

## DI2.3: Integration in the IMS PROMISE project (M42)

Written by:  
Markus Frey, BOMBARDIER  
Dimitris Kiritsis, EPFL

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<b>ABSTRACT:</b>	This report is the deliverable DI2.3 due at M42 and provides the main elements of the Collaboration and Integration activities of PROMISE within the IMS 01008 PROMISE project.

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## Author(s)' contact information

Name	Organisation	E-mail	Tel	Fax
Dimitris Kiritsis	EPFL	Dimitris.kiritsis@epfl.ch	+ 41 21 693 5163	



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## 1 Purpose of this report

The purpose of this deliverable is to provide a report about the overall activities and achievements within the framework of the IMS 01008 PROMISE project. These activities have been already identified and described in the “Integration Policy Paper” of PROMISE delivered at M12 as part of the deliverables DI2.1 to DI2.4, as they were defined in the DoW for the period M1-M12.

## 2 Introduction

A product system’s life cycle is characterised by the three phases: Beginning of Life (BOL), including Design and Production, Middle-of-Life (MOL), including Use, Service and Maintenance and End-of-Life (EOL), characterised by various scenarios such as: reuse of the product with refurbishing, reuse of components with disassembly and refurbishing, disposal with or without incineration etc.

PROMISE focuses on the complete lifecycle of a product with special emphasis in tracking and managing of information at the last two phases of the product’s life cycle, i.e. Use, Service and Maintenance or MOL and EOL, and, the possible feedback of information from these phases to BOL (Design and Production).

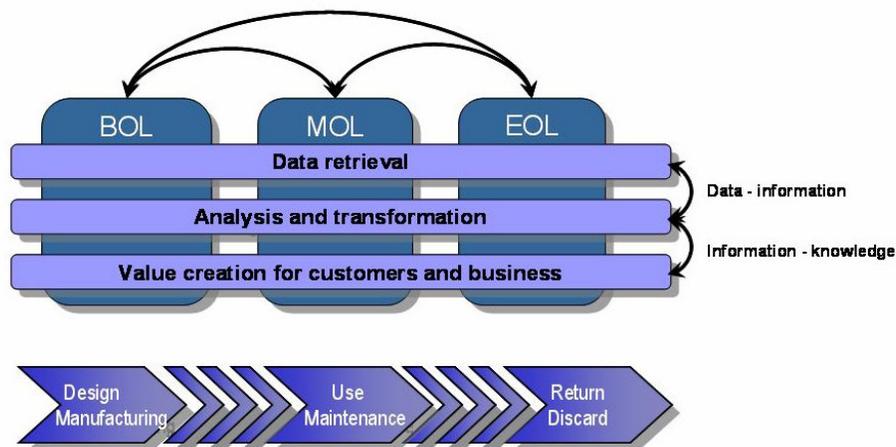


Figure 1. Closing the Product Lifecycle information loops

The reason for PROMISE to focus on the two last phases of a product’s lifecycle is the following:

- Between the first phases, design and production, the information flow is quite complete and supported by intelligent systems like CAD/CAM. Product Data Management (PDM), and Knowledge Management systems are effectively and efficiently used by the industry and, through their influence, by their suppliers

- The information flow becomes less and less complete in and from the MOL phase to the final EOL phase. In fact, for the majority of today’s technological products and especially for those producing “hi-tech” waste, consumer electronics, household “white” machines, vehicles etc., usually the information flow breaks down after the delivery of the product to the customer.

The PROMISE project developed appropriate technologies, including product lifecycle models, Product Embedded Information Devices with associated firmware and software components and tools for decision making based on data gathered throughout a product lifecycle. This is done to enable and exploit the seamless flow, tracing and updating of information about a product, after its delivery to the customer and up to its final destiny (deregistration, decommissioning) and back to the designer and manufacturer.

