

Practical experience in the introduction of industrial environmental information systems on European level

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Abstract

CAEMIS (Computer Aided Environmental Management and Information Systems) ist ein Technologie Transfer Projekt im Rahmen des Innovation Programmes der Europäischen Kommission (DG XIII). Hauptziel ist der Transfer umweltrelevanter Anwendersoftware und Beratungs-Know-how in andere EU-Mitgliedsstaaten und Industriebranchen. LMS Umweltsysteme, ein österreichisches Software- und Beratungshaus repräsentiert dabei den „Technology Provider,„ Partner sind je ein Beratungsunternehmen in Dänemark, Irland und Spanien. Dabei erfolgt die Einführung der Umweltsystemlösung durch die Implementierung der Software bei drei industriellen Anwendungspartnern. Der dafür entwickelte Innovationsansatz wird vorgestellt und die Erfahrungen bei der Systemeinführung werden diskutiert. Als Ergebnis kann eine standardisierte Systemfunktionalität in mehreren europäischen Sprachen erwartet werden. Sie stellt ein Unterstützungswerkzeug für Umweltmanagement-Systeme dar, das in den Referenzinstallationen an die Individualanforderungen angepaßt wird. Parallel dazu wird das CAEMIS-Partnerschaftsmodell entwickelt, um in weiterer Folge als umfassender europäischer Lösungsanbieter für die Fachbereiche Umweltschutz und Arbeitssicherheit auftreten zu können.

Based on a Technology Transfer Project within the EC-funded Innovation Programme (DGXIII) industrial environmental information systems have been introduced on European level during the last two years. The main focus of the project, called CAEMIS (Computer Aided Environmental Management and Information Systems) is the transfer of environmentally related software and consultancy know how to other EU-member states and industrial sectors. LMS Environment is an Austrian based software house and acts as the Technology Provider co-operating with three Intermediaries (Consultancies) from Denmark, Ireland and Spain. Technology assimilation takes place by introducing the environmental business solution at three industrial user sites. The innovation and the experience gained during implementation will be presented and discussed. As a result of the project effort a standardised system of functionality as a support tool for environmental management in several European languages can be made available with reference installations at three user sites. This offers an excellent basis for the further development of the CAEMIS partnership as a European solution provider for management systems in the application field of Environment, Health and Safety.

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1. Introduction

Specific environmental policy developed in Europe during the 70's was driven by the emerging green movements and growing concern of the society. The primary focus of these policies was reduction of emissions to air and water and reduction of waste. Forced by legal obligations, industry reacted to policies by applying „end-of-pipe,, technologies and execution of relevant technical measures. This resulted in a considerable reduction of high-level emissions but it became obvious that this policy would not solve the long term environmental problems and that only a major change in strategy would induce considerable impact in solving the problems. The concept of „integrated pollution prevention and control,, was introduced with focus to the origin of the emissions in the process itself. This requires detailed planning and engineering taking into account technical, economic and environmental parameters.

At the beginning of this transition to preventive measures in the early 90's LMS Environment (LMSE), a software and consultancy company from Austria launched an applied research project within Austrian industry. The general focus was to develop planning techniques and software tools for industrial enterprises supporting decision making for environmentally-related investments and in production control. Based on detailed requirement analyses, the advantages and needs for such concepts have been investigated and clearly defined. A comprehensive functionality has been deduced to support a variety of tasks on operative and strategic levels.

This concerns for example, management of hazardous materials and waste, management of risks related to processing units and installations, controlling of emissions to air and water and monitoring the stream of materials and energy throughout a production plant. Several successful projects have been carried out within Austrian industry whereby the planning techniques were adapted and software pilot installations were made (Kürzl et al. 1994).

During these projects it could be observed that overall success in reducing environmental impacts and increasing economic gains can only be secured if organisational structures and relevant management skills are developed accordingly. Without considerable integration of the new environmentally-related tasks into the whole organisation and the development of respective awareness in personnel, improvements achieved in environmental performance are not sustainable (Kürzl 1995).

EU Policy has also gained momentum in the „sustainable,, direction and appreciated the approach towards more market driven instruments and self responsibility. With the introduction of the „EU Regulation No. 1836/93 allowing voluntary participation by companies in the industrial sector in an European Community eco-management and audit scheme,, this concept received a formal basis followed by ongoing standardisation efforts by the ISO and CEN committees.

