:* Firmware (embedded software)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
It will be specified in detail later in the project

***Software:* Middleware (software that allows different software applications to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Regarding the communication with the EMS, EMS implements a CORBA based North Bound Interface (NBI). NBI should be used to communicate with the EMS. It should be also highlighted that for the communication between INTRACOM and the related NOC a VPN (Virtual Private Network) should be used.

***Software:* D2D (software that allows devices to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
No specific requirements.

***Software:* D2B (software that allows devices to communicate with middleware and/or other software applications)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
IBAS uses Simple Network Management Protocol. This protocol should be used if the product is to communicate with middleware and/or other software applications. There are also security concerns. As in the case of communicating with the EMS, for the communication with the IBAS itself a VPN should be used.

***Software:* Backend software (software for data management, decision making etc)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
INTRACOM don't have a specific technology to require.

***Software:* Decision support software (Local? Remote?)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
INTRACOM will require to the support of decision support software both locally and remotely. There is not any requirement for specific software technologies to be used for this.

Other aspects related to the Technical issues If some aspects are not are covered above, please use this field.

9.2 Business/economical issues A9

As-is, current solution/implementation of the scenario or similar tasks/situations
Describe the As-is solution/implementation that are used today (either as your company or others uses). Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

Support Levels

Call Center and 1st Level Support

When customers experience problems that require software or hardware support, they call INTRACOM's hotline handled by the Technical Support Help Desk. The hotline personnel (Help Desk) then forwards the problem to a dispatcher who creates a trouble ticket on the call tracking system and pass the call to the appropriate engineer. This process will allow technical support personnel to be notified and respond immediately to a request for service.
At this level, the ability to provide general information concerning the product and basic support regarding hardware and software with fair perception of the end-users environment is required in order to solve basic problems that may arise.

On the field support

When a customer problem is not resolved during the previous procedure then a technician visits the customer's site. The ability to provide specific information concerning the end-users environment including the ability to troubleshoot unique problems that may arise is required.
At the customer's site the technician could have access to the EMS and the product itself with the supervision of the customer. As it has already been mentioned, in some cases the agreement between INTRACOM and its customer, allow the company to remotely access the system.
Several cases are identified:

- The problem diagnosis has already been done at the previous level and the technician visits the site to solve the problem.
- The problem diagnosis has not been done, and the technician needs to investigate further at the customer site to perform diagnosis.

The problems may relate to software or hardware or combination.
Usually, software problems are solved via software updates.
Very often, equipment (cards) replacement is required in order to provide a solution to the problem in hand.

Maintenance at the lab

There cases that the customer problem is related to problems of a card, and the technician replace this card with one provided by the company stock. The card that was replaced is provided to the maintenance lab and specific procedures are followed to register the problem and the solution.
The lab personnel uses SIS system to registered the problems and solutions, as well as to keep the cards' history.
Every three months, the lab personnel statistically process the available information, and in case of repetitive faults the Quality Department is informed. Then, they collaboratively prepare a report to be provided to the Product Manager.

Identified Needs

Issues related to Element Management System (BBMS, NBNS, integrated system)

The need was identified to be able to have filtered information related to an element performance and have alarms reported coded and hierarchically structured.
This is required to support the operation of the network and facilitate preventive maintenance. For INTRACOM, this will be helpful in the cases that the company is also responsible for the operation of the network, as well as when remote access is allowed and requested by the customer.

Issues related to Service Levels

- The call tracking system already used by the company should be linked with PROMISE PDKM. The possibility to statistically process the data gathered during the various customer calls is required.
- Simple troubleshooting information shall be available on line for customers.
- The need was identified the technicians that visit the customer site to register and update information about special characteristics and description of the customer site that need to be taken into consideration in troubleshooting and fault diagnosis. This information should be available to the technicians that are going to visit the customer site in future. This is also important in cases that the customer problem has to do with the customer site and not with the product itself.
- The technician needs to have access to the history of the system, and components of it.
- In the case of equipment replacement, the expert should register the replacement made.
- It would be helpful, the technician to have access to previous similar symptoms and diagnosis made for those, as well as to solutions given.
- PROMISE PDKM should interoperate with SIS system.

To-be, Future scenario concept

Describe in more detail the To-be solution/implementation. Describe it in such a way that it is related to the As-is description above. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

The Future scenario is illustrated in the application scenario description made in section 2.7. Some issues are following highlighted.

- When a technician tries to solve a problem through the hotline, then he/she will be able to find in the knowledge base cases with similar symptoms, the diagnosis made, as well as the solution given. The technician will update the PDKM accordingly when the issue is solved.
- When a technician has to visit the customer site then he/she will be able to search in the PDKM for special characteristic of the customer site, as well as to the history of the related IBAS in order to be able to get appropriately prepared.
- The technician will have part of the information locally in the laptop, based on the customer site to be visited. (Because of the large amount of data, and the low speed of transferring a mechanism should be available to allow technicians to transfer the appropriate relevant information to their laptop before visiting the customer site.)
- The technician will update the knowledge base accordingly (see also identified needs in the previous section).
- The procedures and tools used in the lab will be integrated with the PROMISE solution.
- The customers will have access to simple troubleshooting through the web.
- The customers will provide information about hardware updates and problems in their network through a web interface.
- Engineers will have filtered access to the PDKM supported by decision support applications to identify critical problems and repetitive problems.
- Customer support will have filtered access to the information coming from the EMS systems in order to perform preventive maintenance.

Business effects (own business) – negative aspects Describe the negative business effects the application scenario will/could have on your business. (E.g. manpower needs, economy, new business areas, ethical, environmental etc.)
The following negative aspects could be identified: ▪ 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 will be requested to provide information about the operation of the product, as well as about actions taken in components of it (e.g. cards replacements). ▪ Change management will be required in some cases to overcome actors' resistance to changing tools and procedures. ▪ Additional training effort ▪ High confidentiality issues especially with regard to the communication of PROMISE system with an IBAS element or EMS.

Business effects (own business) – positive aspects Describe the business effects the application scenario will/could have on your business. (e.g. Improved business situation Business improvements opportunities (productivity, quality, environment, social issues) etc.
The following positive aspects could be identified: ▪ Technicians will be facilitated in their everyday work by being able to exploit knowledge gained through previous similar situations. ▪ Process will be established and facilitated in order engineers to be informed about repetitive faults that occur and could lead to decision-making about improvements to the product. ▪ Improve product quality and consequently minimise fault occurrence. ▪ Improve Preventive maintenance. ▪ Customers will be provided with services of higher quality. ▪ Customer satisfaction will be increased. ▪ Reduce the environmental impact by extended the life span of the materials (reusability, repairlability).

Cost models What sort of cost models is viable for the application scenario? I.e. how much is the maximum price per PEID, support systems etc? It's important to identify the maximum price range that can be added to a product/vehicle etc as a consequence of the aspects described in this application scenario. Describe therefore aspects that will have a consequence for costs, and in what range the "hurting" price for the customer (or users etc) will be.
It is neither expected nor wanted the implementation of the application scenario to have any impact on the product price to the customer. Additional services will be added.

Other aspects related to the Business/Economical issues If some aspects are not are covered above, please use this field.

9.3 Value-chain issues A9

Make an overview of the value-chain related to the application scenario Describe the partners/business associates/customers etc related to the application scenario. If this already has been covered by earlier illustrations/descriptions, please indicate this in the field below. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
The actors involved are: ▪ The technical support department ▪ The development department ▪ The related product manager ▪ Network operator ▪ Customer

Describe possible downsides/upsides related to: Customers (categorized), Suppliers (categorized), Partners/cooperating companies (categorized) What kind of consequences will the application scenario have for the partners/business associates/customers etc in the value-chain. E.g. Dismantler: Dismantler must invest in new systems for reading/handling discarded products etc, but will have an upside regarding their operations of reuse/remfg etc as they more readily can… E.g. Customer: Customer will experience changes in their maintenance program this can be perceived as a positive or negative aspect (briefly describe why/how)
Customer: ▪ Technicians will be facilitated in performing their everyday tasks but this will have a downside concerning the resistance to change tools and procedures. ▪ Customers will be provided with higher quality of services and products. However, their collaboration is required to provide the manufacturing with product operation information. ▪ Engineers will be provided with information and knowledge related to the product performance and be able to take better justified decisions on that.

Other aspects related to the Value-chain issues If some aspects are not are covered above, please use this field.

9.4 Environmental issues A9

Savings of energy Based on today's As-is situation, try to guesstimate the savings of energy due to the new application scenario (if any). Justify the guesstimate.

Savings of material Based on today's As-is situation, try to guesstimate the savings of material due to the new application scenario (if any). Justify the guesstimate.

