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Communicating Nanotechnology

Why, to whom, saying what and how?

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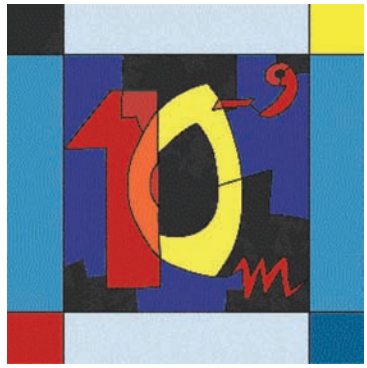
EUROPEAN COMMISSION

COMMUNICATING NANOTECHNOLOGY

Why, to whom, saying what and how?

An action-packed roadmap towards a brand new dialogue



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Everyone is quick to blame the alien.
(Aeschylus)

FOREWORD

Herbert von Bose
Director of Industrial Technologies,
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You cannot have an appropriate social dialogue on nanotechnology without an open-minded, consistent and even audacious communication roadmap aiming to bring everyone in. Good governance depends on it, as the EC had already acknowledged robustly. The Directorate Industrial Technologies of the Directorate-General for Research (DG RTD), is now firmly set to push this bold principle towards building a broad consensus to support the EC's policy on integrated, safe and responsible nanotechnology.

So appropriate communication comes first, and you need a sound and clever method here. You need to know whom you are reaching out to, since audiences are many. You need to envisage the impact you are going to have, in order to make people feel personally involved and eager to know more. You also need to anticipate how you are going to meet the communication needs of the so called 'stakeholders' who have a specific interest in nanotechnology, of young people who might not be quite aware of it yet, and of the general public whom the EC wants to keep fully informed regarding research developments as they come along. All these issues are analysed, structured and packaged in chapters one to three under a new communication model that relates to citizens' concerns and needs.

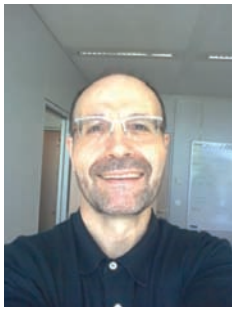
Dialogue and engagement are the next, crucial phase. By building on knowledge and awareness of nanotechnology, this Communication Roadmap comes forward with a whole system of organised mechanisms designed to prepare the ground for very effective feedback and exchange with society. This represents the contents of chapters four and five which set out an ambitious scheme of implementation measures that tests the communications model's efficacy to deliver its messages to millions of citizens effectively.

This communication exercise should, indirectly, have two major, desirable effects: increasing the consensus between stakeholders, society and policymakers on EC decision-making about nanotechnology; and strengthening the image of the EC as an impartial, transparent and trustworthy communicator on nanotechnology.

Innovation and creativity are of the essence here, and indeed the EC wants nanotechnology to speak, as a priority, the many expressive languages of Web platforms, social networks, science centres, multi-platform media news or features and the open dialogue between scientists and citizens. On top of the conventional printed material, audiovisuals and event-related materials, the EC is now looking with special interest at the way art, design, music, theatre and films could enrich the communication of technology.

In this sense, this Communication Roadmap feeds into the philosophy and principles set out by the present European Year of Creativity and Innovation which has been its inspiration. It is a wonderfully stimulating challenge.

PREFACE



Christos Tokamanis
Head of Unit for Nano- and Converging Sciences and Technologies
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The European Commission has been very quick to understand just how hot nanotechnology communication is. This sharp awareness has been matched by the strong interest and real concern of EU institutions, and has steadily produced a growing range of socially engaged policy documents and dedicated projects over the past few years.

The first, crucial steps that shaped the European Commission's whole approach go back to 2004, when the Communication 'Towards a European Strategy for Nanotechnology' ([1]) was published, followed in 2005 by the 'Nanosciences and Nanotechnologies: An Action Plan for Europe 2005-2009' ([2]). In these political documents, a strategy for an *integrated, safe and responsible* nanotechnology was put forward to Europe and the rest of the world. Here, the EC stated that clearly that 'societal impacts need to be examined and taken into account. Dialogue with the public is essential to focus attention on issues of real concern rather than 'science fiction' scenarios.

Engaging a public that might have been inadequately informed so far, or perhaps outright misled because of the very complexity of the issue, is the core challenge. In these policy documents the EC observed that 'nanotechnology is poorly understood. Since it is complex and concerns a scale that is invisible, nanotechnology may be a difficult concept for the public to grasp. While the potential applications of nanotechnology can improve our quality of life, there may be some risk associated with it, as with any new technology – this should be openly acknowledged and investigated. At the same time the public's perception of nanotechnology and its risks should be properly assessed and addressed'.

Involving Europeans in appropriate communication and dialogue is a real asset to the EC, whose aim is to align nanotechnology development with the people's expectations and concerns, and at the same time to pave the way for a level playing field in the global market. Clearly, 'the public trust and dialogue on nanotechnology will be crucial for its long-term development and allow us to profit from its potential benefits. It is evident that the scientific community will have to improve its communication skills.'

The emphasis on this could not have been clearer. The EC aimed to implement the Action Plan's mandate by encouraging 'a better dialogue between researchers, public and private decision-makers, other stakeholders, and the public', and stressing how 'beneficial' this would be 'for understanding possible concerns and tackling them from the standpoints of science and of governance, and to promote informed judgement and engagement'.

