



NANOTOTOUCH - Nanosciences Live in Science Centres and Museums

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(all: Deutsches Museum)

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Abstract

The NANOTOTOUCH project aims to create innovative environments for the broad public to learn about and to discuss nano research by directly involving the actors of research themselves. We do this by taking the laboratory environment and the research work out of enclosed academic campuses and relocating them right in the midst of the public in science museums and science centres.

Three science museums and three science centres will closely cooperate with local university partners to create three permanent Open Nano Lab locations (in Munich, Milan and Gothenburg) and three Nano Researcher Live areas (in Mechelen, Tartu and Naples). In these places the visitors will experience “live” the day-to-day practices and processes of nano research conducted by young scientists.

This peer-to-peer dialogue on an equal basis between lay public and nano-researchers not only creates a bidirectional feedback, it also minimises the expert-to-lay bias (“top-down” approach) inherent present science communication processes with authoritative top researchers. In order to prepare the young scientists for this novel method of communication, NANOTOTOUCH also includes a strong communication skills training component.

NANOTOTOUCH will also establish new role models for choosing science as a career: young adults thinking of entering science will be able to discuss various aspects with young researchers who themselves made this decision recently, whilst upcoming researchers will learn that communication is a self-evident part of their professional identity.

Thus, NANOTOTOUCH pushes science communication to its extreme, merging communication and research in a powerful way and responding to the need for more transparency and accessibility in science. Furthermore, the strong synergetic network approach of the project enables contents and models to be developed for further distribution and implementation in educational and scientific communities.

NANOTOTOUCH - Nanosciences Live in Science Centres and Museums

This project aims to create an innovative place for the broad public to learn about and to discuss nano research by directly involving the scientists and actors of research themselves. We propose a straightforward way to do this by taking the laboratory environment and the research work out of enclosed academic campuses and relocating them right in the midst of the public scene.

This “Open Nano Lab” approach pushes science communication to its extreme. It creates a context in which communication and research overlap and merge in a powerful way. Typically, scientists act in two completely different modes of operation which are completely independent of each other: on the one hand they conduct research within their scientific community, whilst on the other they separately explain or “demonstrate” their work to the lay public. This approach, however, often leads to a top-down science communication which can easily overwhelm or confuse the average person.

According to the “Engagement Continuum” model (fig. 1), most activities and programmes developed by science museums and science centres must be placed at the “passive” end of the continuum. This refers not so much to the presentation methods, but to the role that the public plays in the communication and engagement with science. With NANOTOTOUCH we propose to create the infrastructure and know-how which will relocate the European science museums and science centres to the “active” end of the continuum in regard to nanoscience communication. At the same time the project’s network approach will create capacities in many science centres and smaller institutions, enabling them to reposition themselves further along the continuum and to gain the skills and competences necessary to competently engage and inform the public about nanotechnology and nanoscience.

Engagement Continuum

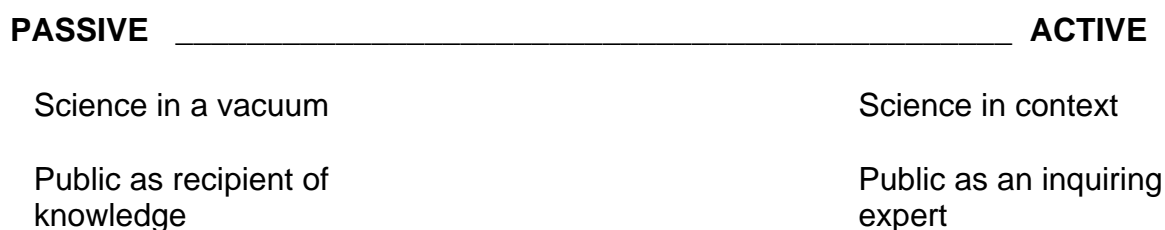


Fig. 1 The "Engagement Continuum" model¹.

Having a full-size, perfectly operational research lab in the public space of the science museum is an idea that breaks right through the conventional lines of demarcation that normally seal off science from society as a separated subsystem. As this approach requires both experience in running scientific research and in dealing with public discourse, a close networking of institutions from both fields is necessary to the benefit of all. Yet the implementation of an Open Science Lab also requires a careful investment and a long-time commitment. Therefore, the project includes not only the complete form of the “Open Nano Lab” but also the “Nano

¹ Einsiedel, A. A., & Einsiedel, E. F. (2004): *Museums as Agora: Diversifying Approaches to Engaging Publics in Research*, in D. Chittenden, G. Farmelo, & B. V. Lewenstein (Eds.), *Creating connections: museums and the public understanding of current research* (pp. 73-86). Walnut Creek, CA: Altamira press

Researcher Live" format, which enhances the usual "meet the scientist" activities with real, authentic research contents within a nano-environment.