Reuse or extended product life Based on today's As-is situation, try to guesstimate the amount of reuse and/or extended product life due to the new application scenario (if any). Justify the guesstimate.
It is expected that PROMISE concept will enhance product repairability and therefore an extension of product life is anticipated.

Other aspects related to the Environmental issues If some aspects are not are covered above, please use this field.

9.5 Social issues A9

Changed labour/work conditions Describe the implications of the application scenario regarding changed labour/work conditions
More effort will be required by the technicians in order to upload information regarding the product, problems occurred and solutions provided, and the customer site and populate PROMISE PDKM. In some cases, additional effort will be required by the customer to inform INTRACOM about the product updates and performance. All the involved actors will have to use the PROMISE PDKM and the related applications.

Social Impact on society Describe, if any, implications of the application scenario regarding Social Impact on society

Ethical issues Is there ethical issues related to the application scenario? IF Yes explain
The confidentiality of the information flow between the customer site and INTRACOM is a very important issue that must be taken into consideration.

Other aspects related to the Social issues If some aspects are not are covered above, please use this field.

Application Scenario Description
BT-LOC Bombardier Transportation (BOL)

Written by:
Markus Frey, Bombardier Transportation

DELIVERABLE NO	Input to DR 3.1, **relates to WP A10**
WORK PACKAGE NO	WP R3, TR 3.1
VERSION NO.	1.3
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Revision History

Date (dd.mm.yyyy)	Version	Author	Comments
08.12.2004	D00	Markus Frey	First draft
13.12.2004	D01	Markus Frey	Inclusion of some remarks from DfX specialists and partners
05.01.2005	1.1	Carl Christian Røstad, SINTEF	Updated v1.0 document – Chapter references below refers to the old chapter structure in v1.0 ♦ 3.14 Technical interfaces - DELETED (transferred to WP R1) ♦ 3.15 Facility and quality technical requirements – DELETED (transferred to WP R1) ♦ 3.16 Hardware and software platforms in use – DELETED (transferred to WP R1) ♦ 4.2 To-be, Future scenario concept - REMOVED ERRONUS DESCRIPTION TEXT ♦ 4.3 GAP analysis of As-is and To-be - REMOVED ♦ 4.6 Cost models - DESCRIPTION CHANGED ♦ 5.2 Describe possible downsides/upsides … - DESCRIPTION UPDATED ♦ 6.4 Improved LCA indications - REMOVED ♦ 6.5 Improved MOL/BOL/EOL options - REMOVED ♦ 7.1 Changed labour/work conditions - DESCRIPTION UPDATED ♦ 7.2 Social Impact on society - DESCRIPTION UPDATED ♦ 7.3 Ethical issues - DESCRIPTION CHANGED
14.01.05	1.2	Markus Frey	New respectively updated content due to first review by DfX specialists in following chapters: • Abstract • 2.1 Purpose and objectives of the scenario • 2.2 Scenario objective(s) rationale • 2.5 Product considered in scenario • 2.6 Interfaces between lifecycle phases • 2.7 Illustration of the application scenario • 2.8 Illustration of the information flow • 2.9 Specific requirements • 3.1 to 3.14 (various chapters) • 4.1 As-is, current solution/implementation of the scenario or similar tasks/situations • 4.2 To-be, future scenario concept • 4.3 Business effects (own business) – negative aspects • 4.5 Cost models • 5.1 Make an overview of the value-chain related to the application scenario • 5.2 Describe possible downsides / upsides • 6.1 Savings of energy • 6.3 Reuse or extended product life • 7.1 Changed labour/work conditions
05.05.2005	1.3	Carl Christian Røstad	Prepared for inclusion in DR3.2

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Abbreviations:

Abbreviations used in this application scenario:

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.)
EOL	End of Life
ERP	Enterprise Resources Planning
LCC	Life Cycle Cost
MOL	Middle of Life
PDA	Personal Digital Assistant
PDKM	Product Data & Knowledge Management
PEID	Product Embedded Information Device
PLM	Product Lifecycle Management
RAM	Reliability, Availability & Maintainability
TRAXX	Trademark of Bombardiers product family of locomotives

10 Application scenario description A10 BOMBARDIER BOL

Where discrepancies, the Demonstrator-document overrides all aspects of this scenario.

Purpose and objective(s) of the scenario
Give a detailed description of the scenario objective – What is the purpose of the scenario

- The overall objective is to close the loop of information between experience embedded in field data (captured mainly by Service and/or product embedded devices) and knowledge (concentrated on Design for X aspects) needed by the engineers to improve the designs and realize more competitive products.
- The scenario contains the "translation" and "transformation" of field data into Design for X knowledge,
  - To be used in the various DfX processes, mainly
    - Design for Acoustics and Vibration
    - Design for Aero & Thermo Dynamics
    - Design for Electrical Systems Compatibility
    - Design for Environment
    - Design for Product Safety
    - Design for Reliability, Availability, Maintainability & Life Cycle Costs
    - Design for Six Sigma
    - Design for Structural Mechanics
    - Design for Testing
    - Design for Vehicle Dynamics
    - Design to Cost,
  - Manageable in common PDKM systems,
  - Supported by a decision making process.
- The field data is mainly available through
  - Condition Monitoring / Condition Based Maintenance
  - Diagnosis System
  - Event Recorder
  - Maintenance Management Systems
  - Inspection Information
  - Failure Reporting Analysis and Corrective Action System (FRACAS)

Scenario objective(s) rationale Describe the rationale for the objective, i.e. why is the objective important and why the objective is important to fulfil
BT gathers already various field data (e.g. from the TRAXX Platform locomotives). This data is primarily used within the specific contract to validate the fulfilment of costumer requirements (e.g. RAM/LCC) and to improve the product performance. But this data does not flow back as DfX knowledge into the Engineering so that it could be used to design new and more competitive products. Therefore it is important to close the loop of information between experience embedded in field data and knowledge needed in the various DfX processes. The developed methodologies and software package shall support this data transformation and provide integration into a PDKM system environment used within Engineering.

Relations with PROMISE objectives Relate the application scenario to the PROMISE objectives as described in the Declaration of Work
This scenario corresponds primarily with the PROMISE objectives to develop new closed-loop life cycle information flow models over the complete product lifecycle. But it will also include elements concerning the PROMISE objectives to develop - new PLM functionalities and adapted IT infrastructure and - new working and business models.

Lifecycle phase relevance (BOL, MOL, EOL) Relate the scenario application to BOL, MOL, EOL, and clearly state the relevance to BOL, MOL and/or EOL
Product data will be gathered from the service of the product (MOL). But the gained DfX knowledge will be used to improve the design of new products (BOL).

Product considered in scenario Describe the products in the scenario (e.g. car, truck). Include related functionality and life cycle issues.
The products considered in this scenario are electric locomotives. Locomotives are usually in service for more than 30 years. Other railway vehicles and / or systems will be taken into consideration as appropriate to fulfil the objectives. The demonstrators will concentrate on electrical and mechanical elements of the traction chain (from pantograph to wheel). If specifically required other systems or subsystems will be included, e.g. brake system for Design for Safety investigations.

Interfaces between lifecycle phases Describe the interfaces between relevant BOL, MOL and/or EOL
Adequate field data is available from warranty phase (usually 1 to 3 years), but generally not from the service by the operators over the product lifespan of over 30 years.

