Deliverable D5.1

Dissemination and Use Plan

1. Identification

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1.1 Abstract

This deliverable describes plans for the dissemination of knowledge gained during the work, and (to the extent that this can be foreseen at the beginning of the project) the exploitation plans of the results for the consortium as a whole, or for individual participants or groups of participants. It expresses in concrete terms dissemination strategies, the target groups and the strategic impact of the project in terms of improvement of competitiveness or creation of market opportunities for the participants.

The Dissemination and Use plan has its counterpart at the Technology Implementation Plan (TIP), which is written at the end of the project. The TIP will describe the participants' actual achievements in dissemination and their plans at that time for the exploitation of their results. The TIP will where appropriate refer back to the original Dissemination and Use plan, indicating how the foreseen activities actually took place, or were modified in the light of circumstances, or where indeed other actions and measures, initially unplanned, were introduced.

1.2 Keywords

Dissemination, Implementation of Results, Marketing, Metrics

1.3 Version history

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1.0	20.3.01	Zeidler, ABB	First draft
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1.4	17.04.01	Zeidler, Müller, ABB	ABB refinements
1.5	19.04.01	Zeidler, Müller, ABB	Refinements of partner’s contributions: OTI, FZI, UniBe
1.6	24.04.01	Zeidler, ABB	Minor corrections

1.4 Classification

The classification of this document is done according to the security / dissemination level categories stated in Annex I (page 35) of the PECOS contract:

Classification	*Dissemination level*
Public (PU)	Public
Restricted (PP)	Restricted to other programme participants (including the Commission Services)
Restricted (RE)	Restricted to a group specified by the consortium (including the Commission Services)
Confidential (CO)	Confidential, only for members of the consortium (including the Commission Services)

1.5 Disclaimer

The information in this document is provided as is and no guarantee or warranty is given that the information is fit for any particular purpose. The user thereof uses the information at its sole risk and liability.

2. Table of Contents

3. Dissemination and the Use Plan for the PECOS Project

In summary, the innovation of the total project is far more than that of the sum of its parts. It is only through the integration of the individual results that the software development paradigm of embedded systems can be shifted towards components, software reuse is enabled, and component-based software may run on embedded systems. While this project goal summary described in Annex 1 depicts the overall anticipated achievements and benefits the individual goals and business benefits of the consortium partners are exceeding the technological goals with the manifold business and organisational goals, activities, and perspectives as well as dissemination. Therefore each consortium member describes the dissemination and the use plans individually to stress the organisational and business goals.

4. ABB

ABB moves from Electrical Engineering Company to new-economy "knowledge" company with special focus on process and manufacturing automation and the related equipment. Thereby various application domains with very specific needs and domain specific regulations are addressed. The Business Unit ´Instruments´ (BUI) develops a large number of different field devices, e.g. transmitters for measuring temperature, pressure, flow and actuators, positioners for transmitting a torque to a valve.

At the *field device leve*l, ABB has to develop, throughout its entire product range, intelligent instruments that provide inherent features for measurement, acting, tracking instrument performance, status and maintenance history. The new Asset Optimisation approach allows preventive maintenance through early detection of degrading functionality. Also features for configuration, maintenance and fast set-up procedures over remote engineering as well as local human machine interfaces are more and more important for the market success of field devices.

At the *communication leve*l, ABB has to support customers in the broad selection of instrumentation and associated communication protocols that best fit their application. ABB has to ensure compatibility of its products (instruments, systems and engineering tools) with the emerging fieldbus standards (Profibus [Profibus] and Foundation Fieldbus [FF]). Fieldbus is a powerful technology that enables the wealth of information available in intelligent field instrument to be accessed and then utilized in innovative preventive maintenance and asset optimisation schemes.

In 1999 the Revenues of the Business Unit Instrumentation were found to 770M USD. See Table 1 for the related Sub Business Units (SBU´s) and geographic locations, sorted by their impact on development and business of the BUI. It could be easily seen that the development of the field devices is run with in the EC countries and therefore directly contributes to the growth and prosperity of the European regions.

Table 1 SBU´s and Locations of BUI

Sub Business Unit	**Locations**
Flow	Germany, UK, USA
Pressure	Germany, Italy, USA
Valves, Actuators, Positioner	Germany, UK, USA, Japan, India, Italy
Controller & Recorder	Germany, UK, USA, Brazil, India
Temperature	Germany
Total Flow	USA

4.1 Motivation

Today, software already dominates the development and maintenance costs of field devices. However, today's field device software is monolithic developed specifically for each field device type. Monolithic software prevents the BUI to serve the field device market with value-added features in a cost-efficient way, e.g.:

- Same functions needed by different field devices are implemented repeatedly at different development locations in different ways.
- Functions and modules are implemented for a specific environment with no standardized interface.
- Long development time (up to 2-3 years for a new device).
- Regression-Tests after software modification are often large scaled because of non-deterministic side effects.