In this light, the Sixth and Seventh Framework Programmes (FP6 and FP7) of the European Union for supporting and funding scientific research and technological development have been playing a pivotal role. They spell out the need for EC-funded nanotechnology research and applications to be responsible and thus respond to the expectations and concerns of European stakeholders.

[1] European Commission (2004): *Towards a European Strategy for Nanotechnology,* COM(2004)338; EC, Brussels, 2004 (http://cordis.europa.eu/nanotechnology/actionplan.htm and http://ec.europa.eu/nanotechnology/pdf/nano_com_en_new.pdf).

[2] European Commission (2005): *Nanosciences and nanotechnologies: An action plan for Europe 2005-2009,* COM (2005) 243, EC, 2005, Brussels, (http://cordis.europa.eu/nanotechnology/actionplan.htm).

The initiatives relating to communication, outreach and societal dialogue include many projects funded within FP6, including pilot projects and international events, and presumably within the current FP7, which will last until 2013.

The need for these communication projects emerged over two years between 2007 and 2008. The main stops along this road were two separate workshops, with a very interesting open Web-based consultation on communication outreach about nanotechnology in between. These workshops involved the participation of 48 international experts from the very different realms of opinion-making, science communication outreach, social engagement, design, arts and, of course, nanotechnology.

In this respect, crucial input was provided by the Web consultation, which impressively built on the results of the first workshop and stayed open for over six months on the nanotechnology website of the European Commission. This exercise enabled us to collect hundreds of comments from the lay public, allowing for a wide variety of views, opinions, expectations and concerns from a broad audience, which were then integrated into the second workshop.

All this led to the publication of a specific call on communication outreach; and as a result four Coordination and Support Actions (CSA) on the same topic were selected and negotiated by the end of 2008, with an overall budget of EUR 5 million.

The EC takes this whole communication effort on nanotechnology so seriously, that it now wants to prepare for an appropriate dialogue among stakeholders about the social challenges of nanotechnology: this has been the focus of two further publications issued at the beginning of 2008 and of other projects launched during this and next year, with special emphasis on television and Web media, as well as on young people.

Reaching the right audiences, with the appropriate message and means is of essence. All these dialogue efforts will culminate into the European Platform on Nano Outreach and Dialogue (NODE): it will deal with a specific system of mechanisms to enliven and coordinate the continuous and open dialogue on nanotechnology within the whole EU society, empowering both EC and Member States with a very challenging tool for delivering technical democracy on nanotechnology.

Clearly, continuity is our priority. In order to achieve this, the present roadmap presents various sets of communication activities and products. Their inclusion into a robust and integrated framework is expected to increase both confidence and trust in the EC, thereby enhancing its image as a truly transparent and trustworthy communicator on nanotechnology.

This document presents the focus, objectives, methodology and actions to be developed in the near future. The main prospective figures of communication outreach and dialogue are just as impressive: it is estimated that around one hundred million citizens will be reached over three years, between 2009 and 2011.

INTRODUCTION

NOTE OF THE AUTHOR

Matteo Bonazzi

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Image is to communication what gold is to a jewel. Though it takes long years to build, the image of any organisation can be swiftly ruined, even if the architect is talented and the workers are conscientious. Communicating such an image is indeed a no-starter without a good, solid communication strategy underpinning this effort. This is not at all about facade. It is not even about what a Communication Roadmap can or cannot bring to any organisation. In this instance, it should be about participation, by involving everyone with an interest in the issues. Meaningful communication creating a relationship and an exchange between stakeholders seems to be especially needed in the case of nanotechnology, where the public is more sceptical and less deferential.

Any conventional approach, so far based on the 'public understanding of science' has to be redressed now. It needs to be turned around into the trickier concept of a 'scientific understanding of publics'. These different audiences could not simply stand any tone they might remotely perceive as condescending. They would just turn you off and tune you out in no time. Clearly, a new mode of communication is required.

A bottom-up approach based on seeking a constant dialogue seems to be much more appropriate. Here, those striving to communicate the wonders of their science also listen to the perceptions, concerns and expectations of the audiences and engage into a discussion with them. Clearly, diverse degrees of interest, sensitiveness, and creativity are needed. They are a plus, they are valuable. Dialogue requires ears as well as voices – indeed the number of ears should double the number of mouths, as several ancient traditions suggested in their own time.

Admittedly, the 'European Ship' is somehow lagging behind on this. Perhaps this is due to the fact that there is hardly one communication strategy model which all European cultures may feel comfortable with. Also, past practices sometimes may have narrowed their focus on the relationship with media and target audiences too much, or they may have been too self-centred. Anticipating events looks like a tall order in any case, although Pierre Massé, founder of French planning, wrote that 'planning should leave nothing to chance'.

As nanotechnology is becoming more deeply embedded in today's life, its crucial, potential opportunities and drawbacks for all society should be explained. But this task cannot be left solely to scientists or technology suppliers, especially considering that with 'hot' issues like new technologies such advantages and risks can often be over- or understated. The concept of novelty associated with science and technology usually induces a wide range of contradictory feelings, embracing enthusiasm yet creating mistrust. This 'crisis' of conventional perception is naturally rooted in the response of most cognitive patterns and behaviours when faced with the unknown, and we should be aware that nanotechnology

strongly stimulates these feelings. This is surely due to nanotechnology's high degree of novelty, the difficulties with a clear 'mental mapping' of its developments and their hazy symbolic representation.