Nano To Touch

Nanosciences Live in Science Centres and Museums

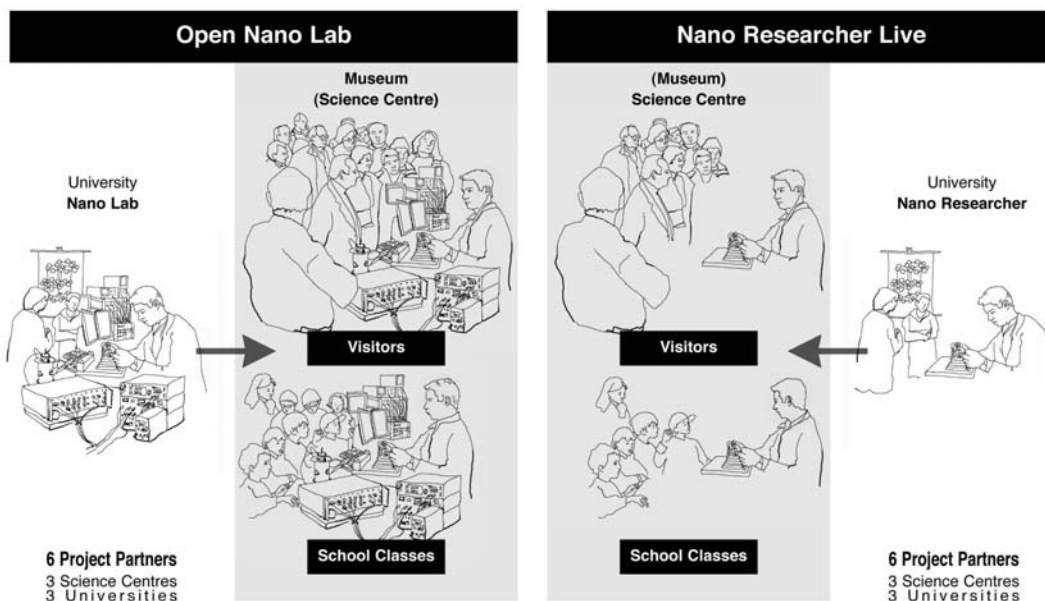


Fig. 2 Scheme of the NANOTOUCH approach

As science centres and science museums are as much rooted in their local communities as they are linked to the scientific community, they are an ideal platform for communicating science to a wide audience. Not only focused on visitors with a basic interest in science, museums reach out to a broad public, especially young people, through their connections with schools.

This project draws on experience gained in a preliminary "Open Nano Lab" at the Deutsches Museum which was established in a simple, provisional way in close cooperation with the local Ludwig-Maximilians-University. This museological experiment has proven so successful and valuable in its two-year test phase that it now deserves to be operated on a much broader and more sustainable European basis.

Project objectives

Our project encompasses seven main objectives:

1. To raise a **sustainable infrastructure of public sites** ("Open Nano Labs" and "Nano Researcher Live" event areas) where the broad public will be informed about nano research on a regular, day-to-day basis and will be able to personally engage with the researchers themselves.
2. To not only inform about recent results of nano science but also **to let the public experience "live" the day-to-day practices and processes of nano research.** Thus, the project answers to the recognized need for a Public Understanding and Engagement with Research rather than a Public Understanding of Science.
3. To offer a **peer-to-peer dialogue on an even basis between lay public and nano researchers** which allows for a bidirectional feedback. To minimize the

expert-to-lay bias (“top-down” approach) inherent to science communication processes, this project explicitly involves young scientists, not the authoritative well-experienced top researchers. It therefore also includes a strong component of communication skills training.