LMSE has introduced this new concept to industrial companies and has developed its techniques and software tools accordingly to these new concepts with the

extension to Health & Safety, so that a complete EH&S Solution has emerged. The chances offered at this development stage concern the transfer of considerable experience and a transition from „client-specific,, software to standardised procedures, techniques and tools at a generalised level, which can be applied to a broad variety of industrial sectors as well as being adjustable to national obligations and EU-Regulations. The maturity of the LMSE software solution seemed to be quite right to apply for a project within the EC-Innovation Programme.

The effort resulted in the CAEMIS (Computer Aided Environmental Management and Information Systems) Technology Transfer Project (European Commission, DG XIII, 1996) which plays an essential role in transferring the results of applied research to the European market. It lays the pathway to technology standardisation and dissemination. It is placed within the concept of transnational cooperation in form of partnerships and specifically serves European industry in managing the environmental challenge.

The Definition Phase started in January 1996 with an EC-supported workshop in Luxembourg. The framework of the Technology Transfer Project was presented and a goal-oriented analysis for the CAEMIS concept was performed with delegates of the newly-formed consortium of environment, health and safety specialists. The tasks and critical pathways for the Definition Phase were defined and a work plan established. With the establishment of the final feasibility study as well as business and working plans the Definition Phase has accumulated in the preparation of the Final Report defining the forthcoming so called Demonstration Phase of the project.

2. Objectives

Innovation with two types of basic technologies takes place within the CAEMIS project. Information Technology (IT) as a key technology plays the dominating part. The other concerns business engineering and planning technologies applied to environmental management systems. Further developments of these two technologies and their optimised integration will lead to new products and services for industrial and commercial enterprises.

Accordingly a variety of objectives have been defined in close cooperation with the project partners. The following summarises the main objectives in relation to the Technology Transfer and implementation.

The IT innovation envisaged offers a variety of opportunities in arranging and optimising business processes as well as information flows within commercial enterprises and industry. Environmentally-related tasks are new and need detailed definition and integration into the existing organisation. Innovative approaches have to be further developed in fields of business and information engineering like:

- system support for optimised work flow in organisations

- efficient dissemination of information in decentralised structures
- user driven data aggregation and analysis on pre-defined enterprise levels
- decision support by certain data views on operative and strategic levels

Technology Assimilation within the CAEMIS project takes place on two levels. The first concerns the introduction of software to the Intermediaries (Consultants) in relation to environmental process engineering and use of software tools. The second level of assimilation refers to system implementation at the user sites. This process takes place with detailed support of LMSE as the Technology Provider, but in close cooperation with all the other project partners.

In an horizontal sense of view, assimilation of the basic technologies (IT and environmental engineering) will take place and are directed to industrial environmental management. This means especially incorporation of partners experience and know-how. Within this process, it will be possible to transfer and further develop the basic technologies into a successful applied technology dedicated to problem-solving and efficient support of environmental management. The detailed objectives of the assimilation tasks will be the following:

- training in concepts and use of environmental software tools
- introduction to system integration and data modelling
- compliance of relevant national and EU Regulations and Directives
- adaptation to local requirements and EU (international) standards
- establishment of a requirement analysis for management systems with the pilot users
- development of a functional specification for the system
- systems adaptation and operative test runs
- training and documentation of necessary routine procedures

For LMSE, as the Technology Provider, one of the most important objectives within the CAEMIS project is the transition of the strongly user-oriented solutions, to „packaged„ software tools, which can be easily distributed via a solution provider scheme. This requires standardisation of procedures and functions as well as new types of user interfaces, allowing customisation with a minimum of IT competence. Besides this product concept, the further important objective is to develop a partner programme, securing top professional services and support from the Technology Provider to the Intermediaries and to the Industrial User.

In general all businesses, especially industrial companies are concerned with environmental, health and safety regulations and thus, are potential CAEMIS clients.