Not every culture tackles a crisis in the same way. In fact, as ancient Chinese monograms teach us, the concept of crisis is designed by two complementary icons combining the representations of 'danger' and 'opportunity'. Novelty in nanotechnology evokes both. That is the reason why such a crisis in conventional perception requires appropriately new communication patterns. The core challenge here is about engaging society in an inclusive dialogue that is able to identify desirable patterns. If opportunities, risks and uncertainties were properly addressed, surely we would all be far closer to the mark of reaching consensus. In this light, the best strategy for developing an EC Communication Roadmap on nanotechnology aims at creating a lively relationship and a continuous exchange between EU institutions and citizens.

The present Roadmap feeds on the philosophy of the European Year of Creativity and Innovation and enriches it at the same time. This Year aims to raise awareness of the importance of creativity and innovation for personal, social and economic development, by disseminating good practices and stimulating education and research. As a result, policy debate on relating issues will be promoted.

As creativity and innovation contribute to economic prosperity as well as to social and individual wellbeing, most EC communication projects, actions and events have chosen this specific, inclusive approach. Every audience, be it young people, teachers, business, organisations or – more broadly – the general public, is being called to get involved at European, national and local levels.

This Communication Roadmap will address all this along three main outlines. First, it will show why and to what extent the European Commission (EC), as a major body funding nanotechnology research and development, has the moral duty to communicate with EU citizens appropriately about the opportunities, risks and uncertainties associated with nanotechnology**.** Secondly, it will be structuring an original method, based on policy analysis and communication theory, to build up pathways enabling EU citizens to be appropriately informed and feed their opinions back to the EC, which will include them in its decision-making process. Finally, it will design dedicated communication and dialogue activities and assess their expected impacts.

The present Roadmap is a true 'first': no other Communication Roadmap on Nanotechnology Research had been designed so far. Whereas communicating is a moral duty, communicating well is a moral responsibility. I do hope to have contributed well enough to fulfil this challenge, so that others may pick it up.

To those whose fears outshine their trust

TABLE OF CONTENTS

WHAT IS IT FOR

PART I.

WHAT IS IT FOR?

FRAMING THE COMMUNICATION ROADMAP

We are firstly going to go through a set of documents, sources and original works in order to identify nanotechnology areas of agreement and disagreement about communicating nanotechnology. This will bring in new suggestions and open up fresh communication perspectives.

1.1 NATURE OF THE TOPIC

'Nanotechnology' is the brand new frontier of technology in Europe and in the world. It defines the development and application of materials and processes at the nanoscale – the scale of individual molecules. Nanomaterials are particles, tubes, membranes and other materials which are measured in nanometres. Nanotechnology encompasses the scientific principles and properties of nanoscience, that can be understood and mastered when operating in the nanoscale domain, and applies them at technology level. Some nanotechnology applications have already emerged and many others are under development. Together, they are expected to have a major impact on the life of every citizen, perhaps as much as other technologies like electricity and electronics had over the whole of the last century. However, as in any other field, some nanotechnology applications may be beneficial as well as harmful. Therefore, informing and engaging the public about nanotechnologies are essential for the responsible development of this new frontier: as nanotechnology is mainly projected in the future, it is expected to involve selected audiences, so communicating to them is a priority. In fact, this early stage of development, when just a few applications have reached the market, is a critical moment for communication on nanotechnology, especially as outreach, open dialogue and debate are declared to be key elements of the European approach to science and technology. Here in the EU nanotechnology takes a very special place, to the extent that information, communication and fostering societal debate on nanotechnology have already become an essential part of many European policy initiatives. So it is clear that (i) communication on nanotechnology is critical for Europe and particularly European institutions; as a consequence (ii) selecting key audiences, how to reach them and defining the priorities for this communication is essential; finally (iii) setting up appropriate actions to be implemented for reaching target audiences via the proper vehicles for conveying appropriate messages is the ultimate step. This overall exercise will allow identifying how nanotechnology can and should be effectively communicated to selected EU audiences: this is the first thing this Communication Roadmap is about.

1.2 PARAMETERS OF THE TOPIC

We start with an analysis to explore what has been studied and done to address selected audiences in order to communicate nanotechnology effectively, with special attention to young people. To achieve this, we have focused our literature and activity review along three main lines: (i) where we are now (the analysis); (ii) where we want to be (the target); (iii) how to get there (the implementation of the Roadmap).

1.3 ANALYSING, TARGETING AND IMPLEMENTING THE TOPIC

First, the overall framework of the document is presented in Part I. Then, the analysis – the target and the implementation of the Communication Roadmap – are developed in Parts II, III, IV respectively. The schedule is developed in Part V.

- Part I. WHAT IS IT FOR? *The STRATEGY*

Shaping the framework concept for designing the Communication Roadmap.

- Part II. WHERE ARE WE NOW? *The ANALYSIS*

Reviewing the most relevant communication literature and EC activities:

(i) current perception of nanotechnology;
(ii) EC policy documents on communicating nanotechnology;
(iii) theory of communicating science and technology and communication road-mapping;
(iv) key areas of nanotechnology to be prioritised in communication;
(v) EC-funded projects on communicating nanotechnology;
(vi) EC-developed communication products.

- Part III. WHERE DO WE WANT TO BE? *The TARGET*

Targeting, structuring and designing the Communication Roadmap: to whom, how and what to communicate.

- Part IV. HOW DO WE GET THERE? *The IMPLEMENTATION*

Implementing the Communication Roadmap: define principles and guidelines; specify projects, activities and products.

- Part V. WHERE and WHEN? *The SCHEDULE*

Summarise the Communication Roadmap's time and space coordinates of projects, activities, products.