4. To bring the academic discourse of the **ethical issues and societal implications of nano technology** down to the more everyday problems and questions of the individual people – expressed in the discussions initiated by the hands-on everyday lab practice in the Open Nano Labs or the Nano Research Live events.
5. To profit from the strength of Science Centres and Museums and bring an interested public, especially students and teachers, into a direct encounter with nano researchers and their activities. These **specially tailored school programs** will allow for a more thorough dialogue and feedback.
6. To **establish new role models** for both sides of the process of taking a career in science: young adults reflecting on a possible career in science will have the opportunity to discuss their ideas with young researchers who themselves made this decision recently; upcoming researchers will learn that communication of their research is a self-evident part of their professional identity. In combination with the communication skills training, the project aims for a sustainable feedback into the scientific community which in the long term will lead to a change in behaviour and a more significant attention to the engagement of the public.
7. To **provide both research and educational institutions with a model for strong and effective linking and collaboration** between them, which is a precondition for developing such program formats. To this effect, the project will codify and document its experiences in detail in several handbooks or “Cookbooks”.

Quality and effectiveness of the support mechanisms

Also, many science communication activities – especially those targeting a broad public, such as printed media, radio and TV – draw primarily on the prominent researcher at the top of his or her career, skilled and well-experienced in popularization. But this is not the typical researcher and thus not necessarily the best choice for a balanced two-way dialogue where experts and lay people meet on an even level and where we can hope to get an honest feedback. For this reason, the NANOTOUCH project focuses on young, upcoming researchers as communicators.

In order to assure the quality and effectiveness of the project, comprehensive training programmes will equip the scientists with the skills needed to present their work in a clear and concise way so that a broad public can grasp and understand the contents and the necessity of nanoresearch and to understand the different perspectives and preoccupations of lay people in respect to their work. The core of the network consists of three “Open Nano Labs” and three “Nano Researcher Live” areas which are especially designed to come as close as possible to an authentic, on-going encounter with research whilst drawing on the experiences made and the models developed within the Open Nano Labs. This approach takes to an extreme the

conclusion of the Wolfendale Committee² that scientists who receive public funding for their research have a duty to communicate their research to the public.

Overall strategy and general description

More than ever it is important for society to comprehend the processes of science, as our future is being shaped in research laboratories. Because of this fact it is vital for our European society that there is a strong and lasting interaction between scientists and the broad public. With nanotechnology posed to be one of the leading industrial fields of the 21st century, European citizens have a need and a right to be informed both about the processes of current research as well as the resulting products. For this reason the Deutsches Museum, one of the largest science and technology museums in the world, commenced the Open Nano Lab project in 2006. In its two years of trial operation, this laboratory has proven to be an extraordinarily effective tool for presenting nano-research and nanotechnology to a wide audience. Many of the 1,4 million international visitors per year to the Deutsches Museum have gained insights into current nano-developments at the Open Nano Lab, ranging from school classes with their teachers to young researchers, from the general public to members of the German parliament. In addition, a number of young scientists have both realised the vital importance of science communication and acquired the skills necessary for relating their work to a diverse audience.

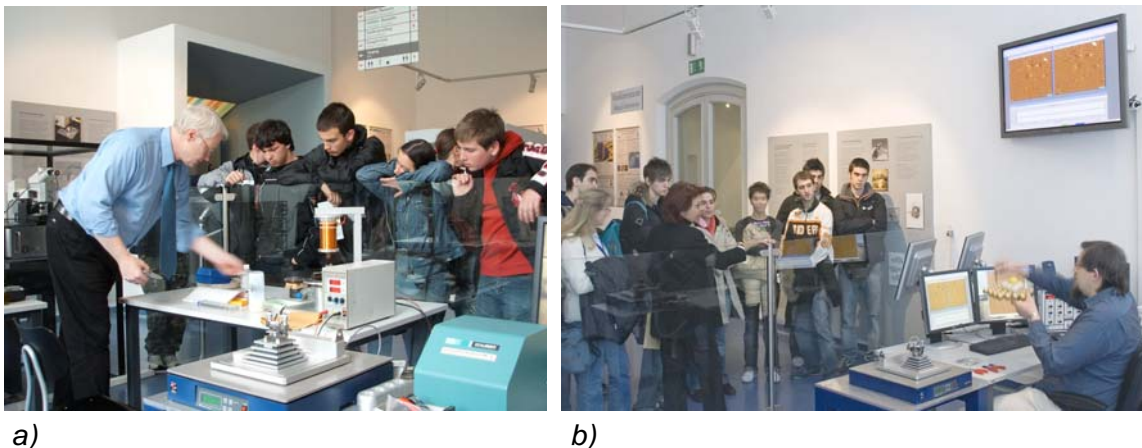


Fig. 3 The Open Nano Lab in the Deutsches Museum

a) the researcher (on the right) explaining the basics aspects of his research to a group of visitors to the museum.

