Book Chapter

Title: Enabling Communities of Practice at EADS Airbus

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Enabling Communities of Practice at EADS Airbus

1. Knowledge Management

A practical definition of knowledge management demonstrates that it is - despite suspicions to the contrary - a well-defined business objective. To manage knowledge means to know (Wilma D. Abney, DaimlerChrysler Corporate University) what is known, who knows it, and how knowledge has been applied and how it can be further leveraged and shared. The task at hand for managers and employees alike is to enable the access to and sharing of information, to leverage expertise and to control information pollution. Key elements of knowledge management are the management of intellectual property (patents and rights), the gathering of information in databases, and the establishment and support of *Communities of Practice* (Drucker et al. 1998).

Communities of Practice consist of people with a common interest who interact to share information and to solve problems in their area of expertise. Communication, both formal and informal, is the main driver of success in a Community of Practice (CoP). Communities of Practice are not static, but evolve and adapt continuously to changes in their knowledge domain. With time, CoPs not only generate their own identity but also shared artefacts. An example for this is the Electronic Book Of Knowledge (EBOK) in the Chrysler group. The EBOK is an important component in the CoP process that documents the knowledge of the CoP members in the form of Lessons Learned or Best Practices (Wenger, Snyder, 2000).

The establishment of strong CoPs and the efficient management of corporate knowledge are vital for companies in knowledge-intensive businesses, in particular, in the face of fierce international competition and in the context of multinational mergers and acquisitions. This is in particular true for EADS Airbus (European Aerospace, Defence and Space Corporation) in the context of recent and future mergers (Daimler-Benz and Chrysler to DaimlerChrysler, DaimlerChrysler Aerospace, Aerospatiale Matra and CASA giving rise to the EADS).

The re-use of Lessons Learned and the adoption of the Best Practices can lead to significant cost savings and process simplifications. Chrysler (now DaimlerChrysler Auburn Hills) is an outstanding success story for the consistent re-use of Lessons Learned and Best Practices. The Chrysler concept of Communities of Practice, which Chrysler engineers refer to as Tech Clubs and the introduction of EBOKs (see fig. 1) has given them a significant advantage over competitors. Time-to-market for new models was cut by a factor greater than two, development costs were slashed by an increase of first-time-right engineering, and the time needed for training new engineers was cut in half. Yellow pages which contain the names and competency-profiles of company experts greatly improved the access to experts and the networking capabilities of new employees.

1.1 The origins of Communities of Practice at Chrysler

Before 1988, Chrysler Corporation employed a traditional, sequential and component-based approach to the production of vehicles. Design used to pass the work on to Engineering, which transferred its results to Procurement, and so on. Due to “stovepipe” thinking and insufficient communication and collaboration between the different functions, lots of costly “re-do” loops used to occur. For example, manufacturing engineers may discover late in the process that the design of a particular part cannot be manufactured and hence reject the part. As a consequence, the Design department had to redesign the part. Clearly, these re-do loops led to significant increases in time-to-market. Not surprisingly, the overall time-to-market for Chrysler vehicles was about 60 months in the mid-1980s, which was not tenable in the face of stiff Japanese competition.

Chrysler’s response to the Japanese threat was to move to a platform-based model for vehicle production. The basic idea was to bring together all development stakeholders of a vehicle in teams. Designers, engineers, representatives from Procurement and Supply as well as marketing experts and advanced manufacturing representatives, would be co-located and work cross-functionally on a product, thereby reducing re-do loops and discovering inconsistencies early on. As a result of the platform concept (and of subsequent developments such as the Tech Clubs and the Engineering Books of Knowledge described below), time-to-market of Chrysler vehicles was cut in half.

After a few years, the platforms were in danger of developing into lateral stovepipes themselves, and it became apparent that knowledge was not flowing easily enough in the original functions for optimized production. An example demonstrating the lack of communication was the fact that a moisture barrier was left out of one model’s door during early engineering tests.

To close strategic gaps in knowledge flow, informal communities of engineers who formerly worked together in the stovepipe organization but who were separated due to the platform reorganization started to appear. Their initial agenda was an informal exchange of Best Practices and Lessons Learned at the different platforms, in the engineers’ respective areas of expertise. Management immediately recognized the importance of these communities to ensure a two-dimensional matrix structure for knowledge flow. Communities were soon institutionalized to form the so-called “Tech Clubs.” The concept was imitated in functional areas other than Engineering and, after the merger of Daimler-Benz AG and Chrysler Corporation in 1998, within parts of the European organization of DaimlerChrysler.