Illustration of the application scenario
Provide an illustration of the application scenario that can be used for communication purposes (e.g. in trade magazines, on the front of reports, slide shows etc). Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

Illustration of 'Design for X' application scenario:

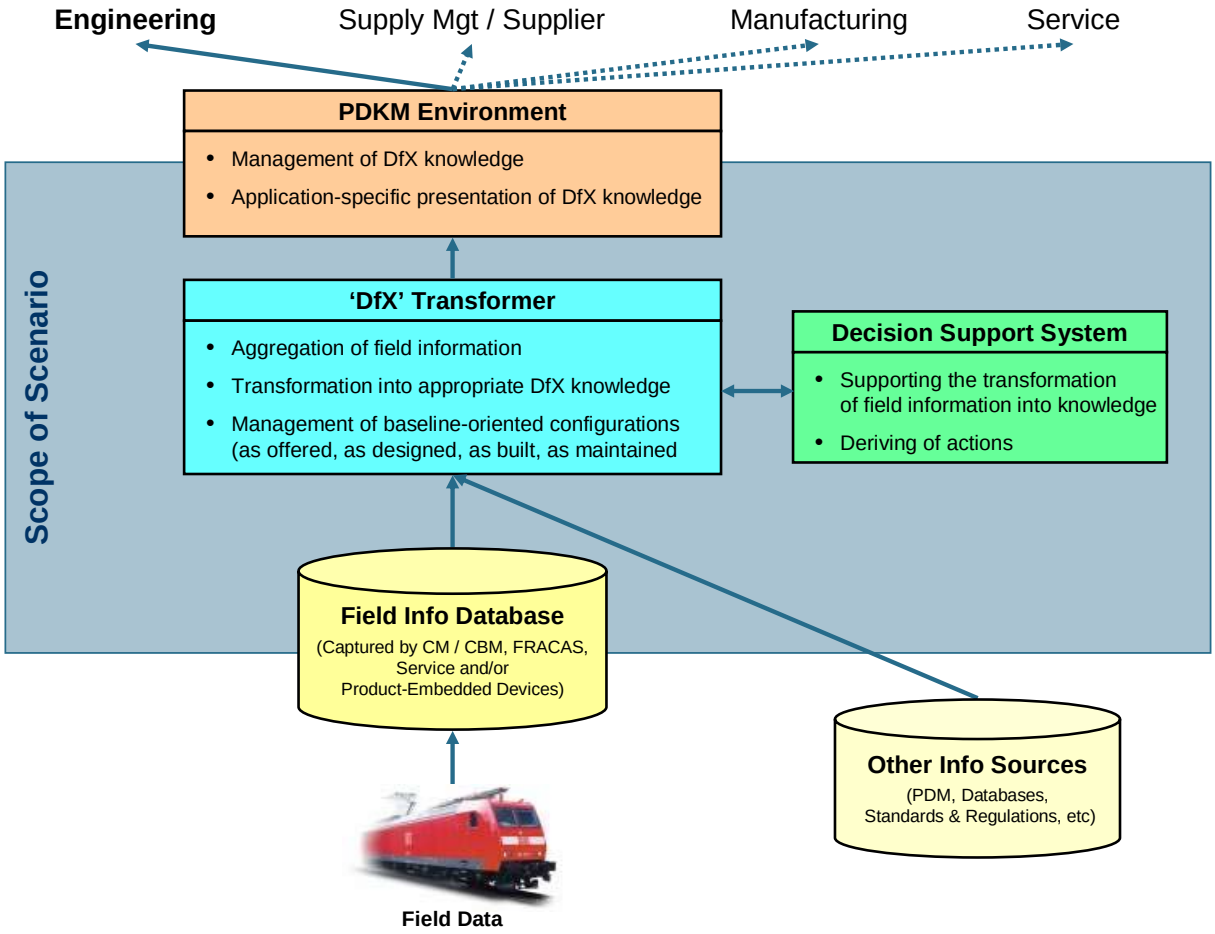
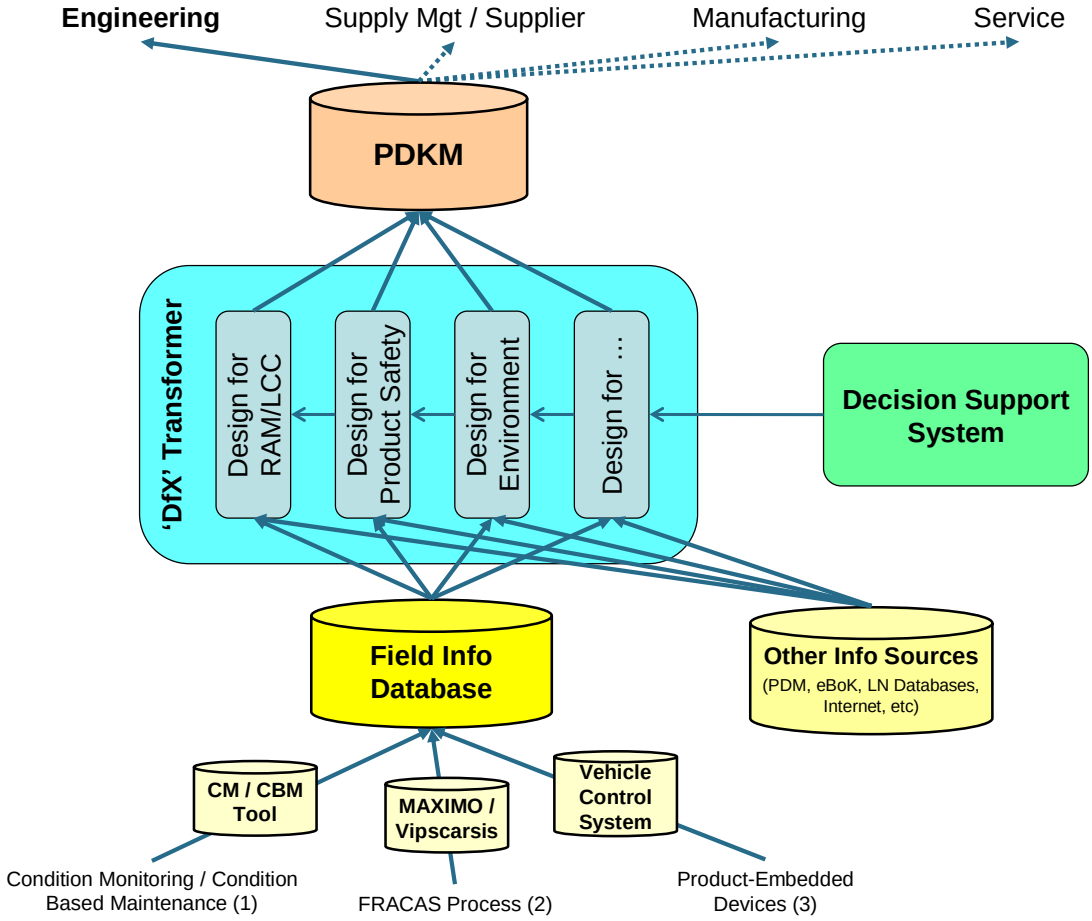


Illustration of the information flow (flowchart)
In order to identify informational requirements, illustrate the flow of information and clearly identify information/data flows by denoting this in the figure. Use rectangles, arrows, circles etc with text. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

Overview on the 'Design for X' information flow:



- CM & CBM and corresponding tools are currently under development.
- FRACAS is supported by a toolset that includes for locomotives mainly MAXIMO & VIPSCARSIS.
- Currently sensors are used as 'Product-Embedded Devices' to register specific behaviours and conditions. The data is gathered and evaluated by the vehicle control software and provided via GSM to the operation base (if needed).

The following definitions are used:

- **Data** - data are raw symbols
  (the display of a digital thermometer reads 98.6 deg-F, which can be directly encoded in ASCII, Unicode, etc.).
- **Information** - information is data processed to be useful
  (my body temperature is 98.6 deg-F, which can be represented, for example, in XML using the previous data encoding but with special tags defined to convey the notion of

temperature and measure).

- **Knowledge** - knowledge is information processed to be useful
  (if my body temperature is greater than 98.6 deg-F, then I may be ill, which can be represented, for example, in XML, using the previous data encoding but with special tags defined to convey its rule-based nature.)

  [source: www.fiatech.org 'Definition of Key Terms']

Specific requirements needed in order to fulfil the objective (user requirements related to WP R1)
If there are some specific requirements that are needed to be fulfilled, please state them here.

- The DfX knowledge shall be manageable in common PDKM systems (e.g. SAP PLM, UGS Teamcenter).
- The translation / transformation of data into knowledge shall be performed by appropriate specialists and shall be supported by a decision making process & tool (where necessary).
- This scenario will primarily concentrate on the important 'Design for X' aspects Reliability, Availability & Maintainability (RAM), Life Cycle Costs (LCC), Product Safety and Environment:
  - Design for RAM/LCC:
    The demonstrator shall support the DfRAM/LCC process by providing appropriate knowledge – mainly regarding reliability & availability information, failure analyses, maintenance procedures and cost information – needed to fulfil the RAM/LCC performance requirements of a new product.
  - Design for Product Safety:
    The demonstrator shall support the DfS process by providing appropriate knowledge – mainly regarding potential hazards, appropriate mitigation mechanisms and performed safety analyses – needed to fulfil the performance requirements regarding safety of a new product.
  - Design for Environment:
    The demonstrator shall support the DfE process by providing appropriate knowledge – mainly regarding material choice (e.g. BT list of prohibited & restricted material), end-of-use aspects, energy and emission related issues – needed to fulfil the environmental performance requirements of a new product.
- The demonstrator shall be as close to the 'reality' as possible, mainly by using
  - real field information available through Condition Monitoring / Condition Based Maintenance, Diagnosis System, Event Recorder, Maintenance Management Systems, Inspection Information, Failure Reporting Analysis and Corrective Action System (FRACAS)
  - and other relevant data and information from various sources (PDM systems, databases, intranet, etc.).