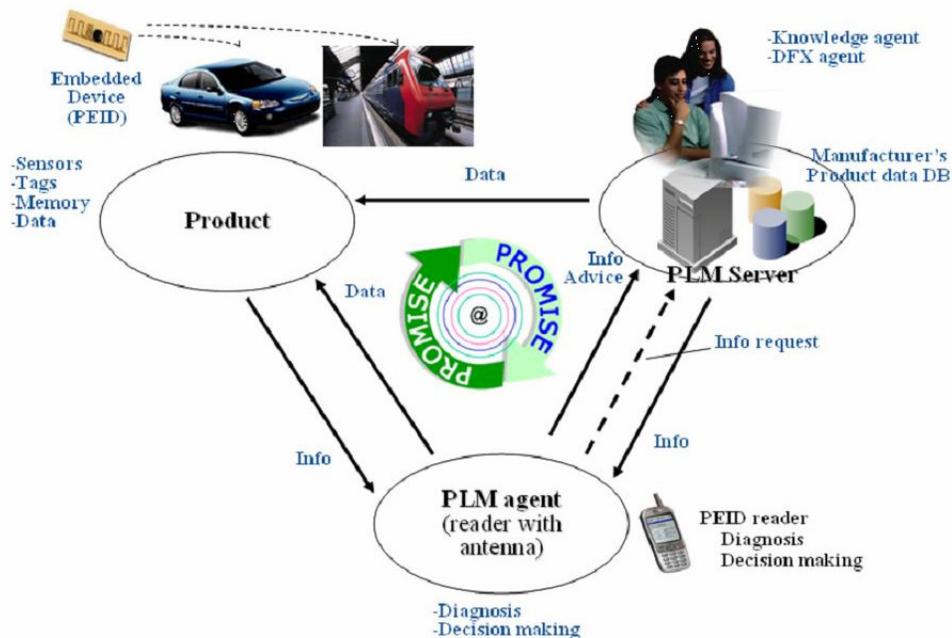


Figure 2. The PROMISE Closed-Loop PLM concept

The breakthrough contribution of PROMISE, in the long term, is to allow information flow management to go beyond the customer, to close the product lifecycle information loops, and to enable the seamless e-Transformation of Product Lifecycle Information into Knowledge.

The PROMISE R&D implementation plan includes fundamental and applied research activities in the disciplines of information systems modelling, smart embedded systems, short and long distance wireless communication technologies, data management and modelling, statistical methods for preventive maintenance, End Of Life planning, Adaptive production management and Design for X as well as applied R&D into materials behaviour during the recycling process.



PROMISE integrates Research Cluster activities which will result in:

- Prototype PROMISE PLM System (Product Lifecycle Management)
- Application Cluster activities covering applications of the PROMISE concepts with more than 10 PROMISE Demonstrators in the Automotive, Railway, Heavy Load Vehicle, EEE, White Goods sectors, machine tool industry, etc.
- Innovation Cluster activities covering Integration & Standardisation and Business Development issues
- Training Cluster activities covering development and delivery of specific training packages for an extended trainee audience involving potential PROMISE technology developers as well as end-users.

PROMISE offers the following business proposition to the Product Lifecycle stakeholders. It creates value by transforming information to knowledge at all phases of the product lifecycle and thus improves product and service quality, efficiency and sustainability. The product and service value may be created at various levels, with respect to the above statement, as follows:

- **Technical:** optimal accomplishment of the expected functions and user expressed and unexpressed needs, after exploiting practical knowledge gathered through the product lifecycle.
- **Economical:** creation of value for the producer (better products, better CRM (Customer Relation Management)), for the service provider (new business opportunities, better CRM), for the product owner (extended product life).
- **Environmental:** minimisation of pollution, resources and energy consumption by applying optimal BOL (Beginning of Life), MOL (Middle of Life) and EOL (End of Life) planning.
- **Social:** comfort, safety, security and satisfaction of the product user, either the operator of the product (e.g. the driver of a truck) and /or the user of the service (e.g. the passenger of a bus, the user of an elevator, etc.).

The development of Product Embedded Information Devices (PEID) is expected to progress rapidly and be largely used for advanced Product Lifecycle Management and real-time data-monitoring throughout the Product Supply Chain and it will expand greatly and explode into a multi-billion dollar market in 2008 and beyond. This technology will particularly allow producers to dramatically increase their capability and capacity to offer high-quality after-sales services while, at the same time, being able to demonstrate responsibility as producers of environmental friendly and sustainable products. Some examples of new after-sales services and breakthrough improvements that will become possible through PROMISE are: new types of leasing services, closing of the information gap in customer relationship management, proof of producer, damage management, and enhancement of security.