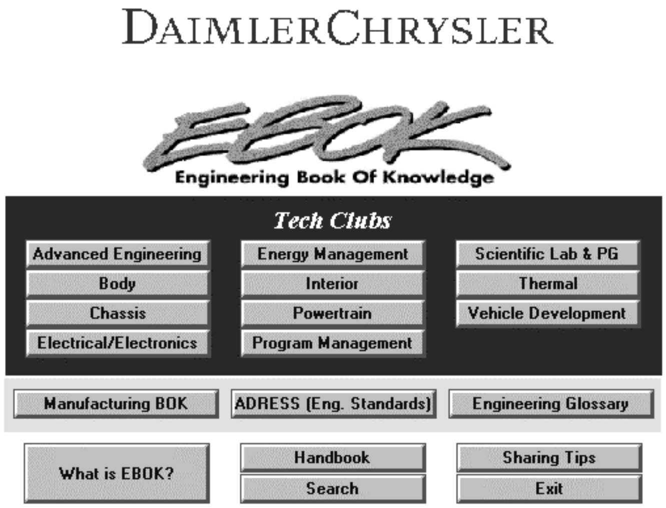

Fig. 1: Entry page to the Chrysler Group's TechClubs/CoPs (Lotus Notes version)

1.2 The origins of Knowledge Management at EADS Airbus

The complexity of high-tech products such as a commercial aircraft results in a flood of detailed information on processes in Engineering, Manufacturing and Sales, for example, in the form of Lessons Learned and Best Practices (Tsafestas 1993). Information technology is an essential enabling tool to evaluate and preprocess the corresponding data. A variety of IT products, technologies and concepts such as intelligent agents, search algorithms, portals, case-based reasoning and others are available today to help individuals sift through databases, customer reports and other forms of electronically available data.

EADS Airbus Engineering realizes the need to preserve and manage its knowledge assets. The drive to structure and preserve corporate knowledge is motivated by several factors. Downsizing during the Dolores project (Dollar Low REScue, mid 90s) lead to significant loss of knowledge. In addition, the competitive climate in the aerospace industry is forcing EADS Airbus to focus on knowledge management. For example, Boeing realizes significant support cost savings through on-line access to information related to repairs and maintenance. Also, Boeing manages its intellectual assets efficiently, leading to a large number of new patents.

The mission of the knowledge management group at Airbus Engineering is to build Communities of Practice, to support them in documenting their core knowledge, and to consolidate existing knowledge management initiatives - where available - into a coherent knowledge management strategy. The knowledge management core team was established about two years ago.

If the highly distributed nature of the engineering work done is considered (see fig. 2), knowledge management also becomes a key feature for integrating distributed engineering and design build teams.

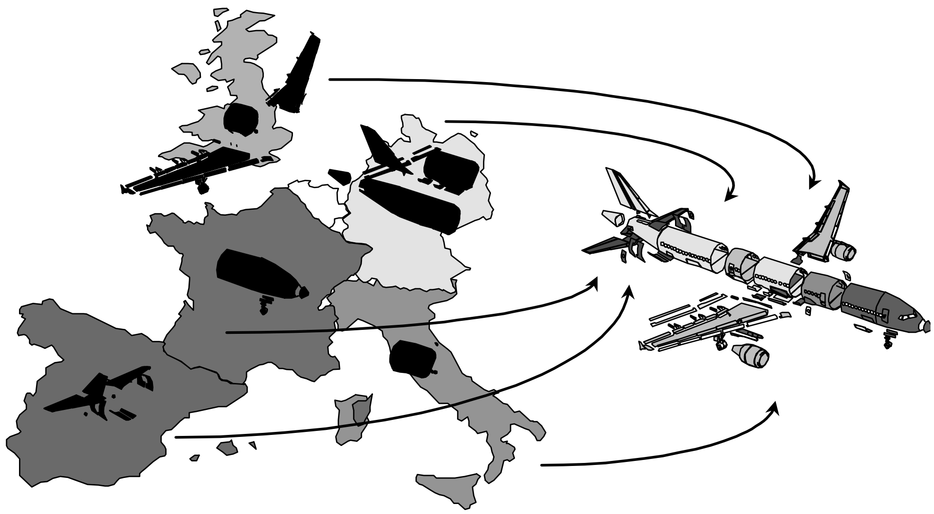

Fig. 2: Workshares and partners within EADS Airbus

The adaptation of Chrysler's Best Practice of Tech Clubs and EBOKs to the business context of Airbus Engineering is currently an important thrust area of the knowledge management group. We would therefore like to start this report of our experiences with an introduction to the CoP/EBOK process in Airbus Engineering and in the light of a newly formed DaimlerChrysler Knowledge Management CoP.