- The monolithic software has a fixed functionality that is hard to understand, to maintain, to extend, and to customize.
- Improve the development by using visual development environment.

The software reuse within the BUI is very limited – activities to build up common solutions for the field devices electronics and embedded software leads to the result that standardising only works on the infrastructure level (e.g., micro-controller, RTOS, Development tools). On the other hand it was found that many software modules on a higher level nearly fulfil the same requirements (e.g. Fieldbus function blocks, Persistence, Human machine interface), but there are no techniques available to package, connect and handle these module variations effectively. Thus the ongoing software process improvement activities are missing a reasonable foundation on top of that they could implement a significant software development improvement and increased business success.

4.2 Business Goals

Before outlining the business goals it should be explicitly stated, those technical goals and their achievement are the prerequisite to achieve those business goals. Therefore it approach of ABB within PECOS is already centred towards those business needs and will be over the time adapted and refined according to the changing business needs. The business goals of ABB BUI are two folds. On one hand motivated with business needs and forces like:

- expand the market position BUI
- clear distinction to competitors
- realisation of smart field devices
- deliver new device generations in shorter time to markets
- reduce cost of sales for the devices
- enhance the visibility and marketing of ABB products by publication of PECOS results

On the other hand more technical nature and therefore closely related to the promises and abilities of component orientation like:

- provide innovative solutions to the field process. Introduce a flexibility and quality of field device functionality, which is unique on the market by adaptable configuration on top of co-operating components.
- fulfil the interoperability and certification requirements of fieldbus standards. Possibly define components for communication, which could reduce the efforts needed today for field device certification.
- carry out a seamless system integration. Introducing a technological approach, which scales up for the complete enterprise modelling and support the integration of all levels of industrial activities.

The following sections elaborate the different points and discuss the expected results and possible business perspectives in more detail. Subsequently the cost savings achievable by application of PECOS' results are discussed. Finally steps and activities planed by ABB BUI are presented, which goes far beyond the scope of the PECOS project.

4.3 Expected Results

The direct solutions out of the PECOS project would be used as one technical strategy for addressing the listed business goals by the known component ware benefits:

- software reuse,
- better maintainability,
- improved flexibility,
- improved quality,
- improved time to market and
- reduced cost of development.

Accompanied with the ABB Software Process Improvement Initiative (ASPI) that forms a basis for reasonable improvements likewise for the ABB BUI's products and the development processes as well as the change in organisational structures.

In the following the expected benefits are listed according to the prior mentioned categories.

BUI's Product Improvements

The Business Unit Instrumentation expects the following improvements for their field device products:

- Highly efficient and reliable component based implementation

Improvements for the software characteristics:

- customisable
- reusable
- updateable

- portable

BUI Process Improvements

For the development process BUI expects from the PECOS project:

- A first small repository of domain specific components for field devices
- Introduction of concepts on the fly to actual product development cycle
- Support for development of components on different platforms with different programming languages like C, C++ and Java
- Support for development of different variants of components for different products
- Support for development and maintenance of different versions of components for different product versions.
- Support for a fast, save and easy to use construction of component based field devices (Constrain Checking, Rule Checking, Graphical Composition)

Organisational

- Reorganisation of the BUI development process with cost savings stated in section 4.5.
- Applying the statements of Ivar Jacobson [Jacobson1997]: a component is 3 times more expensive than a strait forward development to BUI, which has 80 products organised in 10 product families, which utilise 25 software platforms in 7 product families we can calculate:
  - Component reuse within a product family: we can assume that components reused within a product family gain ca. 70% (1-3/10) cost savings
  - Component reuse within all products of BUI reuse within the whole product range (assumption components for the entire BUI has 5 times higher costs) 93% (1-5/80)

4.4 Planed Products developed with PECOS technology within ABB business unit 'Instruments'

BUI produces about 80 of field device types on about 25 different software/electronic platforms.
Publicised as Field^{IT} ABB has several strategic goals for field devices:

- Compatibility with standard field busses
- Exploitation of intelligence in devices
- Asset optimisation of devices (e.g. Maintenance prediction)
- System integration of devices
- Integrated and streamlined engineering
- Streamlined workflow for devices

Generally there are six constraints bound too any field device development project:

- Product Unit Cost
- Cost of Development
- Power Consumption
- Safety areas (ex)
- Time to Market
- Product Functionality
- Project Risk

These constraints are interacting in almost every dimension. Any attempt to improve the condition of one of the constraints, will result in a penalty with one or more of the others. There are strong trade-off´s among product unit cost, time to market, product functionality, and cost of development. Whether or not the device must be bus powered will affect the design effort in terms of development time and cost, and may have an impact on functionality.

