XVII IMEKO World Congress
Metrology in the 3rd Millennium
June 22–27, 2003, Dubrovnik, Croatia

BUILDING A WEB-BASED KNOWLEDGE AND LEARNING HOME FOR MEASUREMENT SCIENCES

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Abstract – E-Learning and web-based training are present-day topics in education. So far this has been less the case in the fields of measurement sciences and technologies, even though there is an increasing need for a stock of basic knowledge and expertise. The following project aims at this target. There are two key aspects in this context:
1. Structuring of knowledge and methods in the field, leading via a sophisticated knowledge network to a multi-dimensional knowledge matrix.
2. Organization and standardization of all activities in the process on the teaching side as well as on the learning side.

The realization of these aspects must be done by means of workflows within the knowledge management system. Those workflows should be automatized as far as possible. The authoring workflow is the most important one.

Keywords: e-learning, knowledge management, authoring workflow

1. INRODUCTION

Science and engineering of measurement play an important role in all natural and technical sciences. This fact is usually ignored in today's education. In the context of numerous projects concerning distant education, e-learning and web-based training the design and construction of a teaching and learning site on the internet has been started, supported by various partners and by the Swiss Federal Government. The project focuses on the presentation of the principles of metrology as a common building for all applications, regardless of the branch of science concerned. This implies that there must be a clear understanding of what metrology means to all people involved in order to enable them to provide such a vessel for knowledge and educational tools. Working on that kind of internet-site has to be largely simplified by automatic processes, both for the production of content and for the management of learning processes. Therefore powerful and efficient information technology tools are vital to reach this ambitious goal.

2. GOAL

Knowledge and professional skill have been dramatically improved in the last few years. Software packages provide enormous tools for practical applications.

But this revolution, which has taken place in all fields of measurement sciences too, remains unstructured and blurred for most people in the measurement community. We notice an extensive helplessness in the laboratories, in industry and even in education.

Just one impression: There is a general lack of acceptance concerning the foundations of measurement sciences and techniques like the main propaedeutic subjects as analysis and linear algebra, or signal- and system-theory as well as stochastics and statistics. Tasks are solved normally by starting with instrumental problems, incorporating general principles and theoretical ideas only if absolutely necessary.

Of course knowledge and tools should be provided in a well-structured and transparent manner, in printed media and in electronic media as well. But we are convinced, that the enormous diversity of ideas within the measurement sciences and technologies can be handled best in a measurement homepage.

Nevertheless knowledge and tools have to be analyzed, identified und structured in a special knowledge network, where didactical aspects are properly and sufficiently considered (Fig. 1.).

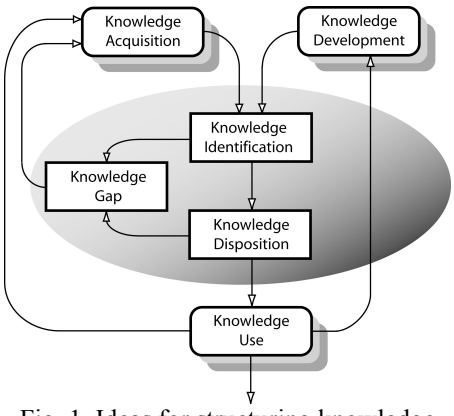

Fig. 1. Ideas for structuring knowledge

The internet-project "Measurement Sciences and Technologies" wants to make a contribution to a decisive improvement concerning the resources of knowledge in the field. We aspire to a pragmatic, simple and quickly useable realisation, which makes digital information better available in the near future.

3. STRUCTURE OF CONTENT

Regarding the range of topics within the science and techniques of measurement a clear structure is essential for effective search processes. This led to a subdivision of the field into three parts:

- propaedeutic topics of measurement
- common basics of measurement
- applications in the field of measurement technologies

At present the project focuses mainly on the common basics of measurement. As prototype fields of application "Measurement of Electrical Quantities" and "Analytical Chemistry" were chosen.

3.1. Structure of the Knowledge Database

Learning tools and knowledge are arranged in a well-defined structure, the centre of which is the so-called module (Fig. 2.).

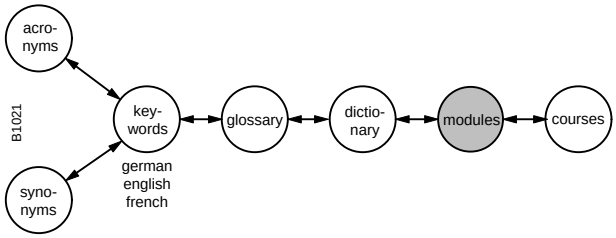

Fig. 2. Structure of knowledge database

3.2. Structure of a Module

A module, the smallest entity of any course, consists of one to three screen contents. Only a very restricted request of a topic will be dealt with. If further information is required, links lead to supplements behind the scene. These additional pieces of information are grouped into four areas covering factual needs (Fig. 3.):

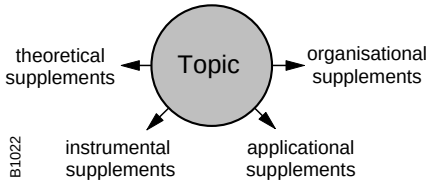

Fig. 3. Structure of a module

Six further subdivisions have proved to be necessary for didactical reasons. They are applicable to all types of supplements mentioned above.

- expansions
- examples
- exercises
- tests
- references
- tools

Within subdivision «examples» a sensor database is built up and within subdivision «exercises» web-based online experiments are provided [1].