1.3 Challenges and Solutions

The knowledge management efforts at Airbus Engineering follow a two-pronged approach. We build the infrastructure and support mechanisms for the creation of effective engineering CoPs. Parallely, we play an active role in the newly formed CoPs for knowledge management within DaimlerChrysler Corporation. The DaimlerChrysler Corporate University (DCCU) leads the Knowledge Management CoP. The community itself includes knowledge managers from all business units. Within the community, Airbus Engineering is responsible for IT-related questions. Chrysler's knowledge management efforts are accepted as Best Practice within and will be implemented throughout the CoP. In the following account, we shall describe the challenges and solutions that we face in establishing the Knowledge Management CoPs and the engineering CoPs.

2. Communities of Practice

The identification and establishment of Communities of Practice can benefit a great deal from the answers to a few basic questions that help to break down the complexity of the task and to structure the knowledge and the people associated. The questions follow an approach suggested by Drs. Etienne Wenger and William Snyder, who support the DCCU and the KM CoP as consultants.

2.1 Key Questions to be answered

What is your knowledge domain?

Given the context of the KM initiative within DaimlerChrysler, the knowledge domain is defined by the following question: How can we transfer the Tech Club/EBOK process from Chrysler to the business units? All processes and people that are vital for answering this question are part of the knowledge domain and of the CoP, respectively. The motivation to form a CoP stems from the fact that DaimlerChrysler faces global competition in a knowledge intensive business. Continuous improvement and innovation supported by the CoP/EBOK process is a must, and enjoys company-wide management support.

Within Airbus Engineering, three prototype CoPs exist, each of which has a different structure to cater to the different customer requirements. The CoP CFK (Composites) centers around composite materials and their use in Engineering, Manufacturing and Sales (see fig. 4). The customer required a somewhat unstructured environment for the EBOKs; three books, one each for Engineering, Manufacturing and Sales, are being used currently. No structure was identified for the chapters. A second CoP focuses on avionic systems and is structured according to ATA specifications. Finally, a CoP called "Methods and Support“ acts as a standard Chrysler-type Tech Club. Its books are organized around topics such as standardization, configuration management, etc.

The motivation for starting these Communities of Practice varies. For example, in avionics, which is a book in the Systems CoP, the business need is to cut down on the training time for incoming engineers and to document existing knowledge (comp. Bach, Vogler, Oesterreich 1999). Other books are being written to homogenize processes and to increase first-time-right engineering.

Who will participate in building the community?

The KM initiative at DaimlerChrysler took off with the DCCU identifying key KM leaders. A kick-off meeting formally started the CoP. The CoP includes representatives from Human Resources, Research and Technology, Finance and Controlling, Quality Management, etc., in addition to KM leaders from all DaimlerChrysler business units. Subgroups that target specific topics, such as IT under the leadership of Airbus Engineering, were formed.
At Airbus Engineering, key account managers interview business unit leaders and experts to identify possible CoPs and useful EBOKs that have a real impact on performance. The key account managers draw upon the information gathered in interviews and on additional information such as knowledge maps which exist for specific areas of expertise (Drucker et al 1998).
An initial CoP and EBOK structure is presented to leading managers and experts and redefined as needed. A kick-off meeting initiates the process and identifies CoP

coordinators and book owners. The key account manager continues to be involved with the CoP and provides support as and when it is needed.

