The Emergence of Virtual Laboratories: Towards New Policies and Strategies for Knowledge Handling
Tuesday 17 October 2000, Baveno, Italy

A session on the Emergence of Virtual Laboratories: Towards New Policies and Strategies for Knowledge Handling, took place on Tuesday 17 October 2000, Baveno/Stresa, Italy within the framework of the 17th International CODATA Conference. It was chaired by Dr. John Rose of UNESCO and was also funded by UNESCO. The session was divided into two sections with eight presentations in total.

BACKGROUND

As identified in the Report of the Expert meeting on Virtual Laboratories, organized by the International Institute of Theoretical and Applied Physics (IITP), Ames, Iowa, USA, 10-12 May, 1999 and supported by UNESCO, it was acknowledged that the motives, opportunities, mechanisms and challenges presented by the development of "Virtual Laboratory" require critical analysis especially if developing country participation is to be insured. Among the objectives behind the session in Baveno was to continue this analysis and build on the recommendations flowing there from and more particularly to further

- Determine the state-of-the-art and trends of Virtual Laboratories with respect particularly to identifying the challenges facing developing countries
- Emphasize and identify how the Virtual Laboratory concept can be used to coordinate activities taking place in different places in order to benefit from the best possible synergies on both the technical and the theoretical levels
- Identify the potential relevance of Virtual Laboratory techniques in advancing and monitoring research and analysis bearing on problems of development
- Recommendations for action at the international level with particular reference to developing countries.

From the above it was clear that if these objectives were to be realized it was imperative that the most important players at this session would have to be people with hands on experience in issues pertaining to VL issues in developing countries. The funding received from UNESCO enabled CODATA to do this, resulting in participants from different African States, regions in South America, Asia and Eastern Europe.

SUMMARY OF THE SESSION

Eight major lectures were presented. These were:

- **Virtual Laboratory Strategies for Development**
  S. M. Radicella, C. Fonda and E. Canessa (Italy)

- **Person to Experiment Communication in Virtual Laboratories**
  K. Froitzheim (Germany)

- **Virtual Laboratory and Virtual Library - Opportunities for and Challenges to Africa**
  G. Olalere Ajayi (Nigeria)

Presentations on case studies

- **International Virtual Laboratory on Fundamental and Applied Problems of Elasticity Theory**
  Y. Murakami, M. Kovalenko (Japan), D. Nechitailenko, A. Gvishiani, V. Strakhov (Russia), M. Diament (France) and H. Kroehl (USA)

- **Creation of Virtual Laboratory on Tropical Wood**
   J. Noah Ngamveng (Cameroon)

- **The Progress of Virtual Laboratories in China**
  Yun-Shen Ma, Jian Miao, Jian-Gen Wu, Liang-Yao Chen, Wei-Heng Zhong, Yan-Dong Zhang, Li-Qing Shao and Dong-Shen Chen (China)

- **Virtual laboratories - A Brazilian-French Experience**
  H. Dou (France) and G. M. Coelho (Brazil)

  The Virtual university and the Teaching from a Distance: The ISEFC Experience in Tunisia
  M.T. Ayadi and K. Bouraoui (Tunisia)

Abstracts of these sessions are contained in Annex One of this Report.

TRENDS IDENTIFIED FROM THE PRESENTATIONS

Several important trends appeared.

A.   The Lectures cited above commented and explained the UNESCO initiative on the use of VL Technology offered by the modern Information and Communication Technology Tools. In the presentation **"Virtual Laboratoty and Virtual Library-Opportunities for and challenges to Africa",** G. Olalere Ajayi, a Data Set (University of Nigeria) from ten countries involving many developing countries was shown to be very instrumental in scientific cooperative projects.

B.   The following lectures were concerned with VLs or attempts at VLs centred on more concrete research in which the data are very close to their creation and to their first codification and description. **"International Virtual Laboratory on Fundamental and Applied Problems of Elasticity Theory"** Y. Murakami et al

The aim is to "revise certain theoretical and applied problems of geophysics on the basis of newly obtained solutions of the elasticity theory". New mathematical tools should be developed in a VL spread over four countries" (Russia, France, Spain and USA).

The talk by Yun-Shen Ma entitled, **"The Progress of Virtual Laboratories in China"**, shows that since the UNESCO Expert Meeting the concept of Virtual Laboratories has contributed to certain projects being carried out in China with government support. Some ten Virtual laboratories participated in the Chinese VL Programme. The presentation by the Shanghai Research Centre for Applied Physics (SRCAP), given as an example, underlines the importance of exploiting networks to take full advantage of expensive instruments. An Optical Spectral Instrument is used to transfer its data to the Internet. This pilot project could be adapted later to this instrument.

The (SRCAP) VL Centre, takes on a broader dimension as a computing centre (1 Gbps bandwidth) to share information resources throughout the country and the world in the future. The use of networks and of Virtual Laboratories should play an essential role in both the scientific and education systems in China.