Pain-points (problems/challenges) Identify the most important problems/challenges related to this scenario (e.g. technical, economical, ethical, environmental, customer related, partner related)
A major challenge will be that adequate field data is mainly available from warranty phase, but not really from the product service by operators. But nevertheless the DfX knowledge should cover the complete lifespan. A true representation of LCC may not be possible due to the complex nature of the Production, Delivery and Operation Contracts for railway rolling stock and the commercially sensitive nature of cost information.

Other aspects related to the Application Scenario If some aspects are not are covered above, please use this field.
Not applicable

10.1 Technical issues A10

***Data&Information*: Product Information requirements** List what sort of data is to be gathered from e.g. PEIDs. Show how the data is to be transformed into information. Use a tree diagram to illustrate the flow of data, starting with the data gathering from e.g. wheel, dampers etc to the right, and flowing into the PEID. From the PEID indicate output flows and show whether the data is sent by internet, radio, gathered by technician to e.g. a PDA
For this application scenario all kind of data and information is used that can be transformed into DfX knowledge. Regarding PEID's, only the data gathered from currently installed PEIDs (e.g. sensors) will be used. But most probably no data gathering with specifically designed PEID's will be necessary. For the DfX demonstrator the necessary data and information shall be provided through currently used information sources (see DATA&INFORMATION: INPUT DATA). For the demonstrator most probably no data gathering with specifically developed PEIDs is feasible. Only if needed data and information can not be made available as described above, the usage of PEIDs shall be considered. The intention is then to use developments from other application scenarios (e.g. WP A4, A5 & A6).

Data&Information: Input data Describe the input data going into the PEIDs (type of data, believed amount of data etc).
Not applicable regarding specifically designed PEID's (see DATA&INFORMATION: PRODUCT INFORMATION REQUIREMENTS). Concerning the overall application scenario, the needed input are various data and information on all kind of characteristic and behaviour of the considered products, systems and components and available in • Condition Monitoring / Condition Based Maintenance • Diagnosis System • Event Recorder • Maintenance Management Systems • Inspection Information • Failure Reporting Analysis and Corrective Action System (FRACAS) • PDM system • Lotus Notes databases • eBoK's (Intranet) • Internet • and other similar data & information sources (DfX basic data, standards, etc.) Only electronic data and information is considered as direct input. Non-electronic data and information has first to be pre-processed into electronic format before it can be transformed into DfX knowledge.

Data&Information: Output data Describe the output data going out from the PEIDs (type of data, believed amount of data etc).
Not applicable regarding specifically designed PEID's (see DATA&INFORMATION: PRODUCT INFORMATION REQUIREMENTS). Concerning the overall application scenario, the needed output are various DfX knowledge manageable in a common PDKM system.

***Data&Information*: Amount of data** Describe the need for storage in the PEIDs (this in order to get a picture of how much storage is needed in e.g. the PEIDs)
Not applicable regarding specifically designed PEID's (see DATA&INFORMATION: PRODUCT INFORMATION REQUIREMENTS). This has to be evaluated in more detail regarding the overall application scenario.

***Hardware*: Hardware** Describe what sort of hardware technologies (PEID, sensors, GPS, networks etc) would be considered to be used or as needed to be developed.
Not applicable regarding specifically designed PEID's (see DATA&INFORMATION: PRODUCT INFORMATION REQUIREMENTS). *[Example for demonstrator: description of diagnostic system (necessary information on used sensors, onboard computers, GSM system, etc)]*

***Hardware:* Life span of devices** What is the needed minimum life span of the devices?
May not be applicable regarding specifically designed PEID's (see DATA&INFORMATION: PRODUCT INFORMATION REQUIREMENTS). However, should PEID's be considered a minimum useful life expectancy of 30 years would be required. This is also valid for all other kind of devices within the overall application scenario.

***Hardware:* Working conditions** Describe under what sort of working conditions the devices are believed to be working under (like impacts, heat, cold, moisture etc)
May not be applicable regarding specifically designed PEID's (see DATA&INFORMATION: PRODUCT INFORMATION REQUIREMENTS). However PEID's for use in the railway environment must fulfil the environmental requirements of EN 50155 for electronic devices, e.g. exacting shock and vibration requirements, extended temperature range (-45° to +80°C) and fully resistant to water ingress. This is also valid for all other kind of devices within the overall application scenario.

***Software:* Firmware (embedded software)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Not applicable regarding specifically designed PEID's (see DATA&INFORMATION: PRODUCT INFORMATION REQUIREMENTS). *[Example for demonstrator: description of diagnostic system (necessary information on used sensors, onboard computers, GSM system, etc)]*

***Software:* Middleware (software that allows different software applications to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Not applicable regarding specifically designed PEID's (see DATA&INFORMATION: PRODUCT INFORMATION REQUIREMENTS). *[Example for demonstrator: description of diagnostic system (necessary information diagnostic software)]*

***Software:* D2D (software that allows devices to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Not applicable regarding specifically designed PEID's (see DATA&INFORMATION: PRODUCT INFORMATION REQUIREMENTS). *[Example for demonstrator: necessary description of vehicle bus / communication]*

***Software:* D2B (software that allows devices to communicate with middleware and/or other software applications)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
Not applicable regarding specifically designed PEID's (see DATA&INFORMATION: PRODUCT INFORMATION REQUIREMENTS). *[Example for demonstrator: necessary description on vehicle bus / communication, GSM interface]*

***Software:* Backend software (software for data management, decision making etc)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
For the transformation / translation of process only one 'easy to use' user interface shall exist, which provides access to all needed data and functionality (portal). The client shall run on Windows XP. All product relevant data, information and knowledge shall be managed in a common PDKM system. The PDM system used today for the product definition is Teamcenter Enterprise (Metaphase CF2). All relevant data for logistics, etc. will be transferred automatically to the ERP system (SAP R3).

***Software:* Decision support software (Local? Remote?)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
The decision support software shall use field information (from field info database) and existing knowledge (from eBoK's, Lotus Notes databases, internet, etc.) to let the DfX specialists efficiently decide how the product data and information has to be translated / transformed into knowledge. The decision support software can be used locally by the DfX specialists (as part of the portal, see SOFTWARE: BACKEND SOFTWARE) and run on Windows XP.

Other aspects related to the Technical issues If some aspects are not are covered above, please use this field.
The scenario includes the provision of the appropriate knowledge for the main DfX processes based on the available data resp. information. • Design for RAM/LCC: The DfRAM/LCC process requires mainly knowledge of products, systems and components regarding - Reliability & availability information (e.g. MTBF, environmental conditions) - Failure analyses (e.g. FMEA) - Spare parts information - Maintenance procedures & plans - Cost information, including maintenance task times • Design for Product Safety: The DfS process requires mainly knowledge of products, systems and components regarding - Asphyxiation - Burns (typically caused by exposure to hot surfaces or substances, as distinct from fires) - Exposure to Biological Hazards - Exposure to Chemicals - Collision (of the vehicle) - Crush - Cut - Derailment - Fall - Fire - Electrocution - Impact (people hitting walls, equipment, etc. or equipment falling onto people, usually as a result of rapid acceleration or deceleration) - Medical Equipment Incompatibility - Malfunction of safety relevant functions • Design for Environment: The DfE process requires mainly knowledge 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)

10.2 Business/economical issues A10

As-is, current solution/implementation of the scenario or similar tasks/situations Describe the As-is solution/implementation that are used today (either as your company or others uses). Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
BT gathers already various field data resp. information (e.g. from the TRAXX Platform locomotives). This information is primarily used within the specific contract to validate the customer requirements and to improve the product performance. This information is usually in a format that only specialists can interpret and use. But this information does not flow back as DfX knowledge into the Engineering so that it could be used to design new and more competitive products.