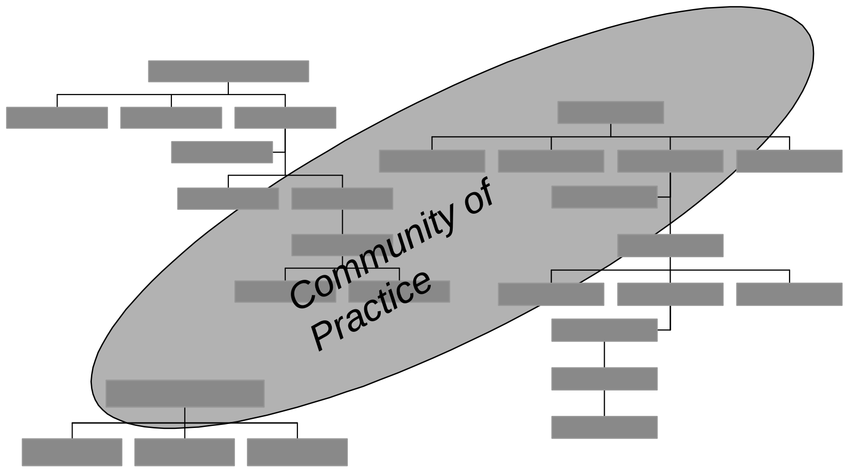

Fig. 3: Communities of Practice across functional boundaries bringing together experts with a specific area of interest

What should the CoP do?

One area of priority for the DaimlerChrysler Knowledge Management Community of Practice is to review the different KM efforts throughout the company to identify Best Practices such as the Chrysler Tech Club/EBOK process and to harmonize the KM efforts throughout the company. For example, at the IT level, an overview of technologies used will be needed. Do IT implementations meet criteria such as user-friendliness, security, flexibility, scalability, and platform-independence? If IT has been outsourced, how competent are the suppliers? How do they perform on price? Which technology is outdated? To answer these questions and to prevent the reinvention of the wheel a J2EE compliant IT platform was chosen. Based on this technology the DaimlerChrysler Research Center India, Bangalore, implemented a modular KM infrastructure.
The task of the Airbus Engineering CoPs is to improve business performance as described earlier. Since the establishment of CoPs has only started recently, no results regarding their performance are available as yet.

2.2 Practical Considerations

Once the basic questions are answered, two practical problems still remain unsolved:
1. How does one encourage the formation of CoPs and what support will they need?
2. How does one quantify the benefits of a CoP?

We will describe our approach to these questions using the example of engineering CoPs at Airbus in the sections that follow.

Encouragement and Support

Enabling a knowledge sharing culture in a large organization is a highly complex task (Bach, Vogler, Oesterreich 1999). Here is a possible approach that describes different areas in which encouragement and support are needed:

Leadership: Leadership of a CoP is a distinction that has to be earned. Choosing the right Tech Club leader is vital for the success of a Tech Club. The leader needs to create and communicate a vision for the Tech Club. In collaboration with carefully chosen experts, he or she needs to identify Tech Club deliverables, chair and manage regular meetings and monitor progress on the EBOK. Open communication must be continuously encouraged.

Mangement Support: Active participation in a CoP implies a work load of about 20% for a CoP leader and about 10% for a CoP member. Employees will make such a large time commitment only if it is sanctioned by or even required from management. Support from leading executives for the CoP/EBOK process is a must.

Motivation: Several incentives can be used to generate employee buy-in for KM efforts. An important motivator is the fact that shared knowledge increases the respect for and the influence of the expert (listing in Yellow Pages, identifying the „KM employee of the month"). Knowledge sharing should also be part of every employee's performance evaluation and thereby directly affect pay hikes and promotions. Other motivating factors can be a reduction in work load to compensate for additional work done in documenting knowledge and premiums such as recognition lunches and barbecues, additional holidays, etc.

Behavior: Organizational behavior must change to create a knowledge sharing work environment. Such a change means accepting employee mistakes and failures as part of a learning process. Admission of failures should not automatically threaten an employee's job. Active support must be given to create a strong group identity.

Education: Employees must be convinced of the benefits and payoffs of KM and must learn to use its tools. Ways to achieve this goal are tutorials and seminars, especially for new employees, since the benefit that comes from using, say, the EBOKs is potentially large in their case. Also, results of the EBOK have to be used in internal training seminars.

Help Desk Support: Support during normal business hours is needed to register and act on customer complaints pertaining to the functionality of the EBOKs, message boards and other means of CoP communication. Help in clarifying Tech Club access rights for supplier personnel and, if need be, help for authors with the editing of complex documents are also needed. In addition, support in the areas of conducting efficient meetings, motivating CoP members, and teaching authors how to write EBOK chapters is essential.

Marketing: Employees have to be made aware of the concept and potential of Communities of Practice. Ways to achieve this awareness include presentations to management and employees, road shows and articles in the company newsletter. Referring potential customers to the results of successful CoPs is especially helpful.