PART II.

WHERE ARE WE NOW?

ANALYSING THE RELEVANT LITERATURE AND EC ACTIVITIES

This section will screen what has been written, done and recently explored on communicating nanotechnology to selected audiences. Research studies are gathered around some common denominators, splitting quantitative from qualitative approaches. In this instance, it is possible to cluster the following sources:

- EC policy documents (on principles, strategy and policy actions essentially);
- methodological research papers (on communication theory of science and technology);
- on-field applicative research (on key areas of nanotechnology to be communicated);
- on-field experiences (projects/activities/exhibitions/products carried out so far).

We have analysed all these documents, sources and works in order to identify areas of agreement and of potential controversy among authors. This should give us a good indication of those areas of research and activities that would guide future EC communication activities. For this purpose, the common definitions, discoveries, approaches, methods, questions and recommendations are explored and taken into account.

2.1 THE CURRENT PERCEPTION OF NANOTECHNOLOGY

Here is a summary of the results coming from various literature and on-field sources, outlining what media, lay public and stakeholders say on nanotechnology. It's quite enough to give a provisional answer to the following questions.

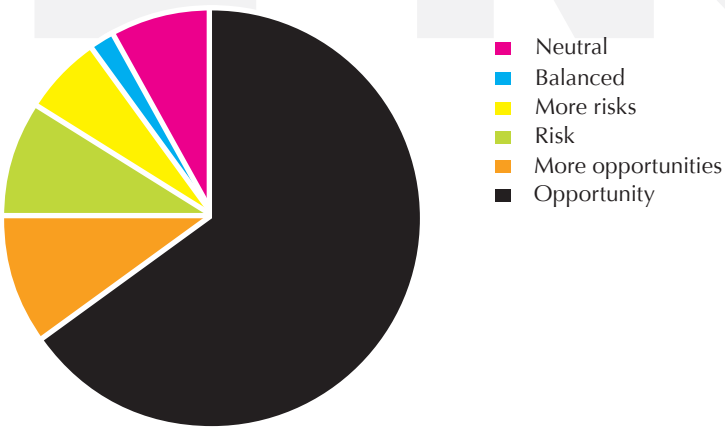
- ***What do the media say?***
- ***What do people say?***
- ***What do stakeholders say?***
- ***What is the general picture?***

2.1.1 What do the media say?

Media surveys show a positive initial vision on nanotechnology. At the same time, dialogue with society comes also clearly across as a crucial priority, which should be aimed at identifying a legitimate degree of acceptance or rejection of all that it represents. However, evidence from surveys shows that **only a small share of the EU population is aware of nanotechnology**. In this light, it is crucial to raise the question as to what knowledge and awareness, if any, these audiences would consider as relevant and appropriate to build a suitable upstream dialogue with the whole of society.

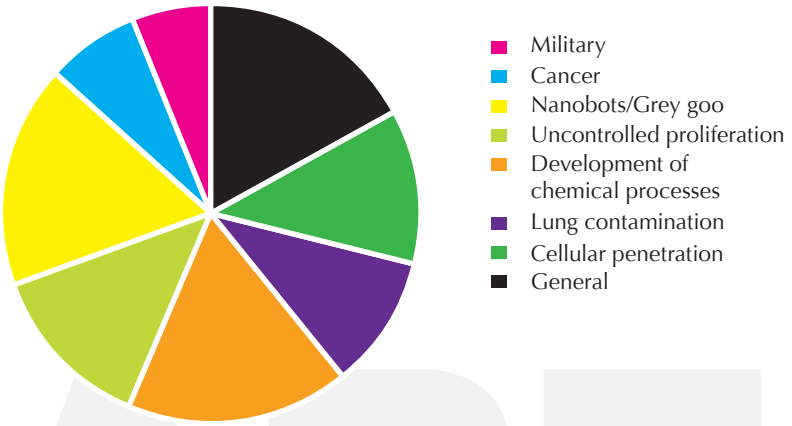
If the printed media seem to be the most upbeat about nano, a broader media analysis shows more subtle results, evolving over time. Several media seem to have switched from an initial, very optimistic attitude and fascination about nano's stunning discoveries to a more realistic interest in specific applications. Another, more sceptical slice of media is raising troubling questions on the darker side of nanotech, which they fear might see the rise of fake nano-products or health problems caused by some cleaning products, e.g. 'Magic-Nano'. Surveys from selected EU media [1] show relatively high optimism with respect to the chances/risk ratio associated with nanotechnology, where the highest rates have been attributed to the prospect of a general improvement in the quality of life and health and the development of new materials. On the other side, the issue of potential for risk across the board is also being raised, from health problems, to a lack of control of production processes, down to military use. Most media make the case for more research and dialogue with society, strengthening the importance of ethical issues. The message coming across loud and clear is that more efforts are needed in the direction of an appropriate approach on nanotechnology communication. More **research and dialogue are indispensable, the media say.**