### 3 International IMS cooperation

PROMISE is organised as an IMS project with partners from six IMS regions:

- European Union (EU)
- Switzerland (CH)
- USA (US)
- Japan (JP)
- Australia (AUS)
- South Korea (ROK)

Consortia of partners in the above regions run five complementary projects that are funded and locally coordinated at a regional level according to corresponding management structures of each region.

The collaboration schema of the PROMISE consortium may be illustrated as in the following Figure 3. This schema reflects the main technical work:

- “DFX implementation” corresponds to the main research activity of the CH partners
- “Logistics/Decision Making, Information Modeling and Management, PEID Technology” corresponds to the main research activity of the EU partners
- “MOL implementation” corresponds to the main research activity of the US partners
- “EOL implementation” corresponds to the main research activity of the AUS partners
- “MOL & EOL implementation” corresponds to the main research activity of the ROK partners
- “Modelling and Simulation” corresponds to the main research activity of the JP partners
- “Requirements and Specifications, Test Cases and Scenarios” correspond to all regions

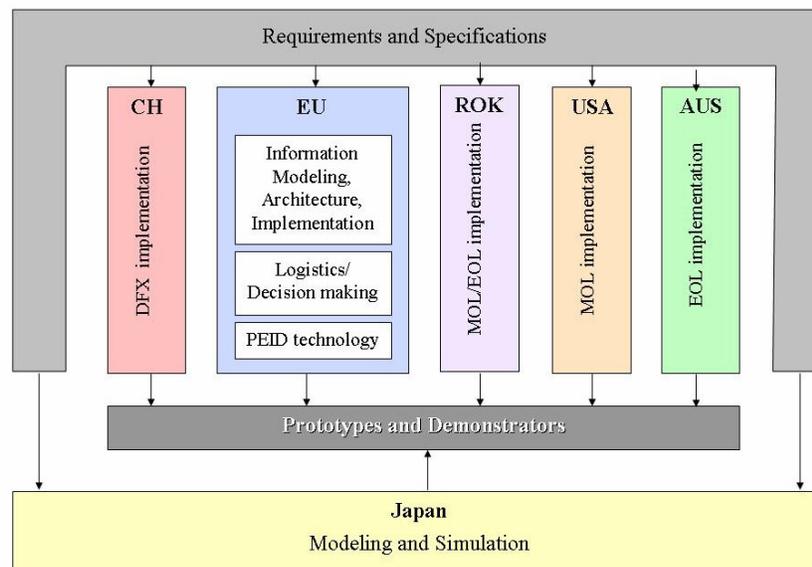


Figure 3: Co-operation between regions



## 4 Project objectives and major achievements

This section provides:

- an overview of the general project mission and objectives,
- shows the project's current relation to the state-of-the-art and
- highlights the major project achievements

### 4.1 Overview of the general project mission and objectives and project's current relation to the state-of-the-art

**Mission:** PROMISE develops technology and business models enabling and exploiting the seamless flow of product information throughout the entire product lifecycle. This will allow for a closed-loop information flow starting from product design and production, to the tracing and updating of product information after its delivery to the customer, up to its final destiny and back to the designer and manufacturer. The technology to be developed for such a closed-loop information flow comprises novel product lifecycle models, Product Embedded Information Devices (PEIDs) with associated firmware and software components, middleware solutions for collecting and aggregating the data from PEIDs, and tools for decision making based on data gathered through a product lifecycle.

**General objectives:** In order to implement its mission, the PROMISE consortium has agreed upon four main objectives:

- Develop new closed-loop life cycle information flow models for Beginning-Of-Life (BOL), Middle-of-Life (MOL) and End-Of-Life (EOL)
- Develop new PLM systems and IT infrastructure exploiting the capabilities of smart product embedded information devices
- Develop new standards to allow the technologies and associated tools to be developed by the PROMISE consortium to be accepted by the market
- Develop new working and business models appropriate for the use and exploitation of the new technologies and tools

### 4.2 Project's current relation to the state-of-the-art

**Current relation to the state-of-the-art:** the PROMISE developments so far are going beyond state-of-the-art in several respects. This may be observed in the following areas:

- **Information flow models:** We have successfully used industry approved modelling methods and tools and produced models for all PROMISE elements, including the complete design of the PROMISE demonstrators. These models are new and innovative and improve the state of the art in that direction. A number of PROMISE publications demonstrate the quality of the produced models.
- **PLM system and IT infrastructure:** a new IT infrastructure has been developed in terms of middleware for PLM. The followed approach is totally new as it is demonstrated in the produced publications.