Measurement of Performance

Objective measurement of the success of knowledge management initiatives is crucial for ensuring continued management support. At Airbus Engineering,

knowledge management initiatives are evaluated along five different criteria which will be discussed in detail below. While the first two criteria are the easiest to measure, the last three generate the greatest value addition.
Generated Knowledge: Generation of knowledge can be measured by the number of CoPs, EBOKs, chapters (initialized and published), experts listed in the Yellow Pages, and discussion groups. A further indicator that measures generated knowledge is the number of Best Practices/Lessons Learned in comparison with the total number of projects. Similarly, the number of interviewed employees who leave the company in relation to the total fluctuation rate is a good indicator of generated or retained corporate knowledge.
Distributed Knowledge: The distribution of knowledge can be measured by the number of downloads and reads for EBOK chapters and the number of CoP meetings and their attendance. The number and activity of discussion groups is also a good measure of knowledge distribution as is the number of workshops on special EBOK topics. Finally, the number of tutorials by experts given to new or less qualified employees also directly measures knowledge distribution.
Applied Knowledge: The number and quality of reader feedback commenting on the relevance of Lessons Learned and Best Practices in their work environment clearly measures the application of knowledge. Other measures include the homogenization of processes through the adaptation of Best Practices, more efficient training of employees and a reduction of the number of suppliers.
Efficiency and Quality of Knowledge Distribution: An important measure is the user's attitude towards the CoP/EBOK process which is revealed by the results of questionnaires and the ratio of positive to negative reader feedback. Indicators for an efficient knowledge distribution are also the time spent between the generation (e.g., end of a project) and the documentation of knowledge or the number of days spent for documenting and distributing knowledge. Further parameters to be considered are the average age of chapters in the EBOK and the time it takes for new employees to come up to speed.
Indirect Parameters: The CoP/EBOK process has a variety of indirect consequences. For example, increase in productivity per employee should be observable, as well as an increase in first-time-right engineering and in innovation. Measurement parameters could be, for instance, the percentage of new products and services in terms of the total product portfolio, the average number of project days per person in research and development, the percentage of products designed with customer participation, and improved response times in customer support.

2.3 An example: The Composite Materials Tech Club

The Composite Materials Community of Practice (short: Composite CoP) at Airbus faces the following business challenge: the quality of the material must be improved and errors in handling composite materials must be reduced.

In particular, this requires close communication and efficient information exchange between Manufacturing, Engineering, Quality and Services. Manufacturing, Engineering and Services are located in different cities (e.g., Stade, Bremen and Hamburg) which further complicates communication.
In addition, competencies have to be managed, for example, in the form of „Yellow Pages". that list experts, their respective area of expertise and contact information.