b) the scientist (on the left) giving a demonstration of nano-effects

[note the scanning probe microscope in the central foreground of both a) and b)]

In our test phase one doctorate student worked permanently in the Open Nano Lab, both conducting his research and coordinating the work of seven other students of various levels of experience, each of whom spent an average of three months in the laboratory. Thus, over two years a total of eight students were able to experience working in the unique environment of a publicly accessible museum, communicating their own research and the thoughts and ideas involved. The museum visitors have been able to observe the students in the daily process of obtaining data and images from their instruments and to see how these are processed to attain the desired information. This is where the often cited dialogue between scientist and lay citizens - including the next generation of researchers - actually takes place.

² Wolfendale Committee (1995): *Final Report*, London, Office of Science and Technology

This dialogue is supported in the Open Nano Lab by a number of elements such as outwards facing visitor monitors which mirror the workplace monitors and thus the scientific work of the scientist. An exhibition of currently available nanoproducts gives an insight into the impact of nanotechnology on daily life, whilst live demonstrations of various nano-effects are an eye-catcher for the visitors whilst at the same time enabling the scientist to present some of the differences between the macroscopic and the nanoscopic world in a simple and easy-to-understand way. Other peripheral elements are information boards, a large-screen TV for showing nano-related film clips, an interactive computer terminal with background information and a simulation of a SPM measurement.

Infrastructure

Over the past two years a prototype Open Nano Lab has been successfully tested in the Deutsches Museum in cooperation with Munich's Ludwig-Maximilians-University. This will serve as the basis for the proposed handbook "Professional guidelines for establishing an Open Nano Lab". The prototype lab is separated from the public area by a low glass wall, clearly defining the laboratory area whilst at the same time enabling the visitors to observe the daily work of the scientists and engage in conversations with them. Scanning probe microscopy research and nanotechnology demonstrations take place within the laboratory area, whilst the nanoprodukt exhibition is located within the public space along with peripheral elements (information boards, scientific posters, media presentations) which augment the visitor's experience.

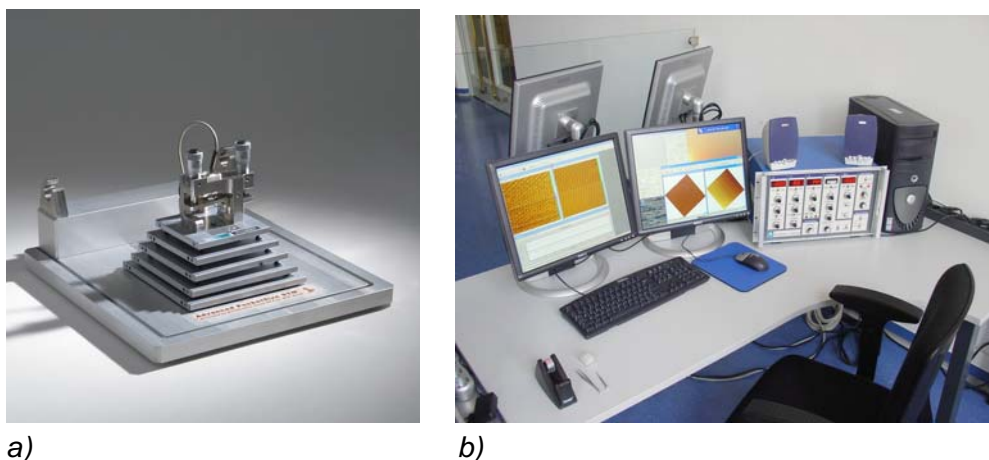


Fig. 4 The main instrumentation of the Open Nano Lab

- a) Scanning Probe Microscope (SPM)*
- b) SPM workstation (note the outward facing visitor monitors)*

After successfully testing the Open Nano Lab and backed up by an extensive visitor evaluation with an international audience, the Deutsches Museum now has the vision of exporting publicly accessible nano-science throughout Europe. Well equipped to help establish further Open Nano Labs in various partner museums, the NANOTOUCH consortium coordinated by the Deutsches Museum will now expand the fundamental idea of live communication by creating Nano Researcher Live programmes in partner science centres. Based on the experiences of the Open Nano Lab project, this new format entails the creation of a nano-environment (e.g. through exhibits, demonstrations and interactive presentations) centred around a live presentation area where scientists from the local partner universities explain and

discuss their current work in a public forum. A local coordinator in the partner science centre organises a presentation on average once every two weeks, discussing in advance with the respective scientist which presentation aids and exhibits are required for supporting a successful dialogue with the attending visitors.