- Business models:** though it is difficult for the industrial PROMISE partners to assess and evaluate the business benefits of the innovative PROMISE technologies, the closer we go towards the implementation of the demonstrators, new business opportunities become clearer. This is reflected in the so far produced business models.
- Standards:** the actual developments of PROMISE and the business interests of the actual industrial partners of PROMISE did not allow demonstrating a progress in line with the original objectives in that direction. However, a new strategy has been developed that wants to promote the PROMISE architectural elements as an open standard in the longer term. This will require that the PROMISE technologies achieve a certain maturity level, expected to happen a couple of years after the end of the current period of the project.

Second, PROMISE will for the first time develop an integrated solution comprising all of these four areas. Third, PROMISE will also implement and exploit its solutions in 11 real-world demonstrators covering a broad range of industrial domains (automotive, railway industry, white goods, brown goods, etc). Its strong focus on industrial applications will allow PROMISE to work out generic solutions covering several industrial domains and application scenarios.

### 4.3 Main achievements

PROMISE provides a **Closed-loop Product Lifecycle Management**, which is a new generation of PLM system that uses smart embedded IT systems which allow the seamless flow and transformation of data and information into knowledge (see figure 4).

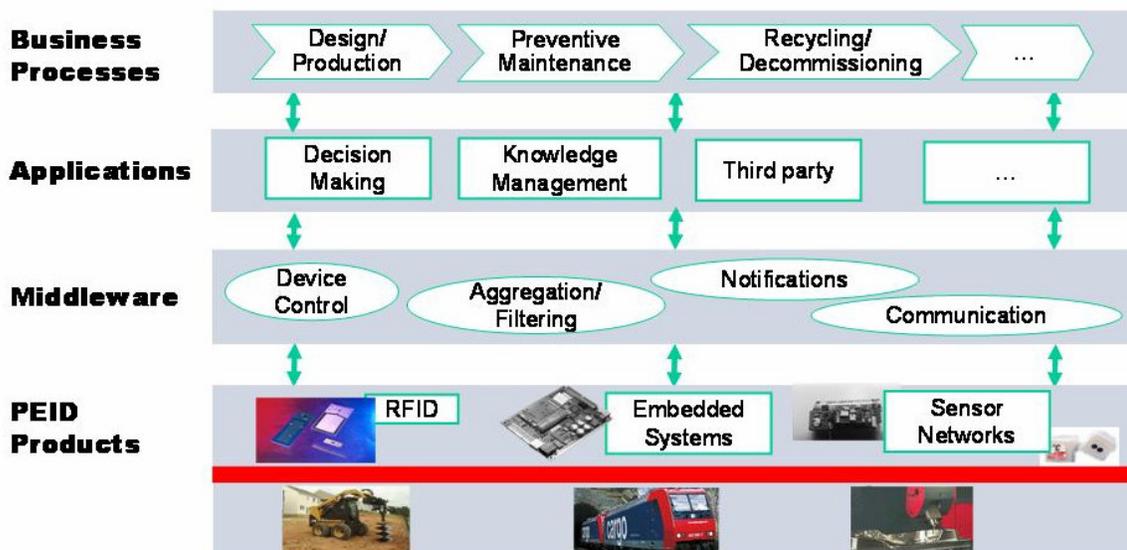


Figure 4: Overview on PROMISE PLM Architecture



The main achievements and work performed to fulfil the objectives have been:

- Consolidated lifecycle models of all demonstrators have been developed and evaluated.
- A PEID core prototype has been implemented.
- Algorithms for transformation of data to information to knowledge have been implemented and integrated in corresponding decision support systems. A number of them are already integrated with the PDKM prototype.
- Implemented object model for management of product item instances and respective field data.
- Running PDKM prototype with basic functions for management and visualization of product item instances and respective field data
- Methods and software tool for the import of heterogeneous field data
- The concept and architecture of the PROMISE Middleware has been developed and implemented in a prototype.
- As further important steps towards the PROMISE's vision of closing the information loop, a comprehensive strategy has been developed and work has been initiated accordingly to integrate and deploy the various PROMISE technologies (PEID, Middleware, PDKM, DSS) in real-world application scenarios.
- Requirements analysis for the advanced design support system based on consideration of entire product life cycle and real data evaluation regarding example product
- Modelling and system framework for evaluation of quality degradation
- Reliability design method based on evaluation of quality degradation
- Maintenance planning for life-cycle management
- Product lifecycle management using network agents and RFID tags for reuse of parts and feedback of operational information
- Development and evaluation of prototypes of the advanced design support system
- A realistic strategy on standards development has been implemented and contacts initiated with the OpenGroup initiative and the ISO relevant STEP committees.
- Expertise on aging of plastics in real environment and its impact on multiple recycling for mainly Electrical and Electronic Equipment:
  - Aging of plastics in real environments;
  - Multiple plastic recycling and processing;
  - Level of materials contamination in a plastic recycling stream

- Detailed designs of various industrial demonstrators focusing on BOL, MOL and EOL in different industrial domains (automotive, railway industry, tool manufacturing, white goods, brown goods, IT industry etc) have been developed, e.g.:
  - a) Monitoring End of Life Vehicles (EOL)
  - b) Heavy load vehicle decommissioning (EOL)
  - c) Tracking and tracing of products for recycling (EOL)
  - d) Predictive maintenance for trucks (MOL)
  - e) Heavy vehicle lifespan estimation (MOL)
  - f) Predictive maintenance for machine tools (MOL)
  - g) EEE white goods (MOL)
  - h) Telecom equipment (MOL)
  - i) Escalator Maintenance planning (MOL)
  - j) Smart Bridge Health Prognostics (MOL)
  - k) Design for X (BOL)
  - l) Adaptive Production (BOL)
  - m) Tracking of material from receipt, processing to storage & shipping, including customer claim tracking (BOL & MOL)