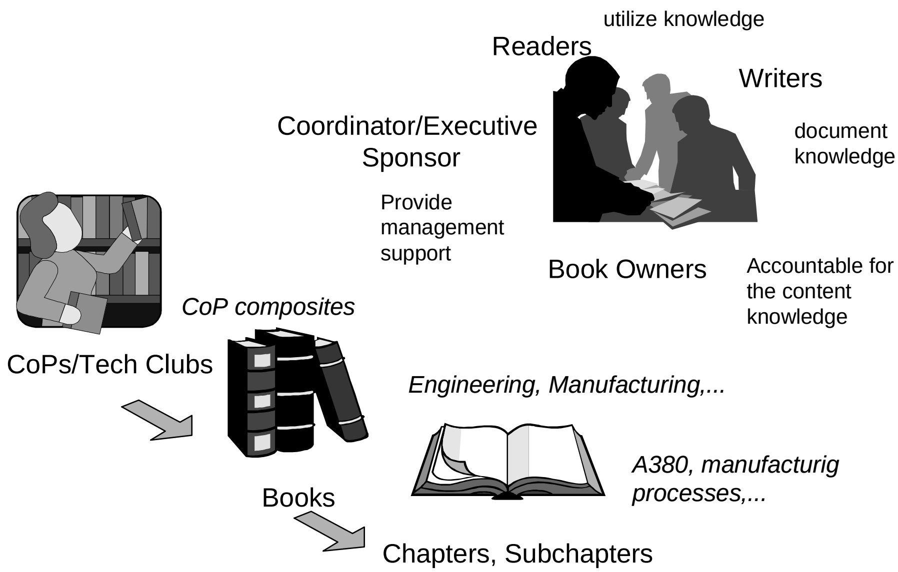

Fig. 4: Knowledge-sharing and functional roles within a CoP

The *Composite Communtiy of Practice* eventually will link all people within Airbus who work on composite materials driven by a strong management support.
The Electronic Books of Kowledge (EBOKs) of this knowledge sharing community mirror its communication needs (see fig. 4): one each for Manufacturing, Engineering and Services. The different chapters of these books typically discuss different technologies, aircraft programmes, standardization practices and so forth. The Lessons Learned and Best Practices are entered by means of an web-enabled application that is easily accessable throughout the plants and engineering offices.
Any member of the CoP (Reader status) can access documents, however, no changes can be made. Writers take a more active role as they write down Best Practices and Lessons Learned. The Book Owners (i.e. Composite Manufacturing, Engineering, Services) are responsible for the Book's overall validity, the specific focus and the approval of content. For the latter they rely on a peer review process, i.e. members of the CoP cross-check all information and approve it.
Lets look at a simple example how this works.
Sometime ago Quality, Services and Engineering noticed some problems with tightness of composite materials that had been produced. For small components there is a simple, non-destructive solution to quickly check the tightness. This was written down as a Best Practice in the following form:

Tightness of sandwich parts shall be checked after manufacturing by dipping parts in warm water. Increased porosity of CFRP sandwich parts may cause water ingression in service. Sandwich parts may suffer defects after manufacturing. Before delivery water tightness shall be checked. This test can be done by dipping this parts in warm water, air bubbles will show possible defects. This test can easily be combined with NDT (Non destructive testing) done in final inspection. If water soak is not possible, x-ray is an option to detect water after NDT.

The message quickly spread. Soon after publishing the Best Practice in the Engineering section of the CoP's EBOK the method was routinely applied within Manufacturing.

3. A Web based system for collecting and distributing knowledge

Information technology is an essential enabler of the knowledge sharing process. The following section describes a web-enabled knowledge portal based on the Engineering Book of Knowledge that allows to write, store and search for Best Practices and Lessons Learned. The documents are discussed and reviewed by peers and if finally approved stored in the knowledge repository.
A successful IT infrastructure must satisfy customer needs, which is why we started with a prototype that is constantly improved and adjusted to meet customer requirements (see also fig. 7). Six criteria must be satisfied by an efficient IT tool for knowledge management:

- User-friendliness
- Security
- Efficient Search
- Flexibility
- Scalability
- Platform-Independence

For example, user friendliness is achieved by using simple web pages to read and upload Best Practices and Lessons Learned. Using a tool like the EBOK should not require additional skills beyond the navigation of the intranet. Full text search of all documents should be possible.

3.1 The basic functionality

To enter the knowledge pools the user has to log in. This is based on a *Single-sign-on* philosophy: The user needs his user ID and password only once to get access to the specific Community of Practice with the books, chapters and subchapters. The user will get access to only those areas (i.e. knowledge books) that he or she is allowed to see.

There are three basic ways of accessing the knowledge repository:

- The user can browse the books and their substructures reading Best Practices and Lessons Learned in random manner,
- he or she can use the structure to navigate through specific books, chapters etc.,
- and information on a specific topic can be retrieved through a key-word search.

By clicking on one of the book icons the user enters the next level of detail where he/she finds sub structures (like chapters and sub chapters) while finally reaching individual documents. The documents have a simple structure containing meta information (i.e. author, date of creation, CoP membership), the title, keywords, a brief abstract and the core information (see fig. 5).

While exploring the CoP the navigation tree is of great help (see fig. 5).

The following search functions are part of the system:

- full text search
- key word search
- search for authors and groups

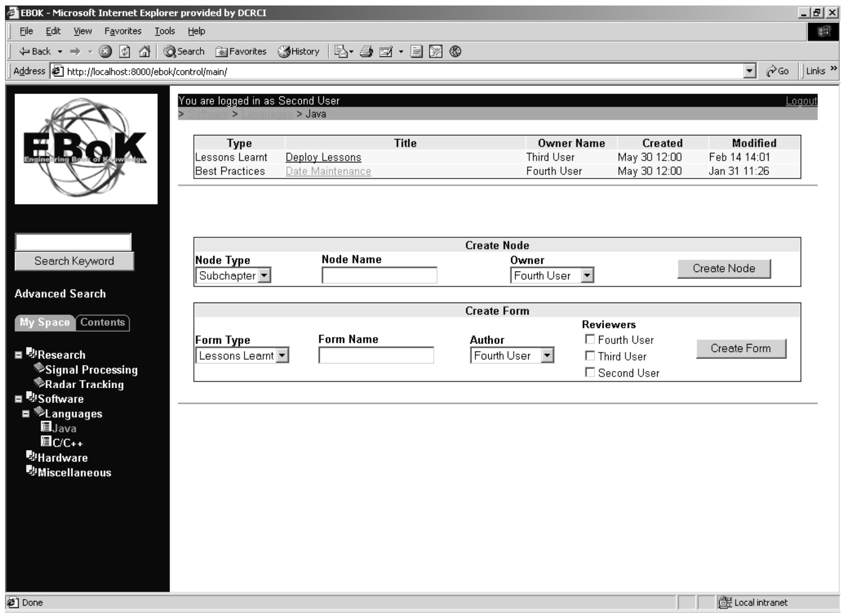

Figure 5: Exploring the knowledge space

Submitting the documents

When a member of a CoP wants to document a specific Lesson Learned or Best Practice she/he only needs to push a button. An input mask pops up.

After filling in the title, name and some keywords the text can be entered directly into the browser window. The text should be short and descriptive. Using copy and paste it is easy to fill in information from other text documents.

Workflow

All documents should be reviewed by peers. This process is directly supported by a workflow engine built into the system.
A document starts as a *DRAFT* version under review. Readers and reviewers will add comments and the author will refine his work. Finally the document is approved by one of the reviewers, typically the book owner, who is responsible for the content, and published (status set to *FINAL)*.
The readers can provide feedback on any chapter/subchapter by filling in comment sheets that are attached to the document.

Help and Statistics

A variety of help and information is available online:

- FAQs for trouble shooting,
- instructions on how to use the different features of the tool (e.g., search module, editing module, etc.),
- general philosophy and value addition for the knowledge management process (what is it, what are the Lessons Learned and Best Practices, what does the company gain?).

3.2 System architecture

The system is a pure Java based implementation built on top of the Java 2 Enterprise Edition (J2EE).
The user interface frontend uses JSPs and Servlets. The main functionality, i.e. the business logic, is implemented by EJBs (Enterprise Java Beans).

The system consists of different modules for

- administration (knowledge structuring and user management)
- document management (to handle documents and meta data)
- search
- workflow (peer review for validity and consistency of the knowledge base)
- help (on-line help and training)
- statistics (reads/writes, feedbacks)

The system architecture comprises three tiers (see fig. 6)

- Tier 1: client with presentation logic (Web tier)
- Tier 2: application logic (EJB tier)
- Tier 3: database server (back end)

The third tier consists of an Oracle 8i enterprise server for data management, the middle tier utilizes IONA's *iPortal application server* for providing the Web and EJB container. The EJBs model event-triggered business logic.

The web tier consists of a servlet that acts as the client’s (browser’s) single point of entry to the system. Depending on the number of users and the back up strategy the application can be distributed over several servers where each server runs one or more CoP components.

By utilizing J2EE technologies it is possible to build a flexible, purely object-oriented, scalable system that can serve large numbers of users.

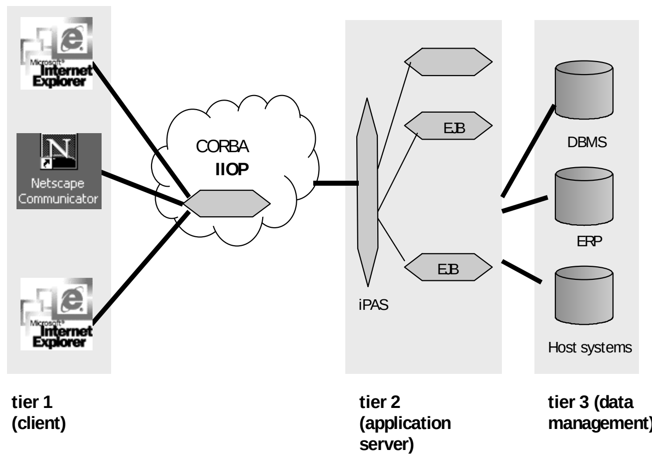

Figure 6: Multi-tier system architecture

4. Lessons Learned and experiences gathered

Figure 7 shows the roots of knowledge management within Chrysler's platform teams and the EBOK roadmap for EADS Airbus.