Balance between perceptual opportunities and risks



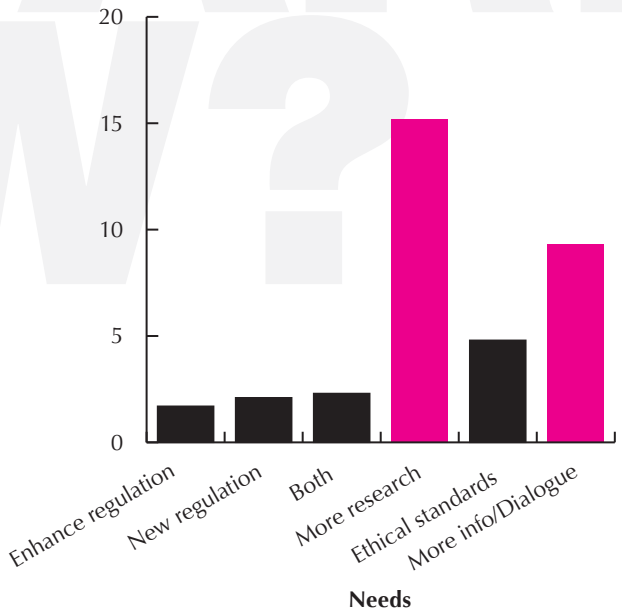
1 Nanotechnologie im Spiegel der Medien – Medienanalyse zur Nanotechnologie. Report (http://www. risiko-dialog.ch/ Themen/Nano/nano_publikationen/Medienanalyse%20Nanotechnologie%20final.pdf; Nanotechnology and Public Attitudes, in: http://www.wilsoncenter.org/index.cfm?fuseaction=news.item&news_id=143531).

Perceived risk: characterisation and structure



(source: data reworked [2])

Perceived needs in sampled articles



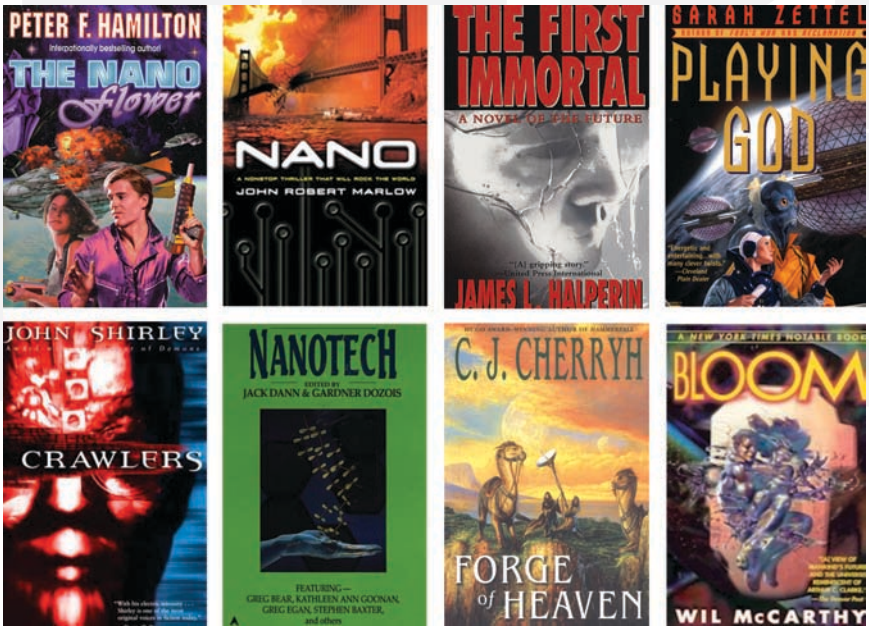
(source: data reworked[3])

[2] Der Spiegel (2004): *Nanotechnologie im Spiegel der Medien – Medienanalyse zur Nanotechnologie* Report (http://www.risiko-dialog.ch/Themen/Nano/nano_publikationen/Medienanalyse%20Nanotechnologie%20final.pdf).

[3] Der Spiegel (2004): *Nanotechnologie im Spiegel der Medien – Medienanalyse zur Nanotechnologie* Report (http://www.risiko-dialog.ch/Themen/Nano/nano_publikationen/Medienanalyse%20Nanotechnologie%20final.pdf).

2.1.2 What do people say?

Appropriate information is clearly a must. Despite media coverage, public understanding of nanotechnology is low, as polls in US, Germany and UK show that up to 75% of the lay public have poor or distorted knowledge about it [4]. Additionally, distinct differences can be drawn between the EU and the US: according to these sources, more than half of the European population does not know anything about nanotechnology, compared to one third of sampled Americans. On the other side, only one third of Europeans think nanotechnology is for the better, as opposed to the response provided by half of the Americans interviewed. This is mainly due to different factors weighing in: (i) cultural icons (i.e. *nano-robots*), (ii) a blurred image favoured by popular media, where nanotechnology is not explained as a new phase of tech exploiting the effects of nanoscale, and (iii) the low efficiency of comparing the nanoworld to two dimensional objects like human hair. The resulting picture is hazy and incorrect as well as difficult to control, emphasising fears over high expectations. This seems to point to a particularly volatile situation where any major negative issue such as accidents could become a catastrophic backlash for the whole sector.