To-be, Future scenario concept Describe in more detail the To-be solution/implementation. Describe it in such a way that it is related to the As-is description above. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
The field information shall flow back as DfX knowledge – managed by a common PDKM system – mainly into the Engineering in a format that it can directly be used by the engineers & designers to design new and more competitive products. The GAPS between AS-IS and TO-BE are mainly: • field data / information are not complete regarding DfX, e.g. condition / environmental information • transformation of field information into knowledge • knowledge directly to be used by engineers & designers • knowledge to be managed by a common PDKM system

Business effects (own business) – negative aspects Describe the negative business effects the application scenario will/could have on your business. (E.g. manpower needs, economy, new business areas, ethical, environmental etc.)
The following negative business could come up: • Additional effort to get appropriate field data from operator and / or additional effort for customer to provide field data • Additional effort for involved persons due to usage of new processes and tools • Additional effort for implementation activities for involved persons because of changes in current processes and tools • Inspiring of inadequate (customer) expectations / requirements

Business effects (own business) – positive aspects Describe the business effects the application scenario will/could have on your business. (e.g. Improved business situation Business improvements opportunities (productivity, quality, environment, social issues) etc.
The main benefit is to establish a process (incl. supporting tools) for the transformation of field information into DfX knowledge resulting in • improved and more competitive product designs, mainly by adequate re-use of proven designs • increased customer satisfaction due to improved fulfilment of customer requirements • reduced design effort by allowing engineers to have direct access to discrete and meaningful DfX product data in every design phase • minimized design changes during product service life (respectively warranty period) due to improved component selection during initial design

Cost models What sort of cost models is viable for the application scenario? I.e. how much is the maximum price per PEID, support systems etc? It's important to identify the maximum price range that can be added to a product/vehicle etc as a consequence of the aspects described in this application scenario. Describe therefore aspects that will have a consequence for costs, and in what range the "hurting" price for the customer (or users etc) will be.
Most probably the costs can not be handed on to the customer. Therefore the investments (PEID's, SW & HW, user training, etc.) and yearly costs (e.g. SW maintenance) shall be reasonable, so that a return on investment occurs at least within 2 years. Further more detailed requirements could be defined in the near future.

Other aspects related to the Business/Economical issues If some aspects are not are covered above, please use this field.
Not applicable

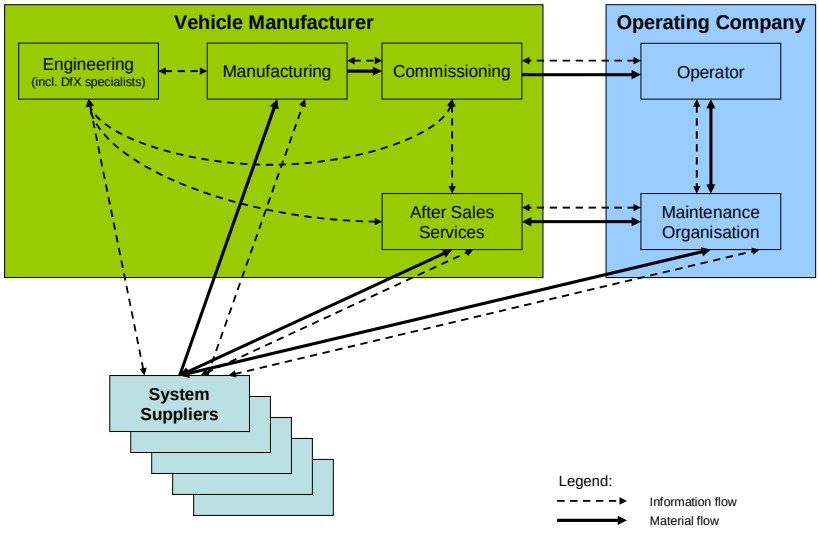
10.3 Value-chain issues A10

Make an overview of the value-chain related to the application scenario
Describe the partners/business associates/customers etc related to the application scenario. If this already has been covered by earlier illustrations/descriptions, please indicate this in the field below. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.

The following general value chains are valid for this application scenario:

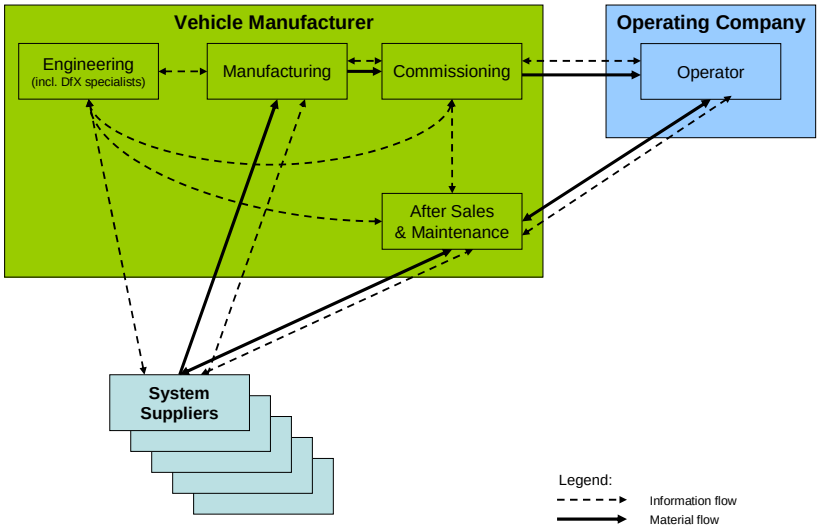
- Main case (e.g. for most state owned operators):

Case I: Operating Company performs Maintenance

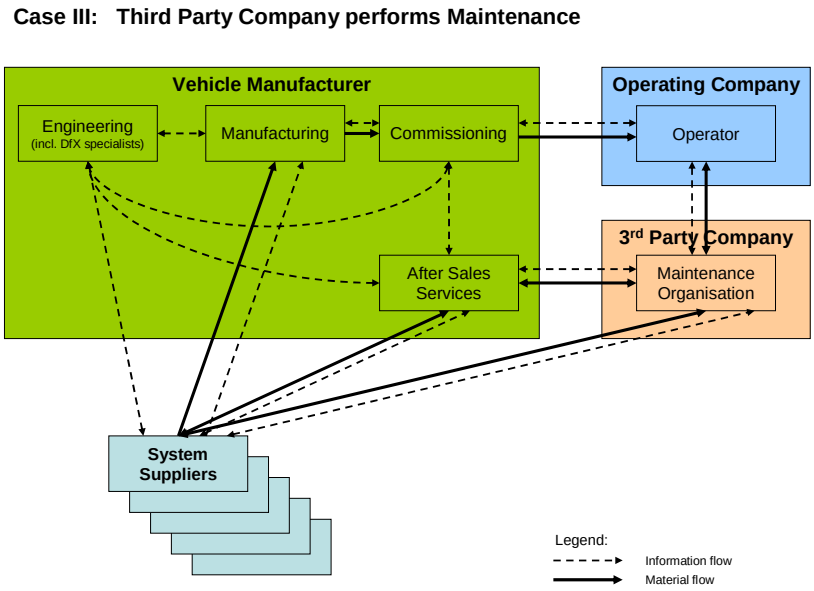


- Secondary case (e.g. for private operators):

Case II: Vehicle Manufacturer performs Maintenance



- Further case:



Describe possible downsides/upsides related to: Customers (categorized), Suppliers (categorized), Partners/cooperating companies (categorized)

What kind of consequences will the application scenario have for the partners/business associates/customers etc in the value-chain.

E.g. Dismantler: Dismantler must invest in new systems for reading/handling discarded products etc, but will have an upside regarding their operations of reuse/remfg etc as they more readily can…

E.g. Customer: Customer will experience changes in their maintenance program this can be perceived as a positive or negative aspect (briefly describe why/how)

- Customer:
  A downside is mainly the disclosure of information about service usage of locomotives by the operators. On the other hand will the operator benefit from improved products.
- Suppliers:
  System suppliers could benefit from improved field information respectively knowledge regarding their scope of supply. But for the system integrator more detailed conclusions on their system performance & quality will be possible.
- Partners companies / consortiums:
  Partners companies / consortiums could benefit from improved field information respectively knowledge regarding their scope of supply. But more detailed conclusions on their system performance & quality will be possible for all partners - which could also be competitors in other areas.

Other aspects related to the Value-chain issues

If some aspects are not are covered above, please use this field.

Not applicable

10.4 Environmental issues A10

Savings of energy Based on today's As-is situation, try to guesstimate the savings of energy due to the new application scenario (if any). Justify the guesstimate.
Savings of energy will be low. Most probably some potential can be identified in the field of Design for Environment, where energy consumption of a system / component is a criterion.

Savings of material Based on today's As-is situation, try to guesstimate the savings of material due to the new application scenario (if any). Justify the guesstimate.
Savings of material will be low to null. At best some potential can be identified in the field of Design for Environment, where material consumption of a system / component could be a criterion.

Reuse or extended product life Based on today's As-is situation, try to guesstimate the amount of reuse and/or extended product life due to the new application scenario (if any). Justify the guesstimate.
The amount of reusing the same system / component design for another product design will be high. This is one of the major benefits of this scenario. The reuse and / or life extension of the product itself will probably be low. The objective of the scenario is to improve the performance (fulfilling customer requirements, e.g. regarding reliability & LCC) of the product during its life and not really to extend it. Therefore a reuse and / or life extension would only be an additional benefit.

