



CHAPTER **1** SUMMARY

The exceptional increase in computing power, storage capacity and network bandwidth of the past decades lies at the basis of a digital revolution, which has only just started. Information is becoming the fuel of our knowledge society and our ability to digest this information, to understand and to share it will determine scientific, economic and social progress.

Problem definition

The scientific community is often a driving force behind technological developments and this is certainly true for the present ICT revolution. An outstanding recent example of the nurturing role of science is the Web. The paradoxical situation that its impact on the scientific world fell behind that on society was due to limitations in network bandwidth. This made it practically impossible to distribute the large amounts of data and information generated in today's networked R&D experiments. It is not until recently that network bandwidth ceased to be a limitation as a result of the impressive breakthrough in optical wide area networking. Now a new generation of applications for the Internet is about to be introduced, unleashed by the availability of ample bandwidth. In parallel another technology is emerging that has the potential to make users share compute power, storage and other resources like expensive experimental facilities (e.g. a mass spectrometer or a large telescope). In analogy with the electricity power grid this technology is called the Grid.

Although these two developments can be seen as impressive enabling technologies for a new leap forward in science and society we are far away still from fully integrating and exploiting their potential in modern every day R&D practice - let alone have spin-off effects in society. The changing scale and scope of experimental science - with its need for accommodating the growing numbers of research coalitions with continuously changing partners

and access to information - require a new research paradigm: (*digitally enhanced science* or *e-Science*). The aim of the Virtual Laboratory for e-Science (VL-E) project is to bridge the gap between the technology push of the high performance networking and the Grid and the application pull of a wide range of scientific experimental applications. It will provide *generic functionalities* that support a wide class of specific e-Science application environments and set up an experimental infrastructure for the evaluation of the ideas.

Mission, strategy, aims, key questions

The mission of the VL-E project is:

To boost e-Science by the creation of an e-Science environment and doing research on methodologies.

The strategy will be:

To carry out concerted research along the complete e-Science technology chain, ranging from applications to networking, focused on new methodologies and reusable components.

The essential components of the total e-Science technology chain are:

- e-Science development areas
- a Virtual Laboratory development area
- a Large Scale Distributed computing development area, consisting of high performance networking and grid parts.

To reach its mission the VL-E project has set itself the following four aims for the duration of the project (four years):

1. Create scientific prototypes of application specific e-Science environments.

In order to verify the applicability of newly developed e-Science ideas, methodologies and techniques, scientific prototypes will be developed for a number of well chosen application domains. These application domains are all challenging in various aspects of the required methodologies and underlying technology. The resulting key question that has to be answered is: *How can we create flexible collaborative e-Science environments providing time and location independent experimentation and allowing the processing, sharing and integration of data and resources from “in vivo” or “in vitro” and “in silico” experiments?*

2. Develop a methodology for re-usable ICT components.

Reusability of ICT components (e.g. virtual laboratory and grid technology) is of key importance to improve R&D. This has an obvious economic impact, because it speeds up the R&D development cycle and broadens its range of applications. The corresponding key question is:

How can we provide a versatile basis for new R&D applications and improve the quality and speed for realizing them by using generic and re-usable software components?

3. Scaling up to e) validating in ‘real-life applications’

To emphasise the integral approach of the consortium, a considerable effort is planned in validating the developed ICT methodologies and technologies by scaling up. This gives insight in the applicability and robustness of these methodologies and techniques over the various domains. The corresponding key questions are:

Will it be possible to create a secure and reliable distributed hardware/software infrastructure base that can be used to provide access to grid computing, storage and visualisation resources, instrumentation and information?

Will the developed methodology and resulting software in the VL-E project scale in real-life applications?

4. Build up and transfer knowledge on effectively realising application specific e-Science environments

Transferring the acquired knowledge, both within the consortium and to society at large, is considered to be of great importance in the VL-E project. The impact of e-Science on the research world and society in general will more likely be achieved when the e-Science paradigm is adopted throughout the public and private research communities. Therefore a dedicated effort will be undertaken to establish a ‘Virtual Laboratory Knowledge Transfer Centre’