In the *first step* BUI will use the PECOS techniques for the *PROFIBUS PA/DP* [Profibus] device families. These devices are not limited to the 10mA power restrictions. These are CONTRAC, ONTRAC, COPA, MAG, TRIO-MASS, TRU-MASS, VORTEX, SWIRL. The electric actuator ONTRAC is already defined as the case study device for the PECOS implementation. In the second step (with the prognostication of available 32-Bit micro controller for this low power domain), BUI will use PECOS for the development of PROFIBUS PA [Profibus] and Fieldbus Foundation [FF] device families: 600T, 2000T, TZID-F, TF12, TF212, COPA, MAG, VORTEX.

4.5 Estimated cost savings and business earnings

1) Cost savings for building and expanding a field device
With PECOS, in generally, the ´building of new devices´ will change to ´compose and expand existing solutions´. By producing around 8 completely new devices every two years and the constantly expansion of about 70% of all field devices the savings are estimated to ≈: 1.5M$/year

2) Cost savings for maintenance
Today about 10..20% of R&D, with PECOS estimated: -50% ≈ 0.8..1.5M$/year

3) Cost savings for training
Today about 1.5 to 3 years needed for the training of a new embedded software developer, with PECOS estimated: - 20% ≈ 200K$ / year

4) Cost savings for electronic design
By using the ´Non functional properties out of the PECOS Repository the effort for determine the electronic requirements and risk analysis's could be decreased to about -20% ≈ 150K$ / year

5) Cost savings by faster system integration
By generating device descriptions (e.g. DTM, DD) for the engineering tools (e.g. FDT; AMS, NI-Configurator) out of the Composition Environment cost savings could be estimated to: -40% ≈ 250K$ / year

6) Costs for component development
Estimated to 900K$/year, 400 K$ for BUI R&D staff, 500 K$ for special component developer.

7) Revenues by early Time to market
By getting 1% more customer contracts by an earlier time to market with PECOS development BUI will obtaining more revenues of about: 7.7M$ / year

Table 2 Summary of savings per year

	Savings in $ / year
Cost savings for building and expanding	1.5M
Cost savings for maintenance	1.15M
Cost savings by faster system integration	250K
Cost savings for training	200K
Cost savings for electronic design	150K
Cost´s for component development	900K
Revenues by earlier Time to market	Earnings 3M (7.7M Revenues)
Overall savings / year	**7,15M$**

Through continuous tracking of cost and progress we assume to prove the estimated cost savings on the short and long term basis by applying metrics outlined in the next sub-sections

4.6 Contribution to ongoing activities

PECOS results will also contribute to the following project of the ABB business units 'Instruments':

4.6.1 The common fieldbus platform project (CFP)

As ABB internal project BUI is actually working on common electronic and software solutions for the fieldbus devices. First outcomes are: common micro controller for the fieldbus devices, common contract for the fieldbus stack supplier, common software development environment (Compiler, Emulator, Test-Tools). CFP is one organisational instrument to disseminate the solutions from the PECOS project within the BUI.

4.6.2 Improving the software development process (ASPI)

ASPI is an initiative by Corporate Research and the ABB business areas with the goal to substantially improve and harmonize the way of software development in the R&D departments of ABB with two goals:

1. Harmonize processes, methods and tools to be used in R&D software development throughout ABB
2. Create a culture of continuous self-improvement in the R&D software development departments with the goal to work on an efficient and mature process level.

Recently the ASPI Team reached a consensus on a *common project management model* for software development within the software development of ABB Automation. The newly established *process responsible unit (PRU) for software development* will introduce the project management model within the development organizations ABB wide.