Following the guidelines elaborated in a handbook, each of the proposed Open Nano Labs and Nano Researcher Live areas will be individually designed according to the resources and the requirements both of the partner science museums / science centres and of the scientists from the partner universities. In each case this will include the research area (for Open Nano Labs) or the presentation area (for Nano Researcher Live events) and further elements such as demonstration areas, nanoproduct exhibitions and static and interactive nano-related presentations. When completed, each of the areas will offer an overview of current nanotechnology research and its implications for everyday life.

In NANOTOTOUCH we will create an initial network consisting of three Open Nano Lab locations (Gothenborg, Milano and Munich) and three Nano Researcher Live areas (Mechelen, Tartu and Naples). These cities were chosen because of their significant established nanotechnology research institutes, a fact fundamental to the realisation of this live science approach. Moreover, collaborations between the research institutions and the science museums / science centres are highly developed in all these cities. In addition, each member of the network will profit both scientifically and museologically from the variety of different nationalities and cultures involved in this project. These factors ensure the strength of the consortium and will provide a good base for a further expansion of the network, especially to Southern and Eastern Europe.

Training and outreach

Museums and Science Centres are ideal places for leaving the ivory tower of science and going public. For this reason, many institutions in Europe are experimenting with new formats for presenting the researcher directly to the visitors. In France, the programme “un chercheur – une manip”, initiated and run by the Palais de la Découverte in Paris, invites scientists to present an experiment from their lab in front of the museum audience. In natural science research, the Natural History Museum in London is conducting a daily programme which offers a glimpse into the world of cutting-edge research. In this project the consortium, building on the experience in dialogue and deliberation of nanotechnology issues of the Deutsches Museum, will greatly contribute to this movement by spreading the Open Nano Lab format to other museums and extending it to Nano Researcher Live events in science centres. In order to ensure the success of this project it is important for the participants to know / experience / learn the following points:

1. Capability of guiding a dialogue concerning a complex issue like nanotechnologies (psychological, pedagogical and communication skills)
2. Knowledge of the advantages of a museum or science centre compared to other media (individually tailored face-to-face discussions about nanotechnologies, media knowledge issues); knowledge about visitor structure and visitor needs (visitor studies issues)
3. Awareness of current risks and advantages discussions concerning nanotechnologies (debate of cultural and social issues)

Due to the planned system of rotation where young PhD or diploma students will work in the museum for an average of three months and then be replaced by a "new" generation of scientists, it is necessary to construct a continuous, stable knowledge base for science communication within the museum.

Two workshops are will take place to transfer this knowledge to the young scientists and to refine the material and information used, whilst an ongoing training programme will enable these contents to be passed on to further generations of scientists. The training programme is based both on the know-how imparted in this workshop and on the experiences of the young scientists. Mentored by the local museum and science centre educator or curator, these contents will be passed on to the "next generation" of young scientists in a continuous process. Papers referring to the workshop issues as well as films will be provided. Thus, the locally trained students will be well equipped for working in public.

The goal of both workshops is to provide the attending museum / science centre educator or curator and the researchers with a theoretical and practical foundation to know / experience / learn the above mentioned points (capability of guiding a dialogue, knowledge of the advantages of a museum or science centre compared to other media, knowledge about visitor structure and visitor needs, awareness of current risks and advantages discussions concerning nanotechnologies). In addition, the workshops are to provide the fundamental equipment and training necessary to successfully implement the process of passing on these skills to the next generation of scientists. Additionally, the second workshop will review the experiences gained since the first workshop, evaluate the success of the established communication methods and correct where necessary.

Running the programmes

The vision of this project is to create an animated, vivid place of encounter in the partner science museums / science centres where visitors come into touch with current nano research, discussing various aspects with the scientists and obtaining in-depth information on nanotechnology. The day-to-day running of the proposed programmes will be based on the experiences of the Open Nano Lab in the Deutsches Museum where students from Munich's Ludwig-Maximilians-University conduct their scanning probe microscopy measurements whilst answering questions and engaging the visitors in discussion. Although apparently simple, the daily operation of the Open Nano Labs requires detailed organisation in order to ensure success. On the one hand the students should spend most of their research time in the laboratories, whilst on the other it is necessary for them to maintain a link with their university to remain up-to-date with developments in the scientific world and to discuss their own results with their peers. In addition, by maintaining a small research group of at least three students in an Open Nano Lab a healthy social environment for the successful conduct of science is generated. These aspects, as well as the ongoing communication training and supervision require local coordination and planning.