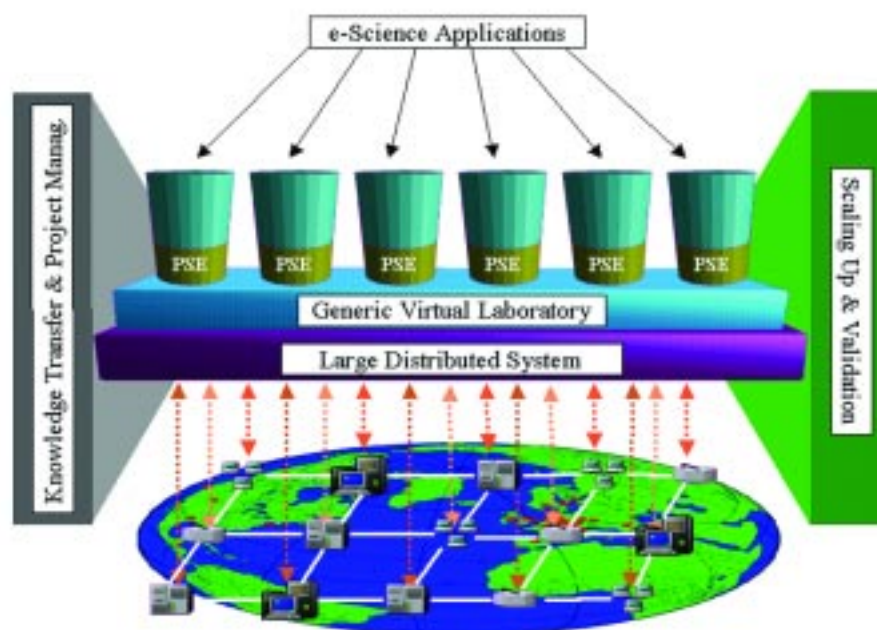


FIGURE 1.1: THE VL-E PROGRAM DEFINES THREE LAYERS OF RESEARCH ACTIVITIES. IN ADDITION IT STUDIES SCALING UP & VALIDATION AND IT PROVIDES KNOWLEDGE TRANSFER. (PSE: PROBLEM SOLVING ENVIRONMENT)

Program

To achieve these aims and address the corresponding key questions a scientific program has been developed comprising of four *program lines*, most of them containing more than one *subprogram*. These program lines structure the research and facilitate the dissemination of results:

e-Science in applications

- This research program line has the objective of creating several research prototypes of advanced e-Science application specific Problem Solving Environments (PSEs) in the area of food science, medical science, telescience, data intensive computing, bioinformatics and biodiversity. All cases will be based on the VL-E generic part of the PSE and the facilities and functionalities it provides. The research prototypes will be further developed towards proof-of-concepts and will act as a driver for key research areas in the generic Virtual Laboratory program line, and as such provide suitable field tests.

Generic Virtual Laboratory methodology

- This research program line develops the fundamental knowledge for the Virtual Laboratory. It focuses on generic methodologies for e-Science such as problem solving, adaptive information disclosure, visualization and user interface, information systems and systems integration. It will apply and test them in the various applications, with the purpose to validate and improve the functionality and performance of the methodologies.

Large Scale Distributed systems

- The focus of this research line is on the fundamental knowledge development in the area of large-scale distributed computer systems, based among others on high performance networking and Grid technology.

Scaling up to & validating in 'real life applications'

- This research line has the objective of doing field-testing for evaluation and scaling up of the proof-of-concept environments under several well-chosen real-life conditions. Two environments (test beds) will be developed for field-testing with the aim to evaluate the methods and tools developed in this project and to integrate methods and tools developed elsewhere. These test beds will be large-scale experimental environments; one will be nationwide, one will be on an international scale

Economical & social relevance

One of the main problems of the Dutch economy is its present small productivity growth compared to other countries and our own historical growth figures. Whatever the cause of this might be, it is well understood in science and technology policy that investment in the information economy - R&D, ICT and higher education - are important factors in accelerating the growth of productivity and strengthening the competitive base of manufacturing, transport, and business services in the Netherlands. VL-E is meeting these requirements by improving the efficiency of access to information in the scientific and engineering process and the Dutch public and private knowledge infrastructure

Consortium

The members of the consortium (21 partners from 19 legal entities) represent all necessary technology push and pull skills necessary to carry out and successfully conclude this complex project. It includes investigators from several major scientific application domains (e.g. food industry, medical and chip industry equipment), specialists in various generic virtual laboratory research areas and researchers on grid and networking. They stem from private research such as Philips, Unilever and IBM or private engineering such as LogicaCMG and FEI, as well as from public research institutions such as the University of Amsterdam, the Vrije Universiteit, Delft University, FOM (physics) institutes AMOLF and NIKHEF, the NWO institute CWI and TNO institutes.

The consortium has established a close collaboration with the Bsik proposals Giga Port Next Generation Networks and Giga Port Next Generation Applications as well as with the Netherlands Bio Informatics Centre.

Project organization

The organizational layers of the project consist of a Supervisory Board, a Scientific Directorate, a financial director and the subprogram leaders. In addition there is an International Advisory Board. The scientific directorate of the VL-E consists of the general director, prof. dr. L.O. Hertzberger and two adjunct-directors, prof. dr. ir. H. Bal and dr. G.R.Meijer. The administrative director is drs. J. Vos.

Knowledge Transfer Centre

A dedicated centre will be established aiming at the transfer of knowledge developed in the project. Transfer will be expected to take place first within the consortium, but will be extended to and carried out in collaboration with closely related organizations, such as SURFnet, the Telematics Institute, the Netherlands Bio Informatics Centre and Astron. Industry and society at large will be an important focus area of knowledge transfer throughout.

Program cost

The total budget of the program amounts to 55,6 MEuro, of which 27.6 MEuro is requested for funding from BSIK.