At the time, LMSE has experience in implementing within medium to large enterprises mainly in the manufacturing industries. The principal objectives of diffusion are therefore horizontal to other sectors as well as vertical to SMEs. The Technology Transfer Project provides the opportunity to approach new regional markets and sectors within the EU with the possibility of further diffusion to other EU member states outside of the project. The following objectives have been defined:

- establishment of the CAEMIS Partnership Network
- development of a partner service and training scheme
- promotion of an European-wide CAEMIS User Group Association with regular publications and official meetings and conferences

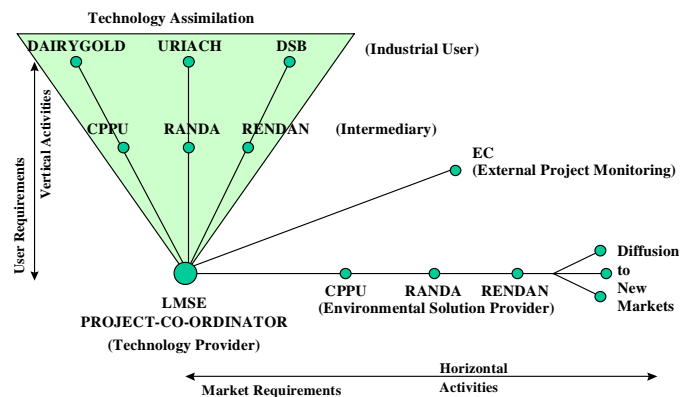
3. Project Realisation

The project work for the Demonstration Phase started in October 1996 with a workshop for detailed planning and the establishment of a framework as a basis for the individual partner implementation projects and is planned to last 30 months.



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PARTNERSHIP AND PROJECT STRUCTURE



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Figure 1
CAEMIS project participants and activity structure

The project structure is presented in Figure 1. LMSE Austria acts as the project co-

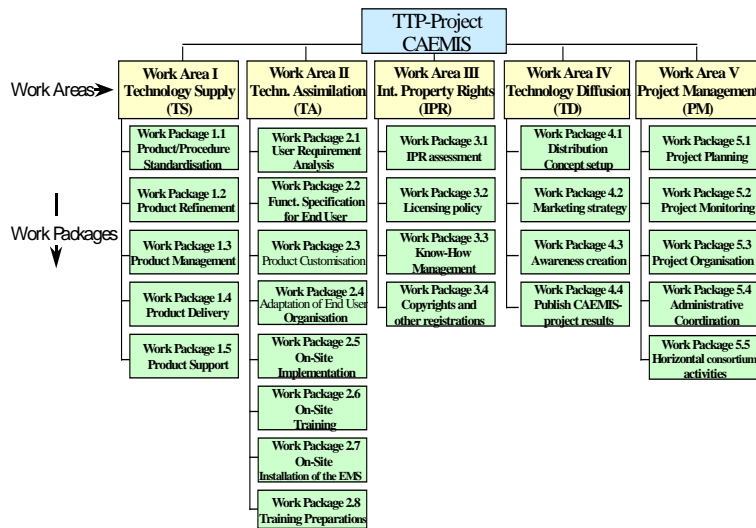
ordinator and Technology Provider. The Intermediaries are represented by the Cleaner Production Promotion Unit (CPPU) of the University Cork, Ireland, Randa Group S. A. a consultancy company from Spain and RENDAN, the Danish Environmental Management Centre, all active as environmental consultants. The Technology Provider and the Intermediaries represent the CAEMIS Partnership. Each Intermediary takes care of the Industrial User as an associated project participant, where the CAEMIS implementation will take place. The user in Ireland is Dairygold, a Co-operative in the Dairy-sector with high technology milk processing. In Denmark it is Banelystensen, a maintenance company within the Danish Railways and in Spain Uriach S. A. a pharmaceutical company.

Besides the participants Figure 1 also shows the activities to be performed within the project. The Technology Assimilation takes place in three different projects between the Technology Provider and the individual regional partners and is presented as vertical activities. The horizontal activities concern the diffusion to new markets which will take place in form of a common partnership established during the project between the Technology Provider and the Intermediaries.



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WORK AREAS AND WORK PACKAGES



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Figure 2
CAEMIS project structure

The whole project structure is shown in Figure 2. It consists of 5 main working areas each further divided into several work packages.

The Work Area Technology Supply is mainly a task for the Technology Provider concerned with product development and generation of product services. It represents the basis for Work Area II Technology Assimilation. The consultancies are establishing the user requirement analysis and the functional specification as a basis for product customisation and implementation at the industry user site. This will be completed by the physical installation of the software system and the industrial user training.

Work Area III is concerned with Intellectual Property Rights, (IPR), a topic which becomes more and more important as the project progresses and know-how and software tools are developed. For the IPR assessment external consultancy is required as well as for copyright issues and the licencing policy.