Other aspects related to the Environmental issues If some aspects are not are covered above, please use this field.
Lifecycle aspects shall noticeably be improved, because this is a major objective of this application scenario.

10.5 Social issues A10

Changed labour/work conditions Describe the implications of the application scenario regarding changed labour/work conditions
Commissioning and servicing persons would probably need to collect more product data in the field info database. Engineers & designers will have to take more care to evaluate the usage of existing designs & knowledge, instead of 're-designing' it again.

Social Impact on society Describe, if any, implications of the application scenario regarding Social Impact on society
None

Ethical issues Is there ethical issues related to the application scenario? IF Yes explain
None

Other aspects related to the Social issues If some aspects are not are covered above, please use this field.
None

Application Scenario Description
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Date (dd.mm.yyyy)	Version	Author	Comments
10.12.2004	1.0	Maurizio Tomasella	The draft version submitted SINTEF
05.01.2005	1.1	Carl Christian Røstad, SINTEF	Updated v1.0 document – Chapter references below refers to the old chapter structure in v1.0 ♦ 3.14 Technical interfaces - DELETED (transferred to WP R1) ♦ 3.15 Facility and quality technical requirements – DELETED (transferred to WP R1) ♦ 3.16 Hardware and software platforms in use – DELETED (transferred to WP R1) ♦ 4.2 To-be, Future scenario concept - REMOVED ERRONUS DESCRIPTION TEXT ♦ 4.3 GAP analysis of As-is and To-be - REMOVED ♦ 4.6 Cost models - DESCRIPTION CHANGED ♦ 5.2 Describe possible downsides/upsides … - DESCRIPTION UPDATED ♦ 6.4 Improved LCA indications - REMOVED ♦ 6.5 Improved MOL/BOL/EOL options - REMOVED ♦ 7.1 Changed labour/work conditions - DESCRIPTION UPDATED ♦ 7.2 Social Impact on society - DESCRIPTION UPDATED ♦ 7.3 Ethical issues - DESCRIPTION CHANGED
14.01.2005	1.2	Maurizio Tomasella, Andrea Matta	The (first) “final” version submitted SINTEF. Updated v1.1 document.
14.02.2005	1.3	Maurizio Tomasella, Andrea Matta	The final version submitted SINTEF. Updated v1.2 document.
18.02.2005	1.3	Maurizio Tomasella, Andrea Matta	Updated version
05.05.2005	1.5	Carl Christian Røstad	Prepared for inclusion in DR3.2

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11 Application scenario description A11 POLIMI BOL

Where discrepancies, the Demonstrator-document overrides all aspects of this scenario.

Purpose and objective(s) of the scenario Give a detailed description of the scenario objective – What is the purpose of the scenario
The purpose of this application scenario is to demonstrate how the PROMISE platform can be used to improve the overall enterprise performance by adapting the production system to the large number of product and process modifications prompted by the availability of feedback information concerning the whole product life cycle.

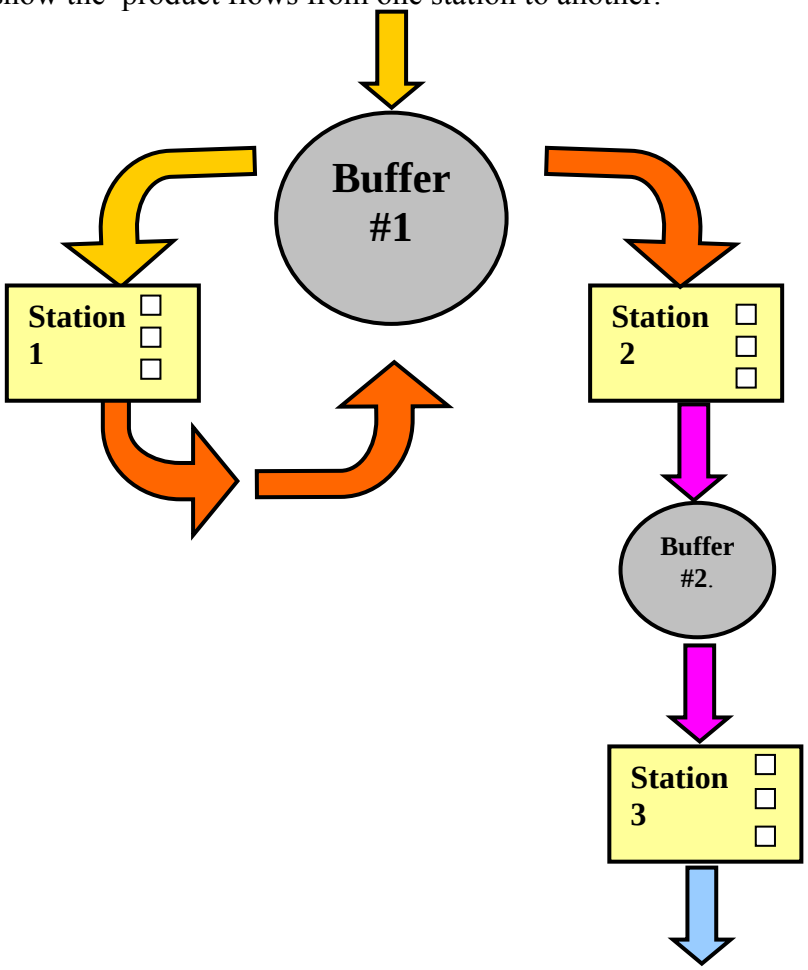
Scenario objective(s) rationale Describe the rationale for the objective, i.e. why is the objective important and why the objective is important to fulfil
Malfunctioning, early wearing or failure of products during MOL and EOL phases are closely connected with the design of the product, its production process and the production system used to realize the same process. These design activities can be improved by tracking the status of products during their use and disposal, thanks to the great amount of data collected. If the information loop is properly closed, the same amount of data can be transformed into knowledge, useful to identify product criticalities, their causes and to provide practical guidelines for the improvement of the product. The frequency of requests of product modifications is expected to increase in a PROMISE context due to the availability of feedback information. Therefore producers will introduce modifications on the system, which may cause performance losses if not adequately forecasted.

Relations with PROMISE objectives Relate the application scenario to the PROMISE objectives as described in the Declaration of Work
As underlined in *section 2.3* of the *Description of Work* document, the PROMISE project has four main objectives. This application scenario will contribute, to objectives #1 and #4. The first is because the demonstrator developed for the scenario will become one of the elements of the PROMISE Decision Support System, in particular the one for the implementation of the Adaptive Production paradigm. So it will be finally included in the integrated PROMISE product lifecycle management system. The second is because the demonstrator will explore human and social issues towards the development of a sustainable business model, in particular in the field of adaptive production, where the integrated product/process/system design will be carried out from a sustainable point of view.

Lifecycle phase relevance (BOL, MOL, EOL) Relate the scenario application to BOL, MOL, EOL, and clearly state the relevance to BOL, MOL and/or EOL
Adaptive Production application scenario mainly involves the BOL phase of a product, so that an integrated approach to the product/process/system design can be carried out .

Product considered in scenario
Describe the products in the scenario (e.g. car, truck). Include related functionality and life cycle issues.