Joseph Noah Ngamveng (Cameroon) in his paper, **"Creation of a Virtual Laboratory on Tropical Wood"**, describes the need to set up a Virtual Laboratory for achieving government objectives (States of Central Africa) to work on the sub-regional research programme on Forestry/Wood of the Congo Basin. It appeared through an interesting discussion that Virtual Laboratories would have to set up African Regional connections in order to establish significant inventory data available and later expand to South/North Laboratory connections.

In the areas involved it is clear that the exchanges are technological but that a gradual and permanent training of local personnel implies an important education/outreach component.

C.   The Tunisian Institute insists on a particular aspect of Virtual Laboratories, which deals with the permanent schooling of people who need to be trained in different skills for their careers. Their vision is to be integrated in UNESCO's conception of a 21st Century characterised as the beginning of a Knowledge Revolution. Professor Malika Trabelsi and Dr. Kamel Bouraoui paper on **"The Virtual University and the Teaching from a Distance: The ISEFC Experience in Tunisia**" deals with these issues.

Capacity of adaptation in a world in which knowledge changes very rapidly needs to be on an international level while yet maintaining the diversity of culture. This implies setting up programs of ongoing adaptation developed by networking and ensuring certain "interactivities".

Education and outreaching imply an even more systematic vision that needs to be embedded in larger concepts. The VL paradigm must be tested in a vehicle to both merge and distinguish the numerous inputs of various cultures.

D.   Henri Dou and G. M.Coelho, **"Virtual Laboratories-A Brazilian-French Experience"**, reported on a pioneering VL. This was created five years ago and involves training in the area of Competitive Intelligence that was conceived, developed and based on French and Brazilian industrial experiences. The system functioned on reciprocity and symmetry between these two countries. Original tools enable co-operation in research and education at the University level, including DEA (Masters Degree) and the PhD level. This complex experiment, which also implies validating studies by degrees recognised in both countries, is equally noted for a further success. It is not only a bi-polar two country VL but in fact a whole network covering a large part of Brazil and requiring a concentrated and ongoing use of internet tools.

E.   E. Canessa, **"Virtual Laboratory Strategies for Development",** outlined the importance of Virtual Laboratories to have tools featuring the most advanced techniques of instrument control, data sharing, electronic collaboration to mention but a few. VLs facilitates the sharing of scientific data in return for access to collectively generated data sets, which are likely to represent a true "gold-mine" for data mining over the coming decades. Another potentiality of VLs is that they can generate an enhanced ability to attract R&D contracts from the private sector due to flexibility of access to professionals, laboratory facilities, expertise, geographic presence, etc. The private sector can provide prototype computer applications and also perform research on the generated VL data sets for specific purposes such as, for example, the development of new pharmaceuticals. The VL approach allows to promote research and education in developing countries and to help reducing the technology gap of the digital divide. Special attention needs to be paid to software tools for VLs in a low-bandwidth network infrastructure in remote areas.

F.   K. Froitzheim, **"Person to Experiment Communication in Virtual Laboratories"**, emphasised by specific examples the absolute importance of multi media and internet communication tools within the VL structure.

Virtual Observatories in Modern Astronomy and Astrophysics- International and Interdisciplinary Aspects

It should be noted here that this session was immediately preceded by a special session on Virtual Observatories in Modern Astronomy and Astrophysics- International and Interdisciplinary Aspects. Although both sessions dealt with independent issues underlying similarities were identified. More particularly:

- In order for a virtual observatory to function a "Sophisticated Management Structure" is required to cope with the distributed and loosely federated nature of the VO structure

- Meticulous studies must be conducted in order to define the clear yet limited objectives of a Virtual Observatory

- Virtual Observatories should be open to all scientists and as far as possible facilitate interdisciplinary use

- Major contributions must be pro-active in devising and agreeing on a clear, simple but flexible in identifying, for example appropriate standards and protocols

- Like Virtual Laboratories, Virtual Observatories must rely on efficient communication network involving high information flow

The following recommendations with the backing of CODATA were flowed from Virtual Observatories sessions:

1   Virtual Observatories should be open to all scientists and enable interdisciplinary use. Data should be non-proprietary, and national virtual observatories should be open to astronomers from all other countries.

2.   Nations and communities of nations should establish virtual observatories or elements. They should include them in their planning for astronomical data, provide funds &resources within their means, and should coordinate with other nations and communities.

3.   Development of Virtual Observatories should be <u>driven by science.</u> Technology should neither drive nor control development. Early and continued involvement of the full spectrum of prospective users—both science and education—is essential. Effective coordination and cooperation among developers of virtual observatories is essential.

4.   Major contributors must be pro-active in devising and agreeing on a clear and simple but flexible approach including a unifying architecture and appropriate standards and protocols.

5.   Developers and sponsors should inform colleagues and other prospective users periodically of the concept and status of virtual observatories and encourage or solicit feedback. This process should begin as soon as possible

These recommendations will be sent, by CODATA, to the various national and international bodies concerned. It is interesting to note that they contain political, strategic and organisational elements, which will probably be the same for Virtual Laboratories in other areas.