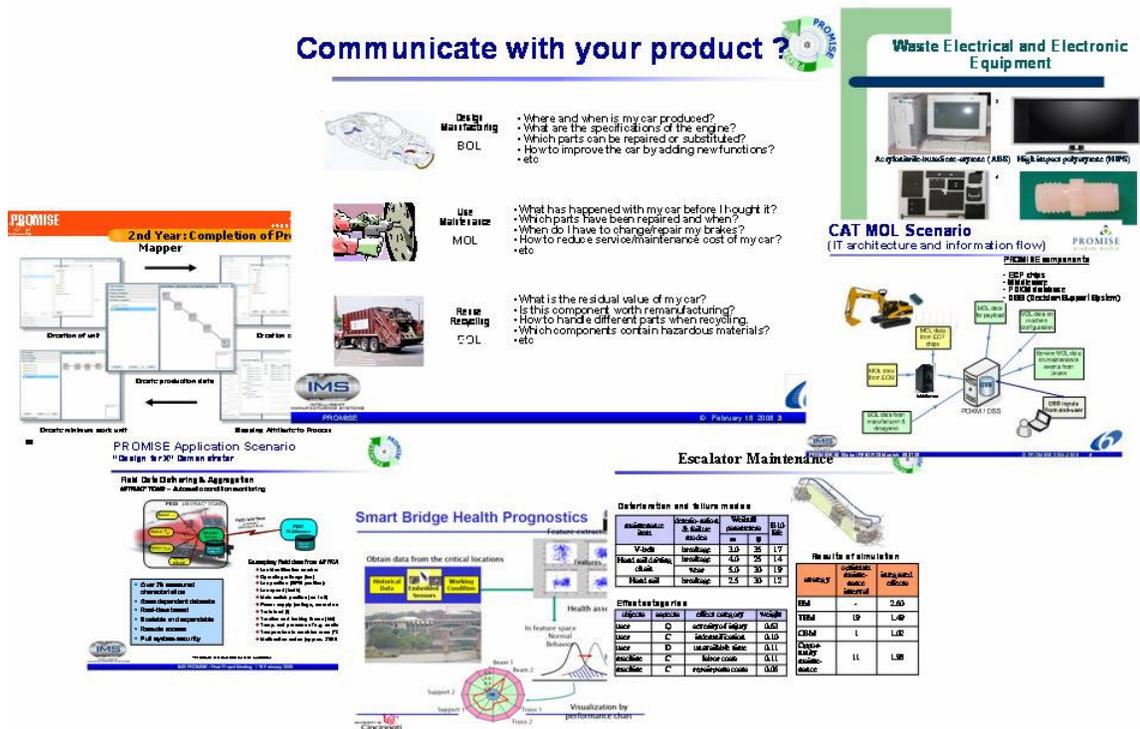


Figure 5: Overview on PROMISE Demonstrators



- Development of 9 training courses consisting of totally 63 modules:
  - a) PROMISE Technologies at System level
  - b) PROMISE DSS Technology
  - c) PROMISE PDKM Technology
  - d) PROMISE PEID Technology
  - e) PROMISE Middleware Technology
  - f) Business course on whole lifecycle
  - g) Business course on BOL Phase
  - h) Business course on MOL Phase
  - i) Business course on EOL Phase

Some PROMISE related activities will be pursued even after project is closed:

- **PROMISE Innovation International Ltd:**

The commercial company “PROMISE Innovation International Ltd” is founded to provide PROMISE technologies to a broad industrial community. Promise Innovation will deliver services and products related to the gathering of lifecycle information and decision support functionality by closing the information loop and communicating across all phases of product life. Promise Innovation will guide and assist its clients to develop products and business processes which benefit their industry, customers and the environment.
- Some common activities related to PROMISE technology will continue between specific partners from various IMS regions (e.g. between IRIS and BIBA).

## 5 Conclusion

The PROMISE project delivers a new type of closed-loop product lifecycle management (PLM) based on product embedded information devices (PEID), which allows a tracking of product information at all times and in any location in the world. Such a PLM system enables product users, maintainers and manufacturers to manage the lifecycle information of their products seamlessly over all lifecycle phases: beginning-of-life (BOL), middle-of-life (MOL) and end-of-life (EOL).

Implementing the PROMISE technology enables process improvements, increases understanding of product life cycles and makes rebuilding and recycling choices more precise with direct environmental benefits, raises the supply chain efficiency and the competitive advantage. Therefore PROMISE PLM provides important benefits to reduce product total costs, to increase product quality & sustainability and to improve competitiveness.

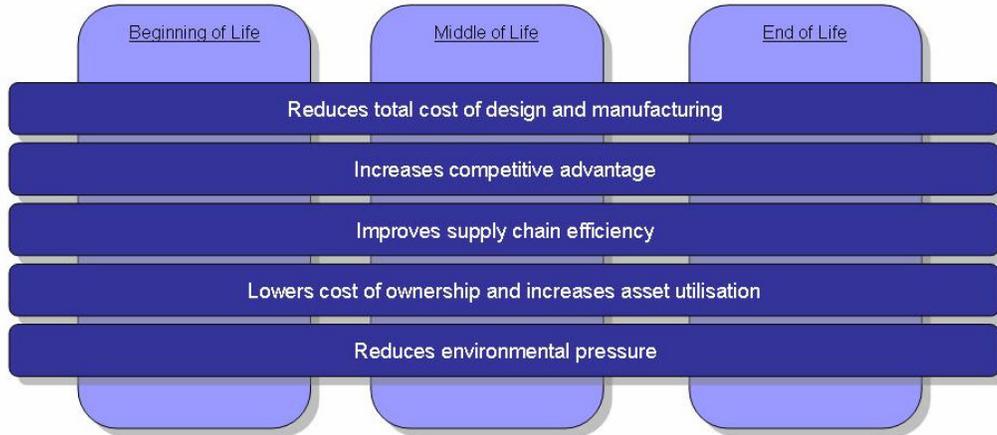


Figure 6: PROMISE business benefits