In addition, the science museums / science centres need to integrate the proposed activities into the context of their regular visitor programmes. To ensure a varied and attractive offer and to fully exploit the potential of the sites, specific target groups should additionally be addressed with customised events such as guided tours, round table discussions with the scientists or other educational resources and material.

The scientists engaged in the Nano Researcher Live events also require not only preliminary communication training, but also a stimulating environment in the museum which helps convey a sense of their daily research work. To this effect it is necessary for the museum to present objects from their laboratories, illustrations, information etc.

Evaluation

The main objective of NANOTOTOUCH is to develop new ways for the communication of research between scientists and the public in the field of nanotechnology. Current research studies have effectively shown that self-efficacy of the scientists regarding their ability to communicate effectively to the public is a main precondition for their willingness to engage in such activities³. Thus it is important to create a communication environment that both supports and encourages the individual researcher.

In regard to the public it is vital to ensure the development of curiosity and interest in nanoscience, as well as the feeling of being able to understand the subject-matter. Without fulfilling these basic requirements, an effective dialogue is not possible. In order to achieve these goals it is necessary to evaluate the effectiveness of the proposed formats. Specific evaluation studies will be designed and conducted which focus on the attainment of the above mentioned goals. These studies will target the effectiveness of various communication strategies developed in the course of this project in regard to two target groups: the public and the scientists.

The results of both of the target groups of the evaluation studies will help optimise the concepts implemented in the Open Nano Labs as well as the programmes of the Nano Researcher Live events. The studies will be so designed that the results are both immediately useful for the project itself, as well as for future activities in the field.

Dissemination

In order to ensure as great an impact of the project as possible, the dissemination strategy of NANOTOTOUCH will use the full potential of the local, national and European networks of each partner of the consortium.

Local dissemination is at the core of this project, with scientists entering into personal dialogue with individuals and small groups of the general public within the science centres and museums. Thus, each NANOTOTOUCH participant is a hub in its own right, able to communicate to interested groups, organisations and individuals. As many are part of local or national networks of related institutions, influential in their fields, they are thus able to disseminate at regional, national and European levels. Many also work with private companies, host private and political events, and can thus disseminate NANOTOTOUCH through these relationships. In addition, meaningful efforts will be allocated to disseminating the project's events to media.

The European Network of Science Centres and Museums "Ecsite" will be a key channel for dissemination, with Ecsite Annual Conferences also serving as crucial events: 1000 professionals from the field of European science communication are attending each year.

³ Ellen Poliakoff / Thomas L. Webb (2007): *What Factors Predict Scientists' Intentions to Participate in Public Engagement of Science Activities?*, Science Communication, Volume 29, Number 2

Consortium

Name of the institution	Town	Country
Deutsches Museum von Meisterwerken der Naturwissenschaft und Technik	Munich	Germany
Ludwig-Maximilians-Universitaet München	Munich	Germany
Fondazione Museo Nazionale della Scienza e della Tecnologia Leonardo da Vinci	Milan	Italy
Università degli Studi di Milano University of Milano – Interdisciplinary Centre for Nanostructured Materials and Interfaces	Milan	Italy
Universeum AB	Gothenburg	Sweden
Chalmers Tekniska Hoegskola AB	Gothenburg	Sweden
Technopolis, the Flemish science centre	Mechelen	Belgium
Universiteit Antwerpen	Antwerp	Belgium
SIHTASUTUS TEADUSKESKUS AHHA Science Centre AHHA Foundation	Tartu	Estonia
TARTU ULIKOOL University of Tartu – Institute of Physics	Tartu	Estonia
Fondazione IDIS-Città della Scienza	Naples	Italy
CONSIGLIO NAZIONALE DELLE RICERCHE National Research Council – Institute of Cybernetics “E.Caianello”	Naples	Italy
Technische Universitaet Muenchen	Munich	Germany
Association Européene des Expositions Scientifiques, Techniques et Industrielles	Brussels	Belgium
Ecsite -The European Network of Science Centres and Museums		