Besides Work Area V, which deals with project management and project organisation, Work Area IV is concerned with Technology Diffusion. In addition to the three reference installations and the know-how transfer a major concern of the project is the development of a European wide market for EHS-Solution. The preparation work is done in this Work Area. It deals with awareness creation, publications and development of a marketing strategy and distribution concept.

The project has passed its mid-term and focuses now on the reference implementations and technology diffusion.

4. EH&S System Innovation

4.1 The four step innovation process

To focus on the IT-related core process of the project there are four major steps in the innovation process as presented in Fig. 3.

Starting with a user's need for IT-tools to efficiently meet external requirements derived from either regulative or voluntary targets, broad experience and the latest in PC-based client/server technology are combined to develop tools, techniques and methods that lead to IT-based solutions of generic management systems. By achieving compatibility with these management systems, new requirements lead to new components as the improvement cycle continues.

First step:

User Requirements and Technology Foundation: This is the basis for the innovation. User requirements are met by building applications on top of the Technology Foundation. The Technology Foundation itself ought to comply to widely accepted standards.

Second step:

Applied Technology: This is the actual application building process. Functionality and features are implemented to form the LMS E1 as an environmental information and management system.

Third step:

Transferable Components: To make the application transferable, it must be divided into components that can easily be plugged together and customised. Additional expertise and technology is required to optimise for implementation.

Fourth step:

Implemented Solution: The LMS E1 is successfully implemented at different industrial sites supporting specific requirements of the relevant users. Further experience in the use of the system can be gained serving as feedback to the innovation cycle.

The process of developing the system solution based on the industrial user situation and requirements is described in the following