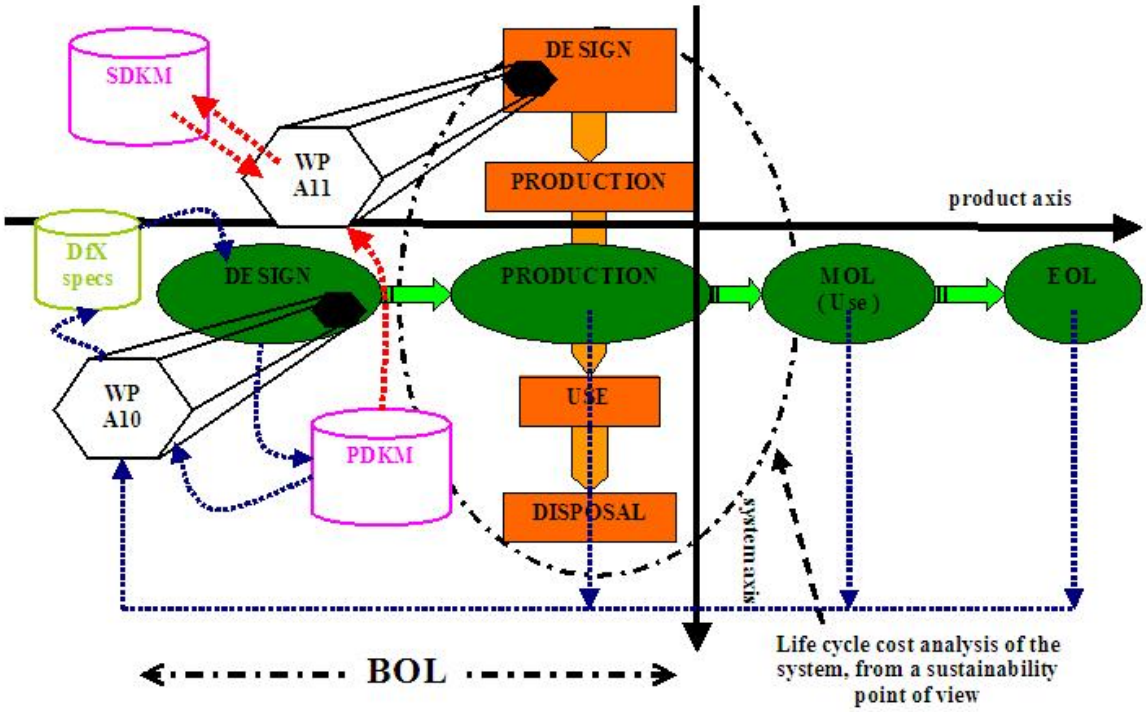
The product to be considered in the scenario will be one of the major subsystems of the car, and in particular the cylinder head group. The production system is the "JTD line" for the production of diesel engines. The layout is composed by a set of three stations, each one having three identical machine tools. Also two buffers are provided in the layout: the former is used both as the buffer for the first station and as inter-operational buffer between the first and the second station. The latter is then used as inter-operational buffer between the second and the third station. Arrows of different colours show the product flows from one station to another.



Interfaces between lifecycle phases
Describe the interfaces between relevant BOL, MOL and/or EOL

This application scenario mainly involves BOL issues but also affects and is affected by the MOL and EOL phases. However the Adaptive Production theme does not require any explicit interface between the three phases.

Illustration of the application scenario Provide an illustration of the application scenario that can be used for communication purposes (e.g. in trade magazines, on the front of reports, slide shows etc). Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
The Adaptive Production scenario can be illustrated as reported below. The aim is to reconfigure the system, given the modifications to the product/process. In the green blocks you can see the life cycle phases from the PROMISE point of view; Design and Production constitute together the BOL phase. In the orange blocks you can see the life cycle of the production system. An emphasis will be given to the sustainability of the system reconfiguration. With the word “system” is intended here the set of hardware and software resources whose aim is to realize the whole production process, (e.g. production lines, FMSs, job shops, ...). With PDKM (Product Data Knowledge Management) is intended the storage and management system of product data and knowledge, one of the essential elements of the PROMISE platform. With SDKM (System Data Knowledge Management) is intended the set of data (with the relative knowledge) concerning the production system. The PROMISE platform gathers data from the whole product lifecycle, which are transformed into knowledge concerning the product. This can be used by the different product lifecycle stakeholders to improve one or more of the lifecycle phases and sub-phases. For instance they can be used in the BOL to modify features of the product as required by e.g. Predictive Maintenance or EOL processing. The collected data will increase product/process modifications relative to the current situation. Once the modifications have been decided, it is essential to make the system work according to the new “rules” in the most efficient way possible. To achieve this it is important to have a kit of tools which will help the decision maker to reconfigure the production system (e.g. the production line) or even to design/configure a new one. This is the area of the demonstrator developed in WP A11 for the present scenario. The related information flow about the system/process/product is depicted in dashed red lines.



Scenario description

The process/product modifications affecting a family of products are identified and properly modelled, e.g. a set of scenarios for these type of modifications is given with the relative set of probability distributions.

The Adaptive Production paradigm forces the decision maker to decide how the system layout should be modified (e.g. "Should the number of machine tools be increased, decreased, or remain the same?" And, if in the case, "How many new machine tools should be added and what kind of machine tools?") or how the inter-operational buffers should be modified in order to maximize a certain type of objective function (e.g. the system throughput), following the product/process modification scenarios.

The reconfiguration activities should take into consideration the whole set of modification scenarios concerning the product/process, considering also all the implications which a certain feasible configuration of the production system can cause to its lifecycle.

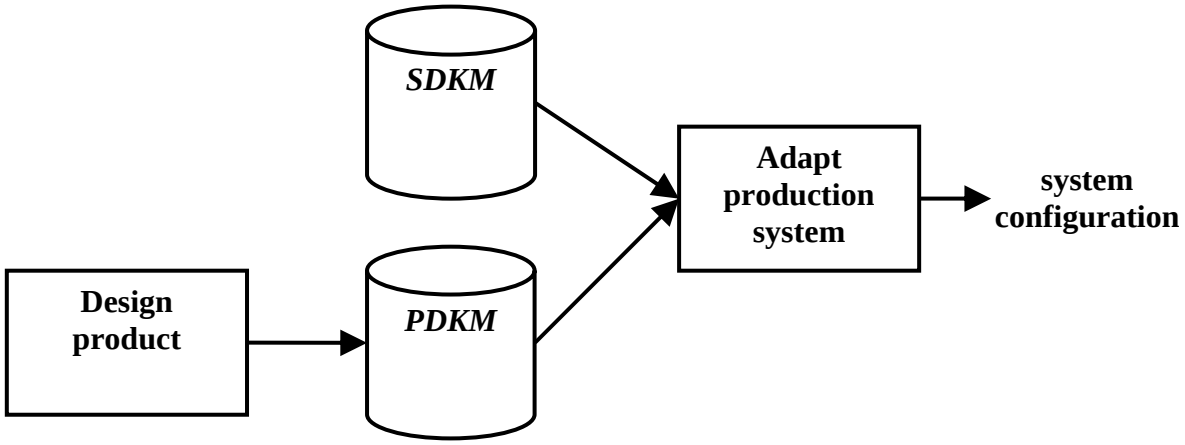
Illustration of the information flow (flowchart) In order to identify informational requirements, illustrate the flow of information and clearly identify information/data flows by denoting this in the figure. Use rectangles, arrows, circles etc with text. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
An information flowchart for the application scenario has already been described in the answer to the previous question.

Specific requirements needed in order to fulfil the objective (user requirements related to WP R1) If there are some specific requirements that are needed to be fulfilled, please state them here.
None

Pain-points (problems/challenges) Identify the most important problems/challenges related to this scenario (e.g. technical, economical, ethical, environmental, customer related, partner related)
The main pain point is surely the analysis and modelling of the future most probable scenarios for the product/process modifications. The problem is that not all markets give the possibility to the decision maker to collect all the needed data about product/process modifications, which are essential for the analysis.

Other aspects related to the Application Scenario If some aspects are not are covered above, please use this field.

11.1 Technical issues A11

***Data&Information*: Product Information requirements** List what sort of data is to be gathered from e.g. PEIDs. Show how the data is to be transformed into information. Use a tree diagram to illustrate the flow of data, starting with the data gathering from e.g. wheel, dampers etc to the right, and flowing into the PEID. From the PEID indicate output flows and show whether the data is sent by internet, radio, gathered by technician to e.g. a PDA
As this section called "Technical issues" has been intended by the authors of this document as the definition of the PEID related issues regarding the product involved in the scenario, answers to these questions cannot be given from this point of view. This because, as stated above, this application scenario focuses on the production system, the product being anyone of the products involved in the rest of PROMISE application scenarios. So we do not need any PEID to be attached to the machine tool because we do not need to follow the system lifecycle. Anyway here a simple model of the input and output data can be found, in order to state from the very beginning all data and information involved in the scenario. 

Data&Information: Input data Describe the input data going into the PEIDs (type of data, believed amount of data etc).
With regard to the application scenario definition given in the answer to question 2.7 and the diagram in the answer to the previous question, one may underline that the ownership of the appropriate data about the future evolution of process plans, bills of materials and demand will enable the decision maker to face the scenario.

Data&Information: Output data Describe the output data going out from the PEIDs (type of data, believed amount of data etc).
The Adaptive Production Scenario has one and only output, which is a (new) configuration for the production system, in particular the one that best fits to the objective chosen before the analysis. The output data will contain for example the number/type of machine tools, the number/type of inter-operational buffers (in particular their capacity), and so on.