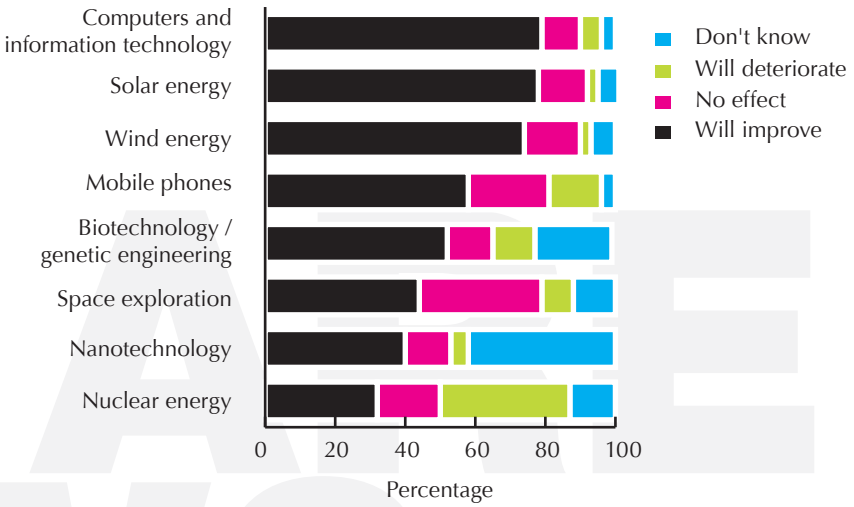
Science fiction loves nano, often putting forward a biased image

A Eurobarometer analysis gave an interesting at-a-glance picture of optimism and pessimism about technology in the European Union, putting nano in comparison with other

[4] BMRB international (**2005**): Nanotechnology: views of the general public: (http://www.nanotech.org.uk); Cobb, M.D.; Macoubrie (**2004**): 'Public perceptions about nanotechnology: risks, benefits and trust'.,J, J.Nanoparticle Res., 2004, 6, 395-405; Gaskell, G.; Allum, N.; Stares, S. (**2003**): Europeans and Biotechnology in 2002: Eurobarometer 58.0; Methodology Institute, London School of Economics, London UK Bainbridge, W.S., (**2002**): 'Public attitudes towards nanotechnology' (**2002**): J.Nanoparticle Res. 2002, 4, 561-570; TA-Swiss (**2006**): Swiss publifocus on nanotechnologies, (**2006**), in TA-SWISS, the Centre for Technology Assessment.

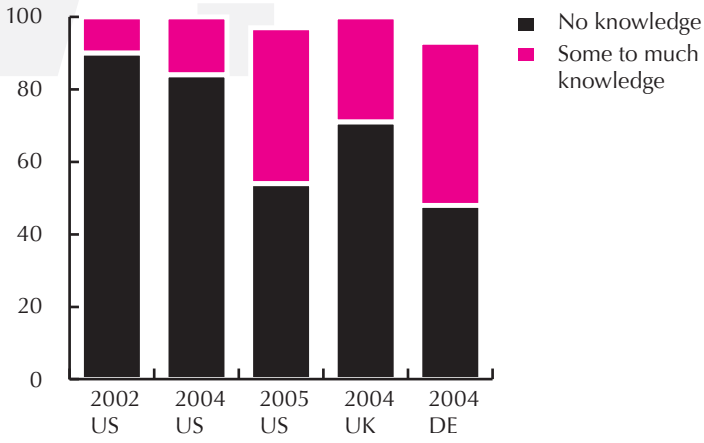
research areas (Figure 1) ([5]). Even more revealingly, commercial surveys ([6]) in the US, UK and Germany (DE) show the awareness gap: people with no knowledge are many more than people having a degree of knowledge ranging from 'some' to 'much' (Figure 2).

Figure1. Optimism and pessimism for eight technologies in 2005



(source: data reworked ([7]))

Figure 2. Knowledge of nanotechnology



[5] Stares, S. (2003): *quoted paper.*

[6] BMRB international (2005): *quoted paper*

[7] Stares, S. (2003): *quoted paper.*

It's easy to conclude that the public is not well informed about nanotechnology at all. Also, if the printed media tend to emphasise **more benefits** than risks, the lay public perceives **more risks** than experts do. Clearly, the crucial issue is the risk factor, and the distinction between **perceived and real risks**. Generally speaking, it is possible to evaluate real risks associated to the toxicity of nanotechnology along the life cycle of manufacturing, use and final disposal of nano-engineered products, especially nanoparticles. Identifying and characterising hazards, exposure and the associated risk are the main steps of this process: however, assessing risks is expensive, data are insufficient so far but sufficient to cause concern, which is worsened by the lack of clear regulatory regimes. In fact, few companies over 1 000 employees do risk assessment due to high cost, and most start-up companies do not develop any risk assessment at all despite the fact that a lack of consumer trust could negatively affect the acceptance of their nanotechnology products heavily.

Perceived risks seem to relate to a very **low awareness** of nanotechnology and to the **lack of engagement** of consumers on the topic, especially for start-up companies. As a consequence, an increasing number of studies advocate the inclusion of non-experts in the process of exploring the mechanisms of social dialogue on acceptance or rejection of nanotechnology, in order to increase its transparency and effectiveness.

Clearly, many feel more research on toxicology is required, together with a need to join splintered efforts, share data and eliminate ambiguous regulations, hopefully under the shield of an international authority. But more efforts are also likely to be needed to identify appropriate mechanisms to promote social awareness on nanotechnology, whose potentialities, perceived and real risks need to be thoroughly examined.

2.1.3 What do stakeholders say?

The main stakeholders' attitudes on nanotechnology are summarised as follows (Figure 3) ([8]).

Figure 3. What US and EU stakeholders say and do on nanotechnology

	WHAT THEY SAY on nano	WHAT THEY DO on nano
Industry	Risk assessment is adequate	Setting guidelines
Start-ups	Assessing risk is expensive	Reluctant to raise safety issues
NGOs	Focus on risk	Ask for more testing/regulation
Regul.bodies	Learning curve	Enhancing current regulation
Insurers	Dialogue on risk	Worrying publicly
Researchers	Funding is needed	Studying public attitudes
Media	Enthusiasm, suspicions, sci-fi	Wondrous prospects/Haunting stories
Consumers	Magic, out of control	Disorientation

(source: data reworked ([9]))

These answers have given way to some major considerations about the urgency and necessity of improving communication outreach on nanotechnology. They should be examined together with the data gathered by a specific survey of communication outreach products on nanotechnology produced by the EC ([10]).