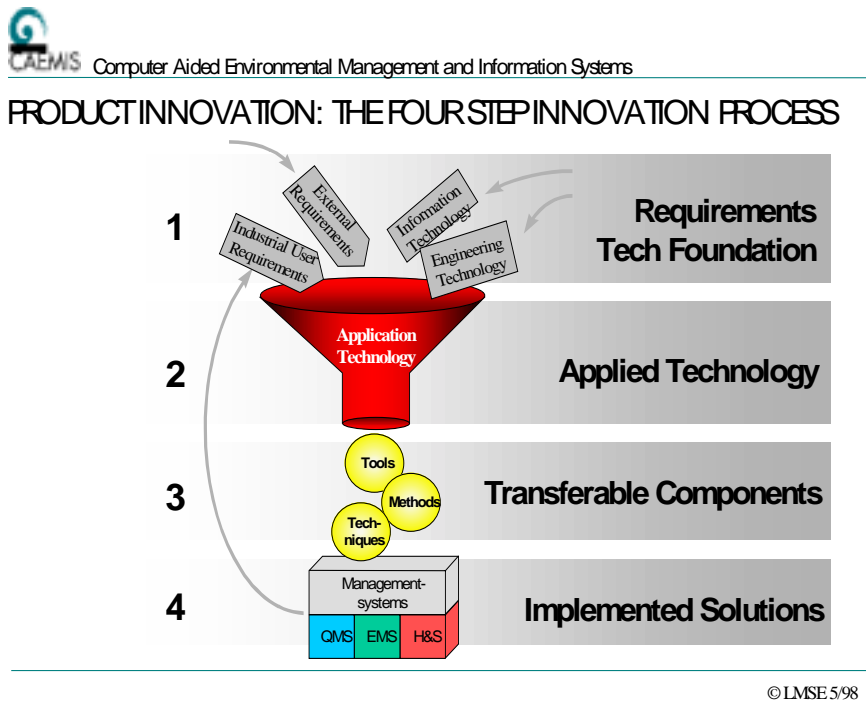


Figure 3
The four step innovation process

4.2 Situation at industrial site

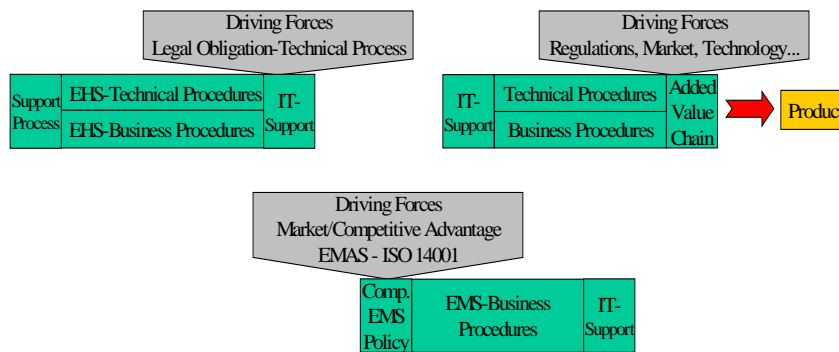
The principal initial situation is presented in Fig.4. The well established IT-support system for the Added Value Chain (AVC) processes assists the relevant technical and business procedures. Continuous business process reengineering is well accepted as driving forces like market, technology etc are constantly changing the production and product environment.

Environment, Health and Safety (EH&S) serves as a support process to the AVC and technical as well as business procedures develop in accordance with the occurrence of specific driving forces, especially legal obligations. EH&S business processes are not optimised in general and need detailed analysis, if an IT-System should be introduced. A task, which is often neglected, leading to suboptimized solutions. Further business processes are introduced by the implementation of an environmental management system. Experience shows that detailed integration of this newly emerging procedures needs additional effort and planning. Only detailed tuning of the procedures between the three systems can lead to business success, customer satisfaction and efficient support by an IT-solution.



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PRODUCT INNOVATION: SITUATION AT INDUSTRIAL SITE (MANAGEMENT PROCESS)



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Figure 4
Situation at industrial site with the three relevant management domains and their procedures

4.3 EH&S Business Solution

The whole resulting business solution will be continuously further developed. It consists of a detailed requirement analysis followed by business process engineering in the three business areas. Here work flow, information flow, relevant data and organisation is defined accordingly. It will be completed by the customised IT-application tools.

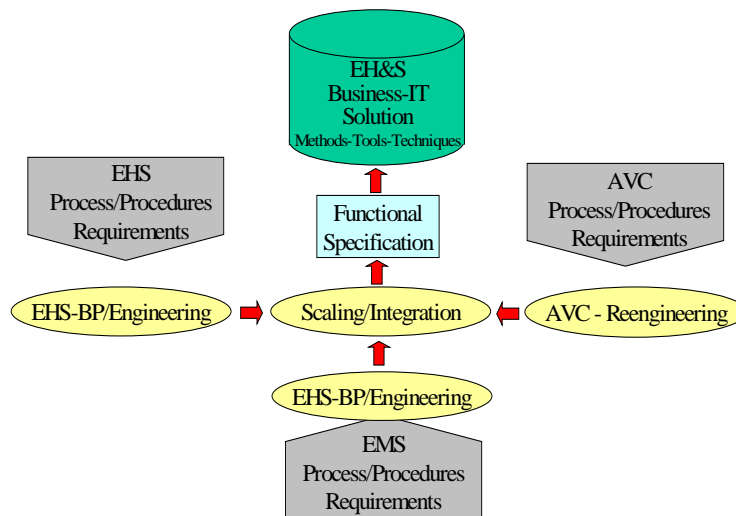
Fig. 5 illustrates the process of the EH&S-business solution generation in detail. Based on the user requirements and the results of the process engineering the general architecture of the system can be scaled and the depth of necessary integration defined. The comparison between the existing EH&S standard solution and the results of the engineering phase lead to the functional specification, which clearly describes especially the additional customising efforts for the individual system to be implemented.

As a result the EH&S-Solution, exhibits adapted methods for system engineering, the basic techniques of the technology foundation and the application IT-Tools, which have to be completed accordingly to additional specific requirements as defined in the functional specification.



CAEMIS Computer Aided Environmental Management and Information Systems

PRODUCT INNOVATION: EH&S BUSINESS SOLUTION



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Figure 5
EH&S business solution building process

The advantages of this procedure for EH&S systems engineering and implementation are manifold. They secure that

- the customer gets what he really needs
- the business procedures are optimised and integrated
- the IT-solution is integrated in the workflow and technical system environment
- and data can be made readily available for the information needs of the whole organisation

5. Evaluation of CAEMIS Results

5.1 The Implementation

The main challenge of the project is the transfer of a software solution developed for a specific national business environment to other European countries and specifically other market sectors. The requirement analysis in the different countries showed that the legal obligations in relation to the protection of the environment by industry are still varying significantly between the EU member states.