***Data&Information*: Amount of data** Describe the need for storage in the PEIDs (this in order to get a picture of how much storage is needed in e.g. the PEIDs)
"Not applicable" See answer to DATA&INFORMATION: PRODUCT INFORMATION REQUIREMENTS

***Hardware*: Hardware** Describe what sort of hardware technologies (PEID, sensors, GPS, networks etc) would be considered to be used or as needed to be developed.
"Not applicable" See answer to DATA&INFORMATION: PRODUCT INFORMATION REQUIREMENTS

***Hardware:* Life span of devices** What is the needed minimum life span of the devices?
"Not applicable" See answer to DATA&INFORMATION: PRODUCT INFORMATION REQUIREMENTS

***Hardware:* Working conditions** Describe under what sort of working conditions the devices are believed to be working under (like impacts, heat, cold, moisture etc)
"Not applicable" See answer to DATA&INFORMATION: PRODUCT INFORMATION REQUIREMENTS

***Software:* Firmware (embedded software)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
"Not applicable" See answer to DATA&INFORMATION: PRODUCT INFORMATION REQUIREMENTS

***Software:* Middleware (software that allows different software applications to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
"Not applicable" See answer to DATA&INFORMATION: PRODUCT INFORMATION REQUIREMENTS

***Software:* D2D (software that allows devices to communicate)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
"Not applicable" See answer to DATA&INFORMATION: PRODUCT INFORMATION REQUIREMENTS

***Software:* D2B (software that allows devices to communicate with middleware and/or other software applications)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
"Not applicable" See answer to DATA&INFORMATION: PRODUCT INFORMATION REQUIREMENTS

***Software:* Backend software (software for data management, decision making etc)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
The backend software needed for the present application scenario relies on the presence of, at least, two software tools for data management, which correspond to the two big data bases contained in Fig. 1. The PDKM software is the one defined and used inside the PROMISE platform, as been designed and implemented by the activities performed in WP R7. The SDKM is a simple list providing the needed data about the system..

***Software:* Decision support software (Local? Remote?)** Describe what sort (if any) software technologies would be considered to be used or as needed to be developed.
The demonstrator developed in this scenario will become part of the PROMISE decision support system.

Other aspects related to the Technical issues If some aspects are not are covered above, please use this field.

11.2 Business/economical issues A11

As-is, current solution/implementation of the scenario or similar tasks/situations Describe the As-is solution/implementation that are used today (either as your company or others uses). Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
Reconfiguration of production systems is nowadays carried out without taking into consideration the different sort of product/process modifications. This is because of the unavailability of the proper data needed for the analysis.

To-be, Future scenario concept Describe in more detail the To-be solution/implementation. Describe it in such a way that it is related to the As-is description above. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
The implementation of the PROMISE system will enable the decision maker to decide the best configuration for a production system making use of data collected during the entire product lifecycle, so the solution to the reconfiguration problem will be less partial than it is today. The gap from the “as-is” and the “to be” situations can only be filled by the existence of a system that takes into account from the beginning the future evolutions of the product.

Business effects (own business) – negative aspects Describe the negative business effects the application scenario (described in section 1) will/could have on your business. (E.g. manpower needs, economy, new business areas, ethical, environmental etc.)
The implementation of the Adaptive Production paradigm inside an already existing firm could have some negative aspects on business management, like: • The justification of costs due to either the first acquisition of the needed software or to the updating activities of the same software. • The difficulties inside the enterprise to implement the new system configuration due to the cost of the reconfiguration activities, though these system modifications are strongly based on some economical motivations, and more generally the hostilities to accept the output of the decision support system.

Business effects (own business) – positive aspects Describe the business effects the application scenario will/could have on your business. (e.g. Improved business situation Business improvements opportunities (productivity, quality, environment, social issues) etc.
The use of the software tool will allow advantages both in the general approach with which the enterprise chooses its facilities and in the reconfiguration itself. First of all, engineers will have the possibility to use a rapid tool to design the system by exploring a wide set of potential alternatives in a structured way. Then, more specific benefits can be gained with the adoption of the new configuration which takes into consideration some information about the product/process, which were unknown at the time the system was first configured, e.g. : • Modification needs about the product/process requested by the market. If the enterprise becomes aware of the most probable product/process future modifications, system configuration activities could be carried out evaluating different scenarios. In this way the enterprise can prove the feasibility of new solutions to its production problem, with a nearly complete analysis. • Modification "plans" about the product/process, in order to force the introduction of innovative solutions for the next future. In this way the enterprise role becomes proactive, compelling its competitors to react to the new changes. Such important piece of information can be used to study which new system configuration best accomplishes to the enterprise objectives, and to provide an estimate of the potential improvements in terms of the most important technological factors, such as productivity, manufacturing flexibility, product/process quality, … The added value which can be found in such a type of analysis derives from the information concerning process/product modifications, which are not adequately considered in the current situation.

Cost models What sort of cost models is viable for the application scenario? I.e. how much is the maximum price per PEID, support systems etc? It's important to identify the maximum price range that can be added to a product/vehicle etc as a consequence of the aspects described in this application scenario. Describe therefore aspects that will have a consequence for costs, and in what range the "hurting" price for the customer (or users etc) will be.
The Adaptive Production scenario does not need neither specific PEID devices nor the related hardware/software/firmware/… , so the main costs involved in the scenario could be costs concerning the software for decision support in the system (re)configuration. It is impossible for the moment to give a detailed estimate of all of these costs; anyway here the typical costs concerning the decision support software can be listed: • Software acquisition cost • Software maintenance cost • Employees/workers training cost • Software customization cost With "Software customization costs" are intended all of the costs concerning the activities of customizing the software to the specific production system.

Other aspects related to the Business/Economical issues If some aspects are not are covered above, please use this field.

11.3 Value-chain issues A11

Make an overview of the value-chain related to the application scenario Describe the partners/business associates/customers etc related to the application scenario. If this already has been covered by earlier illustrations/descriptions, please indicate this in the field below. Feel free to illustrate with figures as fit. Use the font Arial Narrow no smaller than 8 pts. If the illustration does not fit the format of this page, insert it and make it fit by dragging the figure smaller. Remember to include the figure as a separate file (in JPEG, GIF, Visio-format or include it in a Word or Powerpoint-file.
This Application Scenario mainly involves as a unique big stakeholder the extended enterprise as a whole, with particular regard to the business unit which manufactures the product. In fact all activities concerning the (re)configuration of the system can be accounted to this business unit, whose aim is to obtain the product (with or without modification, following the market needs) by realizing the production process in the most efficient way. So a real value-chain for this Application Scenario cannot be described. However a list of the people directly involved in the scenario can be given: • *System designers*. The most involved in the benefits deriving from the scenario. They directly use the decision support software to prove the feasibility of new system configurations with the aim to react to the process/product modifications following the new market needs or to force new product/process solutions playing a first row role in the same market. • *Product designers*. The product designer is involved in the scenario because he determines the inputs to the (re)configuration activities and, at the same time, to the decision support software. If the new product solutions cannot be implemented in any new system configuration, due to their unfeasibility, the product designers should generate alternative product modifications to satisfy the market. • *Process designers*. Same role as the one played by product designers, but concerning the process. • *System managers*. System managers can have a certain number of benefits from the (re)configuration of the production system, deriving from the improvement in productivity, quality, and so on. They can also have some downsides due to the difficulty to decide and implement the new management policies for the production system.

Describe possible downsides/upsides related to: Customers (categorized), Suppliers (categorized), Partners/cooperating companies (categorized) What kind of consequences will the application scenario have for the partners/business associates/customers etc in the value-chain. E.g. Dismantler: Dismantler must invest in new systems for reading/handling discarded products etc, but will have an upside regarding their operations of reuse/remfg etc as they more readily can… E.g. Customer: Customer will experience changes in their maintenance program this can be perceived as a positive or negative aspect (briefly describe why/how)
See answers to BUSINESS EFFECTS (OWN BUSINESS) – POSITIVE & NEGATIVE EFFECTS

Other aspects related to the Value-chain issues If some aspects are not are covered above, please use this field.

11.4 Environmental issues A11

Savings of energy Based on today's As-is situation, try to guesstimate the savings of energy due to the new application scenario (if any). Justify the guesstimate.
Not applicable

Savings of material Based on today's As-is situation, try to guesstimate the savings of material due to the new application scenario (if any). Justify the guesstimate.
Not applicable

Reuse or extended product life Based on today's As-is situation, try to guesstimate the amount of reuse and/or extended product life due to the new application scenario (if any). Justify the guesstimate.
Not applicable

Other aspects related to the Environmental issues If some aspects are not are covered above, please use this field.

11.5 Social issues A11

Changed labour/work conditions Describe the implications of the application scenario regarding changed labour/work conditions
Changes in the labour/work conditions can only be described in the specific case of enterprise implementing and using the decision support system based on the Adaptive Production demonstrator.

Social Impact on society Describe, if any, implications of the application scenario regarding Social Impact on society
None.

Ethical issues Is there ethical issues related to the application scenario? IF Yes explain
None.

Other aspects related to the Social issues If some aspects are not are covered above, please use this field.