By initiating, growing und supporting CoPs at Airbus we made a couple of important observations that led to the following Lessons Learned:

1. *Top Management attention is crucial to overcome internal resistance.* Fortunately, our KM initiative had the support of Airbus' Head of Engineering, formely Dr. Wolfgang Schneider. This soon turned out to be a key factor when it came to the day to day implementation of knowledge management processes.
2. *Marketing and story telling is important.* To convince people about the ideas of knowledge management you have to be prepared to do a lot of marketing. Story telling is an important part of that. At Airbus it was very helpful when members of our first CoPs could tell about their success stories.
3. *CoPs need a well defined structure, but be careful not to formalize too much.* A well defined knowledge structure helped the CoPs to gain momentum. However, some CoPs tried to formalize to much which led to a decline in participation.
4. *Don't get stuck in a tool discussion.* Some groups at Airbus spent a lot of time looking out for the best tool to use for their documentation processes, which led to lengthy discussions on document management systems, groupware, and product data management. These groups lost their focus.
5. *Use open software standards.* CoPs and KM initiatives are very dynamic. Their needs change with time. A KM tool should seamlessly integrate with different knowledge sources, both structured (i.e. relational data) and unstructured. Look out for interoperability standards and connectivity.
6. *Align knowledge management with the major business processes.* At the beginning many CoPs felt that knowledge management was just something over and above their daily business, with no immediate value addition. Show how to integrate KM initiatives into their daily operations. Many CoP meetings,

discussing the current status of the knowledge repository could be aligned with the regular expert group meetings.

7. *Treat peoples' concerns seriously.* Knowlege is power and to document your knowledge, viz. giving it away, made some people very uneasy. They simply felt that it would be easier now to replace them. We found it extremely important to treat these concerns seriously. A knowledge sharing culture does not emerge overnight - it has to be developed step by step.

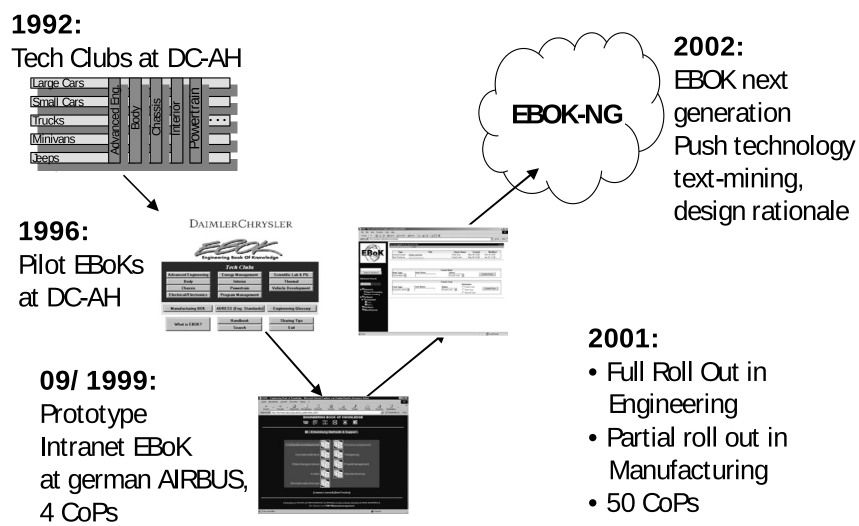

Figure 7: History and future plans for the EBOK

5. Summary

EADS Airbus Engineering realizes the need to preserve and manage its knowledge assets.
The knowledge management process is driven by the establishment of Communities of Practice (CoPs) that actively share knowledge.

The paper introduced a web-based system, called the Engineering Book of Knowledge that helps groups of people to share and discuss their knowledge. The system is a pure Java implementation based on the J2EE plattform.

Figure 7 summarizes the development phases from the first Communities of Practice at Chrysler to the first prototypes at Airbus and the release of the web-enabled EBOK.
This system will be further enhanced to become a powerful knowledge portal including advanced search features, knowledge push, advanced personalization and connectivity with other knowledge sources (guidelines, digital libraries, ERP, engineering systems).

Glossary

COP Community of Practice

DC-AH	DaimlerChrysler Auburn Hills (Chrysler group)
DC-S	DaimlerChrysler Stuttgart
DMS	Document Management System
EBOK	Engineering Book of Knowledge
EJB	Enterprise Java Beans
ERP	Enterprise Resource Planning
IIOP	Internet Inter Orb Protocol
KM	Knowledge Management
J2EE	Java 2 Enterprise Edition
JSP	Java Server Pages
NDT	Non destructive testing

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