Austria has probably one of the most advanced legal systems followed by Germany forcing companies to take actions and implement organisational structures to cope with the situation. This can be seen as a ongoing process over the last twenty years and has been accepted as good practice over time. In many other European countries, the experience is not always so extensive and therefore the status and appreciation of the situation is quite different.

During the first project phase, dealing mainly with the analysis of requirements on the national and user level, it became apparent that the view to the process and business activities as supplied by the software was very new to the partners and users. This resulted in a much larger effort in collecting information and data and generated additional discussions and intense communication to establish the actual user requirements.

Initial deficiencies in transparency and awareness led to the appreciation that the system offered had only limited areas of application to the specific business organisations. However, as the user's business processes were analysed in more detail, it became evident that many processes could be supported by the software with substantial advantages and benefits.

By comparing the requirements and the system, individual „Functional Specifications, have been established for each user. The results showed that environmental tasks were not defined and engineered in detail on the operative level and that documentation requirements were mainly limited to external parties. Industry and company-specific forms and reports are individual, but the software systems

functionality has proven to be sufficiently extensive and flexible to deal successfully with national and local requirements.

However, by introducing an environmental management system, as an ongoing process, the specific workflow will be reengineered and documented. It presents a further basis for deeper system integration into organisation and operative procedures. The strategic aspects will also be further enhanced leading to new requirements in internal reporting (controlling) and representation of environmental information to the public. This specifically covers the requirements by e.g. „Integrated Pollution Control Licensing,, in Ireland or the „Green Accounting,, as defined in Denmark.

By comparing the five European countries where LMSE has gained implementation experience, it can be stated that the approaches to environmental management and relevant legislation are still quite different, thus resulting in different levels and resolutions of data acquisition, documentation and reporting.

The necessity of harmonisation in the European Union is quite evident and should be pushed forward on all environmental subjects as it was done with the European Waste catalogue for example. The CAEMIS project with its results could provide experience in collecting and representation of environmental data, leading to environmental data standards to be used for environmental management systems. The system allows continuous or periodical collection of these data leading to time dependent representations of data, thereby defining environmental performance of certain entity.

5.2 System Standardisation and Technology Transfer

A further major result of the project is a standardised software product for European wide use. One of the most important challenges encountered has been the availability of the software in different languages. The introduction of the technology for multilingual functionality, was a technical task, which could be realised in a straight forward way. The translation itself proved to be a much more difficult and time consuming task than anticipated before. The software was based on terminology generally defined in Austrian and German environmental legislation. The direct translation from German to the other project partners languages proved not to be successful. It was agreed to establish an English master version by the Technology Provider for further translation into other languages.

Even this approach showed that the terminology is very heterogeneous in the different languages. This is mainly due to the different levels of maturity in environmental legislation and standardisation where new terminology is continuously defined. Therefore one additional result of the project will be a glossary of environmental terms as used in the software in German and English language. It can be

extended also to any other European languages, incorporating detailed references to definitions of terms in legislation and other official documentation. With the additional efforts of the partners the software will be available in German, English, Spanish and Danish at the end of the project.

The technology transfer was supposed to take place on the technical (IT) level, the consultancy level and the application level. The requirements for an „environmental solution provider,, offering business consultancy and software are quite manifold and specific. It showed that transfer of this know how needs time and effort and extensive involvement of the partners.

Experience shows that it is difficult and costly for technology partners to develop and maintain this know-how for delivery to new customers. As a result, the CAEMIS Partnership has emerged as a network where all partners contribute their specific know-how to the business solution. This optimises utilisation of the know-how and adds value to each specific customer project. Besides the system implementation and successful use at the user sites, the establishment of the CAEMIS Partnership and development of an European-wide business model will be one of the most important results out of the project for future successful co-operation.

6 Summary and Outlook

EC-funded Innovation projects provide a solid basis for small and medium companies to establish European wide co-operation and business solution from individual innovative initiatives. However, the complexity of the technology transfer should not be underestimated. It results in an extensive project structure, which needs a very high communication level, advanced project management skills and competence in the innovative technology under consideration. For the CAEMIS project, a standardised system of functionality in several European languages as a support tool for environmental management can be made available with reference installation at three industrial user sites. This offers an excellent basis for the further development of the EH&S IT-solution as well as the CAEMIS Partnership as a European solution provider for management systems in the application field of Environment, Health and Safety.

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