However, the discussions on the presentations chaired by John Rose showed that the complexity of problems differed greatly according to the discipline presented. The method employed, by the astronomers, is rich in showing how to achieve a common definition, a precise project and a method for setting up a budgeted project. It is in these areas that the meeting brought constructive experiences to those disciplines present who sought solutions to real problems, perhaps often more difficult because they are more general and less subsidised. Therefore both sessions, although distinctly different were complimentary to each other and discussions that ensued were mutually beneficial to all participants.

Round Table on International Cooperation on Virtual Laboratories

Immediately following the session, a special Round Table on International Cooperation on Virtual Laboratories took place.

Conclusions

1.   What became clear was the need to build an inherent structure when addressing Virtual Laboratory issues as different approaches exists between various institutions

2.   A Virtual Laboratory must have a reliable network structure allowing fast communication. It must also have computing facilities and reliable technical experts to maintain the basic network

3.   The structure should be -

   ▪   Viable
   ▪   Stable
   ▪   Have a size and scale of effort to meet the major scientific and technological challenges- this may even be beyond the capacity of a single laboratory
   ▪   Have the resources and expertise required for the scientific and technical goals could be distributed among the institutions

4. Flowing from the preceding point is the underlying importance of education and training in order to facilitate the establishment of the structure

5. It is imperative that the objective of the Virtual Laboratory is clearly defined and the need for long-term planning is a pre requisite to its success

6. A VL approach can also assist in the promotion of research and education in developing countries. It should be noted also that the administration in some countries sees the VL system as an intrusion by a foreign country into their areas of research and education. However what became clear from this session is that if the UNESCO ideal was adhered to ie that the world should work to integrate its talent, creativity and cultural variety for the <u>benefit for all</u>, then the VL should be seen as a tool which under virtual space that can be used for the benefit for all and not a tool that threatens free sovereignty.

RECOMMENDATIONS

The Virtual Laboratory meeting in Baveno/Stresa, concentrated on the important progress achieved in the scientific communities worldwide. It was essential that the information transferred from UNESCO to CODATA, thanks to the action of John Rose, be finalised by a session in order to sensitise and change opinion. The session in Baveno/Stresa served this very purpose. In particular, several important points should be noted.

A. As was stated in the Report of the Expert meeting on Virtual Laboratories in Iwoa, the Virtual Laboratory represents a potential for a new paradigm- and a new culture- of science that can produce unanticipated breakthroughs when they are shared cognitive functions. However it was clear from the presentations in Baveno that in order to achieve this potential, the policies and best practices for VLs would have to be identified and the appropriate technologies would have to be promoted and developed and this was universally applicable to all countries but even more so to developing countries. A very important out come from this session was the identification of issues which future CODATA Programs will address through its Task Groups and Projects which are also very relevant to VL technologies- On-line Manuals – Training, Data handling, Data base building, CODATA Journal – sharing new knowledge, On-line workshops – state of the art learning an data visualization, to name but a few. It was declared that CODATA will explore and exploit the possibility of fostering the creation of concrete virtual laboratories and technology promotion laboratories. The creation of a new Task Group on "Virtual Laboratories: Implementation Strategies and Management" could be envisaged to work on the necessary steps of
- Defining projects
- Associating different resources and funding policies.

B. It was recommended that CODATA will explore and exploit possibilities to organize and participate in concrete virtual laboratories research and technology promotion projects. The focus of these CODATA activities will be its Task Group "Virtual Laboratories and Data Management", which was approved by the CODATA General Assembly in Stresa, immediately following the conference.

C. CODATA and UNESCO took on board the various proposals stemming from the VL concept and considered by UNESCO as a model for future training in the scientific world.

D. For CODATA, the synthesis, Knowledge, Information, Communication (KIC), the basis of CODATA activities, naturally favours VLs. Co-operation with UNESCO was extremely fruitful and should be followed through efficiently in different ways in the area of V.L. This co-operation and these laboratories are not only efficient tools in science and technology but are also efficient tools in furthering culture.

E Overall the session was well attended and an important outcome from the meeting was it created a general awareness of the important potential of Virtual Laboratory technology as a scientific tool especially in developing countries. The session developed some of the issues that had already been touched on in the VL session held within the framework of the First International CODATA Africa Workshop in Dakar, Senegal in July 2000.-which was also financially supported by UNESCO

Publication and Dissemination

- Abstracts of all of the presentations were contained in the Special Book of Abstracts prepared and distributed to over 240 participants at the conference.

- The abstracts are also available on the website **http://www.codata.org**

- Since the Conference all authors have been invited to submit full papers of their presentations and these are currently been prepared for electronic publication.

- A decision was made at the recent CODATA Executive Committee meeting in February 2001 to establish a new journal on Scientific and Engineering Data to be published electronically on the internet. It will deal with issues relevant to the CODATA Community. It is envisaged that some of the issues raised in this VL session in Baveno may be further developed and form the subject matter for future Journal articles.

Finally, CODATA would like to formally thank UNESCO and more particularly Dr. John Rose for his support towards this session. It is only with this financial backing from UNESCO that those speakers and participants from developing countries were able to attend.