Biased knowledge on nanotechnology is self-explanatory: display of some anti-nano logos selected by the World Social Forum of Nairobi in 2007

[8] BMRB international (2005), Cobb, M.D.; Macoubrie (2004), Gaskell, G.; Allum, N.; Stares, S. (2003), Bainbridge, W.S., (2002), TA-Swiss (2006): *quoted papers*.

[9] Bonazzi, M. (2009A): 'Communication outreach in nanotechnology: focus on young audiences', *EuroNanoForum2009*, proceedings, poster n° 169 (http://www.czech-in.org/euronano/website/posters.pdf) and Bonazzi, M. (2009B): 'EU communication outreach in nanotechnology: EC-funded projects', presentation and article in session 'New nano projects in the ECSITE network', *ECSITE-Annual Conference 2009*, Proceedings, 5-6 June 2009, p. 48 (http://www.ecsite-conference.net/content/user/File/2announcement2009final.pdf). Data reworked from: BMRB international (2005), Cobb, M.D.; Macoubrie (2004), Gaskell, G.; Allum, N.; Stares, S. (2003), Bainbridge, W.S., (2002), TA-Swiss (2006) *quoted papers*.

[10] Bonazzi, M. (2004): *Survey on communication outreach in nanotechnology through National Contact Points*, European Commission, DG RTD G.4, internal working paper.

2.1.4 What is the general picture?

While striving to identify key recommendations to the European Commission for an effective nanotechnology communication outreach, these are, in brief, the considerations that should be kept in mind:

- about **75% of the EU population has poor knowledge** of nanotechnology;
- the media show a positive vision, but the lay public perceives more risks than the experts;
- the opportunities (mainly on new materials and health) seem to exceed the risks (homogeneous);
- the EC image with respect to nanotechnology is dispersed into different publics;
- most urgently **needed** by media, lay public and non-governmental organisations (NGOs): (i) more **research** on real risks, privacy, ethics, decision-making, (ii) more **communication**, (iii) more societal **dialogue and engagement;**
- more efforts should be been made towards identifying key audiences and reaching unsure, uninterested, poorly educated youngsters.

2.2 KEY EC POLICY DOCUMENTS ON COMMUNICATING NANOTECHNOLOGY

In May 2004 the European Commission (EC) adopted the Communication 'Towards a European Strategy for Nanotechnology' ([11]) and in June 2005, the EC published 'Nanosciences and nanotechnologies: An Action Plan for Europe 2005-2009' ([12]). More recently in 2008, the Commission's Recommendation on a code of conduct for responsible nanosciences and nanotechnologies research ([13]) was published stating that 'good governance of nanotechnology and nanoscience (i.e. N&N) research should take into account the need and desire of all stakeholders to be aware of the specific challenges and opportunities raised by N&N. A general culture of responsibility should be created …'

[11] European Commission (2004): *Towards a European Strategy for Nanotechnology*, COM(2004)338; EC, Brussels, 2004 (http://cordis.europa.eu/nanotechnology/actionplan.htm).

[12] European Commission (2004): *Towards a European Strategy for Nanotechnology*, COM(2004)338; EC, Brussels, 2004 (http://cordis.europa.eu/nanotechnology/actionplan.htm).

[13] European Commission (2008): *Commission Recommendation on a code of conduct for responsible nanosciences and nanotechnologies research*, C(2008) 424 final, Brussels, 07/02/2008 (http://ec.europa.eu/nanotechnology/pdf/nanocode-rec_pe0894c_en.pdf).

This Code of Conduct is based on a set of general principles whose calls to action aimed at guaranteeing their respect by all stakeholders.

- ***Meaning***: N&N research should be comprehensible to the public, respecting fundamental rights and be conducted in the interest of the well-being of individuals and society in their design, implementation, dissemination and use.

- ***Sustainability***: N&N research activities should be safe, ethical and contribute to sustainable development serving the sustainability objectives of the Community as well as contributing to the United Nations' Millennium Development Goals ([14]). They should not harm or create a biological, physical or moral threat to people, animals, plants or the environment, at present or in the future.

- ***Precaution***: N&N research activities should be conducted in accordance with the precautionary principle, anticipating potential environmental, health and safety impacts of N&N outcomes and taking due precautions, proportional to the level of protection, while encouraging progress for the benefit of society and the environment.

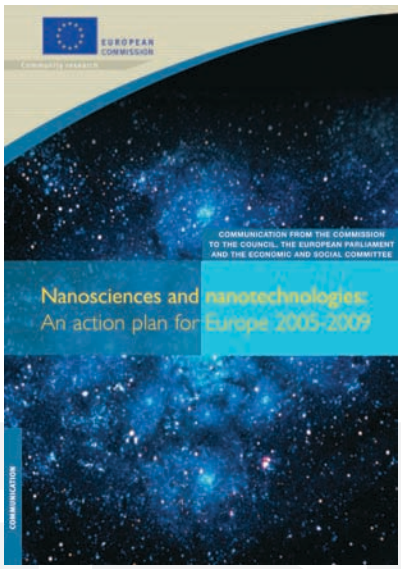
- ***Inclusiveness***: governance of N&N research activities should be guided by the principles of openness to all stakeholders, transparency and respect for the legitimate right of access to information. It should allow the participation in decision-making processes of all stakeholders involved in or concerned by N&N research activities.