3.3. Levels of content

Three levels of content for individual needs of students and visitors are available:

- basic knowledge
- core knowledge
- expert knowledge

Thus different layers of well-defined attributes connect the various categories mentioned above to the topic concerned. This requires a multi-dimensional matrix of information (meta data), which can be searched, tracked and combined.

3.4. Structure of courses

Courses are not the main topic of the project. They are assembled from any number of modules by various authors and lecturers, depending on the need of the instructor involved. Thus a course can be adjusted easily to current and local needs of customers in academia and business world. Several courses can be linked to a lecture.

Course fees have to be paid by people who need personal supervision and final certificates for a special degree.

3.5. Glossary

The glossary can be considered as an entrance to the main part of the homepage. A curious visitor, normally only interested in the meaning of a keyword, will be led step by step to more informative contents concerning the chosen topic.

All keywords in a text or in a module are linked to the glossary system, containing the keyword, a glossary text, common abbreviations, standards and guides, synonyms and translations of the keywords from German into English and French.

Within a course or lecture all relevant keywords can be extracted on-screen or sent to a printer. The printed version serves as a useful overview for lecturers and students as well.

The content of the glossary is located in a special database, serving the needs in flexibility and adaptability to the quick changing scene of this specific field. Even formulas and figures can easily be incorporated.

A glossary-editor will publish the content of an author, as soon as it has been reviewed by an expert. But rights and duties always remain with the author concerned.

4. SEARCH FUNCTIONS

Efficient searching and information retrieval is one of the main challenges in a web-based learning environment. We follow two directions:

- knowledge-based navigation within a knowledge net
- traditional search by keywords within full text or meta-data

Guests who feel at home in the field of measurement sciences will be able to navigate within a knowledge network. Especially authors, editors and reviewers will prefer this

path because it is the most familiar and informative. They will position themselves easily at the right point and will forward a suggestion to the administration if a specific point in question cannot be found or is missing at all. Therefore the knowledge network will be very dynamic, it will grow and improve gradually. Several editors are responsible for the content of certain attributed areas within the knowledge network.

Usually full-text search is disappointing due to an enormous number of hits. A search of metadata is more effective. Therefore all major documents are accompanied by a normalized set of metadata.

5. CONTENT MANAGEMENT

These concepts have to rely on a suitable content management system (Fig. 4.). Main problems concern structuring and connecting the different databases, the management of different file types, different browsers, different operating systems and so on.

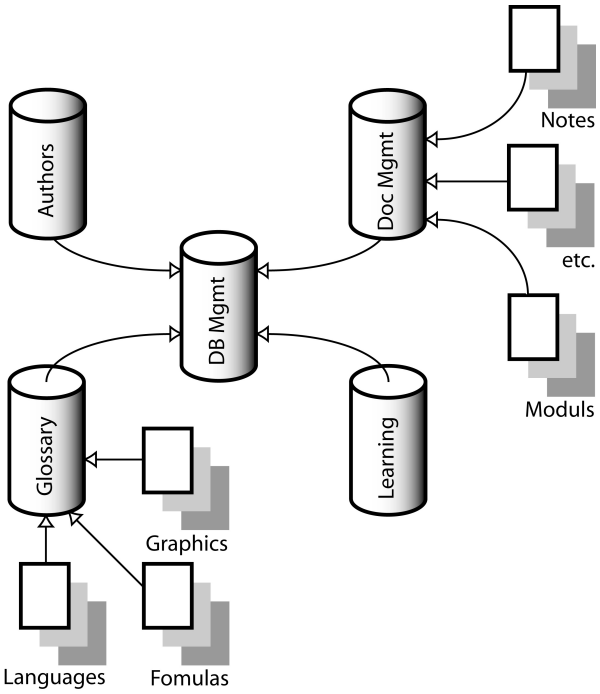

Fig. 4. Simplified structure of the content management

6. WORK FLOW

Most of the processes within the internet site involve various kinds of persons: non-registered and registered users, students, contributing authors, editors, reviewers, organizing administrators and external persons such as sponsors.

In order to keep administrative efforts at a minimum, workflows in the knowledge and content management system are automatized to the extent possible. The most important one is the authoring workflow, which is analogous to the one in print-publishing processes (Fig. 5.).

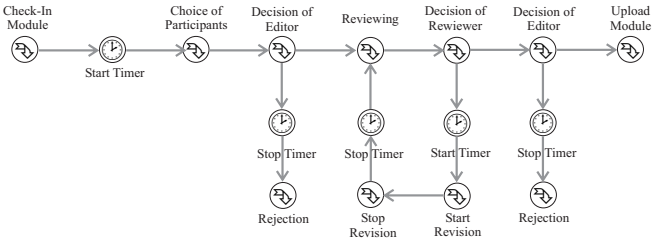

Fig. 5. Simplified structure of the authoring workflow

We assume that authors (lecturers) are willing to contribute to the knowledge and teaching environment only if they are not obliged to write any lines of programming code. Therefore ordinary MS Word files, which may already be structured within well-defined style-sheets, are accepted as input documents. The transfer to XML, HTML PS or PDF files must occur automatically without any manual interference.

7. OUTLOOK

The development of the project is in progress and should be available as a prototype by the end of 2003. Further development is planned to parallel the productive running mode. Any partners' major and minor contributions will then be welcome in this common network.

We expect to gain major contributions of content mainly by authors of the academic area, but later also by experts of the measurement community in industry, commerce, scientific groups and application.

8. CONCLUSION

The Internet-Project "Measurement Sciences and Technologies" is presented. The main topic concerns the definition and structuring of knowledge and professional skill in the field of measurement sciences. Some aspects of the technical solutions are mentioned.

REFERENCES

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