4.6.3 Seamless system integration

Field devices are integrated within the automation process by fieldbus connections with which distributed digital programmable controllers can be networked, from field level to cell level. The joint operation of several automation, engineering and visualization systems with their distributed peripherals is the key features of these techniques. To get sophisticated solutions in this customer area BUI has initiated a project task with the Business Unit ´Control´ with the goals to closely fit the requirements and constantly include the results out of the PECOS project in both key areas of the automation process. Thereby ABB's Corporate Research plays a central role of knowledge pool and will act as multiplier for ABB.

5. Forschungszentrum Informatik Karlsruhe

The research institute FZI as non-profit consortium partner is in charge of external information dissemination about the project results. The Program Structure group of FZI (PROST) in charge of running the project is disseminating via three different channels:

- **Dissemination to industry:** PROST will use the additional expertise gained in the PECOS project within its technology transfer tasks to industry focussing on the region of South Germany. In particular, the close link to the software industry established in the past years enables a fast regional exploitation. This will be carried out mainly within consulting projects and various national and international projects in which PROST is involved in and is expected to be involved in.
- **Dissemination to academia:** PROST will disseminate the project results in several conferences. PROST will continue to work on the PECOS methodology also after the end of the project and will always publish the latest results in academic conferences or journals.
- **Dissemination to students (teaching)**: Due to its co-operation with the University of Karlsruhe, PROST will transfer the experience and results to the university in order to provide a high level of teaching of students and participants of the continuation courses. In particular, lessons learned of the projects will be used in the lectures on “Software out of components” and “Compiler technology”, both given by the group of Prof. Dr. Gerhard Goos at the University of Karlsruhe.

The dissemination via these three channels also increases the business opportunities of PROST: The dissemination to industry increases the visibility of the group in order to enable the group to acquire challenging projects with industrial partners. The dissemination to academia increases the academic visibility of the group and thus makes it easier to get the interest of high-potential people to work for PROST. Finally the dissemination to students by teaching educates the students to become high-potentials. To sum it up: PECOS makes it possible to attract

- qualified people to work for PROST and
- innovative customers with challenging projects to work with PROST.

In fact, we expect to acquire at least three projects and get one new scientist because of our participation in the PECOS project.

Of course, the participation in PECOS is not by chance but it follows the groups clear strategy to extends its fields of competence: Take existing experiences and technologies and evaluate them in new fields of application to move them one step further. In PECOS the existing experiences and technologies came from two fields of competences:

- Software reengineering: During the FAMOOS projects we developed methods and tools for analysing, visualising and reengineering existing software systems. The knowledge we gained there are used and extended in the composition environment (e.g., source code analysis, glue-code generation) and the meta modelling (e.g., models for component systems).

- Software composition: During several projects with industry (e.g., IBM, ABB, CAS) and with the university of Karlsruhe (e.g., COMPOST) we developed a profound knowledge in using components in "unrestricted" (e.g., in terms of memory, speed of processors, power consumption) distributed environments. Since building software for embedded devices is a field of rapidly growing importance, we want to transfer this knowledge to the embedded world.

This is also reflected in the fact, that PECOS provides an interesting basis for PhD research. Two topics which are currently being researched into in the framework of a PhD are code transformation and generation techniques as well as software system modelling. Both topics are very central in the PECOS project. PROST expects that the PhD research of the current participants and future PhD students will directly benefit from the project results and from the experience gained during the project. Furthermore, the project and its results are expected to provide a sound basis for more far-reaching research in the area of component-base software development.

6. Object Technology International

OTI's primary business is the development of OO component based (embedded) software development environments. The current set of tools is marketed through IBM as IBM VisualAge Smalltalk(TM) and IBM VisualAge for Java (TM) for personal computer, server and mainframe worlds. For the embedded market, OTI has developed IBM VisualAge Micro Edition (TM).

IBM VisualAge Micro Edition(TM) contains four main components. First, there is an advanced Integrated Development Environment (IDE) to develop embedded applications. Second, a repository supports the development process by allowing versioning, sharing and storage of source files and resources. Third, a set of tools such as a remote debugger, a remote profiler and a packager can improve the quality of the software produced. Finally, IBM VisualAge Micro Edition (TM) supports multiple Java Virtual Machines for a variety of platforms to deploy embedded applications.

IBM and OTI continuously update their product lines and produce the next generation of their development tools. One such evolution is based on a common workbench and has extension points for multiple languages and target platforms. This new IDE framework is based on an open environment that leaves enough flexibility to extend basic functionality with specific user-defined features. Therefore, OTI feels that this framework is very well suited to be used as the basis upon which PECOS-specific tools can be built.

