Knowledge Management in Interdisciplinary Scientific Research

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In the paper are presented ideas regarding the computer based methods employed to gain knowledge which were used in different fields of science. Basically, the models offer results expressed in different ways which can be converted in computer information. The synthesis of the results can be done if flexible interfaces are used and different types of analysis are employed. This integration is natural if it is not used as a final stage to gain knowledge, but from the first stages, as one of the basic concepts of the research. The wide range of important results of the interdisciplinary research along the latest 20 years confirm the effectiveness of this strategic concept.

Keywords: research, interdisciplinarity, data management, knowledge.

Introduction

We live in a fast changing world with new, different and complex problems which require solutions conceived in an upper level of understanding and where the management of change is an effective instrument. The white areas on the map of knowledge can be explored only if new means of investigation are designed. Research is the major direction which offers new information and when several fields of science offer results which can be used in an unique interdisciplinary research, a revolution is started.

Basic ideas

There are several layers of refinement of the information, with respect to the instrument of investigation employed. Figure 1 presents the correspondence between the complexity of the approach and the importance of the results. As it can be noticed the basic layer is the technology which is continuously evolving, so the overall hierarchy is dynamic. Below technology there would be the layer of the simple observations and deductions which offer basic information considered ‘noise’, this layer being neglected in the figure below. The pyramidal hierarchy is just a two-dimensional representation, in fact the set of relations being far more complex. There should be also noticed that data, information and knowledge are parts of an unique and continuous unit, without disjunctive components.

If the results of these levels of approach are used to develop the technology, a new cycle of the pursuit of wisdom begins.

If we section the structure presented in figure 1 with an horizontal plane we can identify several sets of technologies, methods and models. Figure 2 presents a set of three types of models employed in engineering.

Each type of model consists of several categories of lower-level models according to the specific hypotheses and the methods employed to solve the problems.

As it can be noticed, hybrid models can be also conceived, the results of the different
models being convergent for a well posed problem followed by accurate studies.

**Integration of the information**

All the results of the different studies must meet in a gathering area where their synergic effect offers a new perspective, an upper level of understanding. In order to have a strategic direction right from the beginning, there must be identified the common aspects of the different types of solutions. After several studies and projects there was noticed that numerical methods, matrix based approaches and computer programming can be found in most of the fields of science. Moreover, the techniques, algorithms and software used to process matrices can be employed as a general knowhow to be used in complex approaches.

There was designed a software instrument consisting of a set of programs written in different programming languages which use a common data structure. This idea offers to the investigator the opportunity to transfer data from an environment or programming language to another environment or programming language. In this way the data processing technique uses the best features of all the programming languages considered.

![Fig.3. Data processing method based on matrices](image)

Figure 3 presents the programming languages employed 10 years ago, which use a common data type which is a text file with a static structure, similar to a table. Each element of the matrix is a record in this ASCII file which can be accessed from any programming language.

For instance, a research project can use experimental data expressed as text files which are converted in ASCII “matrix” files. Next, these files can be used in any programming language in order to fulfill a given task. As an example, large amount of data can be processed in FoxPro and visualized in Excel; numerical methods can be used in MathCAD, MATLAB or in original software written in Pascal, C or Java; complex 3D drawings can be automatically done in CAD systems. Dynamic memory allocation and other optimizations were also designed. Even the data processing technique might look atomized, the general concept is to use all the facilities of the library of programs in order to create a dedicated and flexible instrument of investigation.

![Fig.4. Programming language and a set of requirements](image)

At present, the creation of a dedicated software is far more simple because there are programming languages whose features meet most of the requirements. Figure 4 presents the facilities of the Java programming language. Another strong point is the large number of libraries of applications which can be found over the Internet.

An interesting and relevant aspect regarding the importance of the knowledge management in research can be noticed in figure 5. Thus, all the facilities presented in figure 4 are employed in this complex model: virtual reality, communication between the remote operators, numerical models of the oil spill, databases where the changes of the scene are stored, SWING interface.

**Conclusion**

Even modern technologies offer new solutions consisting of accurate results presented as numbers or as graphical information, there is still a lot of work to be done in the integration of the results. The synergie of these separate results can be used to reach an upper
level of understanding. Software solutions were conceived in order to apply in an effective way this concept and the results are relevant and important.

New software technologies offer better facilities which can be used to create libraries of software applications. Further on, these libraries can be employed to create effective research software instruments. Interdisciplinary research requires such software approaches which are the unique solution to create complex and accurate models of our dynamic nowadays world.

References

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