6.1 Business Goals

The business goal for OTI to participate in the PECOS project is to increase its market share in the rapidly growing world of software development tools for embedded systems. OTI wants to achieve this by adapting a component-based software development methodology and integrating that with the current (or forthcoming) set of OTI and IBM development tools. And furthermore OTI hopes to provide its users with an option of developing hybrid Java and C/C++ applications. This would allow enjoying the benefits of fast and less error-prone application development provided by Java without losing the ability to meet the severe hardware constraints (power, size and peripherals) that embedded devices impose.

For the next-generation of tooling, OTI is especially interested in heterogeneous deployment in the embedded systems domain. OTI envisions a ultra-light component deployment environment that encapsulates both C/C++ and Java seamlessly working together.

6.2 Expected Results

As direct results from the Pecos projects for OTI's business goals, OTI expects the following:

- A Java runtime in the embedded systems domain including:
    - A working port of the J9 Java Virtual Machine to field device as specified for the PECOS project
    - Experience with porting Java virtual machines to hardware-constrained devices in the embedded systems field.
    - Dynamic installation and deployment of Java components in an ultra-light runtime environment.
    - Exploration of real-time Java for embedded devices.

- A heterogeneous runtime environment that provides:
  - Dynamic C/C++ component runtime environment.
  - Integration facilities between C/C++ and Java to make them interoperable.
- Extensions to OTI's development tools targeted at component-based software development for embedded systems.
- Extensions to OTI's development tools that allow designers to manage non-functional constraints such as real-time deadlines and power consumption limitations.
- Increase the number of European partners using OTI technology in the embedded and real-time systems market.

6.3 Dissemination of results

OTI will disseminate the results as described above through a variety of channels both inside and outside of the company. OTI has established a set of European Partners (including Ericsson, Microdoc, Turnkiek, and IBM Germany, with discussions ongoing with Santini, Becker, VDO, ENEA, and Audi) to commercialise the technology. We provide educational material to partners so that they may establish courses to aid in the dissemination of the results. In particular, Microdoc, in Germany, has been offering courses based on this material. In addition, information about porting the Java VM in the form of a cookbook will be disseminated internally in OTI, and provided to certain partners.

The tools that OTI builds for the PECOS project will become available - either directly or after further development - in upcoming releases of OTI's and IBM's development tools or as separate extensions to the current development suite. Since OTI is a commercial technology provider, bringing the tools developed for PECOS to new customers will increase its market share for the embedded systems and allow it to enter the field device market. OTI is going to use advertising at conferences, seminars, the web, magazines and books to increase the visibility of component-based development to potential customers.

Although OTI/IBM is an international company and thus the use of the results will not be restricted to Europe, the main expertise will develop in the laboratories in the Netherlands and France. This will facilitate more direct support for European customers and the opportunity of entering new, close partnerships within the European commercial and scientific community.

As a result of the dissemination efforts, OTI expects an increment in the market share of OTI and IBM technology in the embedded system and field-device market of 15% in the next few years. In addition, with the technological advances provided by PECOS OTI can enhance its image of being a trusted and innovative provider of complete and flexible Java solutions for the whole range of systems: from large mainframes to small and specialized devices. Although many other developments play a role and it would thus be meaningless to put a figure on the direct effect of PECOS it will definitively help OTI to improve the position of any of its Java products.

7. University of Berne

As a University research partner, UNIBE intends to use the PECOS project as context for a new generation of PhD students and university students, and to disseminate the results in several conferences.

UNIBE has a strong tradition of PhD students working in the context of European projects with industrial partners. This is continued by the PECOS project, that provides a perfect working context for such important research topics as component mining and composition of non-functional requirements. The PECOS project allows these PhD students to test their results and solutions on concrete cases and problems.

The academic visibility of UNIBE will be raised by publishing the results of the research performed in the context of PECOS in academic conferences, workshops and journals. Several publications, based on results obtained in the PECOS project on the meta-model and component architecture, are currently being prepared for important conferences such as ECOOP (European Conference on Object-Oriented Programming) and OOPSLA (Conference on Object-Oriented Programming, Systems, Languages and Applications). As the project continues, advanced results on component composition and reuse will certainly yield more publications.

As soon as the material is mature enough, it will be used as foundation for tutorials presented at major conferences (such as ECOOP and OOPSLA). It will also be used in courses for Master's Students, where research results are typically used in the more advanced courses. This approach is the same as what was done with the results of an ESPRIT project that Unibe previously participated in. OOPSLA tutorials like 'Object-Oriented Reengineering and courses like 'Software Reengineering' were the result.

8. References

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