- ***Excellence***: N&N research activities should meet the best scientific standards, including standards underpinning the integrity of research and standards relating to Good Laboratory Practices ([14]).

- ***Innovation***: governance of N&N research activities should encourage maximum creativity, flexibility and planning ability for innovation and growth.

- ***Accountability***: researchers and research organisations should remain accountable for the social, environmental and human health impacts that their N&N research may impose on present and future generations.

[14] *The United Nations Millennium Declaration*, General Assembly resolution 55/2, 8/9/2000.



Preparing for appropriate communication and dialogue on nanotechnology impel the EC to develop foresight-thinking, strategies and policies

These policy papers define a series of actions for the immediate implementation of a safe, integrated and responsible strategy for nanosciences and nanotechnologies. These documents have declared that a responsible approach on nanotechnology must address citizens' expectations and concerns and have asked the EU Member States to create the conditions for an effective two-way dialogue with the public, making a specific focus on selected audiences.

These EC policy documents describe the reasons underlying the current situation clearly. Most schools' curricula, of course, do not cover this subject well yet, which may partly account for current surveys ([15]) showing that a large majority of Europeans is not informed or engaged on nanotechnology. Although 'nano' words appear frequently in the media, nanotechnology is poorly understood; some think of nano as a form of 'magic' ([16]), others fear mainly the risks. Unfortunately, these misunderstandings and misperceptions about science are not isolated phenomena ([17]). Although some of the problems of communicating nanotechnology depend on its special characteristics – for example, the invisible nature of nanotechnology and its novelty and revolutionary approach – the experience of communicating other new technologies shows that the public needs to be introduced to them in a clear and simple way, taking into account public needs and interests, preferably from the very beginning of this technology's development.

15 European Commission (2005): *Nanosciences and nanotechnologies: An action plan for Europe 2005-2009*, COM(2005)243, Brussels, 2005.

16 European Commission (2001): 'Europeans, Science and Technology' in *Eurobarometer* 55.2, Brussels, December 2001;

17 European Commission (2006): 'Europeans and Biotechnology in 2005: Patterns and Trends', in *Eurobarometer*, Brussels, July 2006.

18 European Commission (2004): *Nanotechnology: views of the general public* (2004), EC, Brussels.

19 Bonazzi, M.(ed.), (2007A): *Working paper resulting from the workshop on: Strategy for communication outreach in nanotechnology*, EC, Brussels, 6th February 2007 (http://cordis.europa.eu/nanotechnology/src/publication_events.htm).

The EC has already looked further into changing a traditional science and technology communication approach called the 'deficit model', according to which the public must understand science in order to accept it. This model is no longer working well ([18]), and seems completely obsolete ([19]): this change can be summed up by saying that for communicating science and technology the '*scientific understanding of public*' has now become more important than the '*public understanding of science*' ([20]). Consequently, it is possible to see how European institutions such as the European Commission have moved from a top-down to a bottom-up communication approach on nanotechnology, promoting a 'dialogue' model ([21]) based on science communication as a multi-way exchange of information between specialists and non-specialists ([22]), rather than a one-way communication ([23]). It describes a process that enables each party to share, listen and be listened to in full respect of the other's points of view. This dialogue model of communicating nanotechnology is founded on an interactive approach seeking to involve many audiences in the discussion and to provide the most complete range of viewpoints and perspectives ([24]). Additionally, a clear message has been sent to communicate and dialogue with selected audiences about nanotechnology. Among these, a very important segment consists of youngsters, pre-adolescents, adolescents (or 'teens') and young adults. If they can be informed about nanotechnology in a balanced way, both on its exciting prospects and potential risks, these selected audiences may become well informed and engaged on this subject and contribute to the public debate and decision-making on nanotechnology ([25]) in the future.

On the institution side, clear actions and indications are coming from recent initiatives by the European Commission. The EC launched a three-year long process including two separate workshops, with an open Web-based consultation on nanotechnology communication outreach: (i) the first workshop (organised on 6 February 2007) focused on the main issues to frame a strategy ([26]); (ii) the open Web consultation (from May to October 2007) ([27]) provided a fundamental input of comments and questions to be addressed in the (iii) second workshop (organised on 25 and 26 October 2007), identifying a set of potential actions to be developed by the EC ([28]). These initiatives involved the participation of 48 international experts from the fields of opinion-making, science communication outreach, social engagement, design, arts and nanotechnology. ([29]) A crucial input on these issues was provided by the Web consultation, that asked important questions emerging from the first workshop and remained online for over six months on the nanotechnology website of the European Commission. The result was very fruitful, in that hundreds of comments from the lay public, especially young people, were collected. That wide variety of views, opinions, expectations and concerns went on to be integrated into the second workshop.

[20] Bonazzi, M. and Palumbo, J. (eds.), (2007): *Report from the workshop - Communication Outreach in Nanotechnology: from recommendation to action,* EC, Brussels, 24-25 October 2007 (http://cordis.europa.eu/nanotechnology/src/publication_events.htm).

[21] Bonazzi, M.(ed.), (2007B): *Working Paper resulting from: Open Web consultation on a Strategy for communication outreach in nanotechnology,* EC, Brussels, March-October 2007 (http://cordis.europa.eu/nanotechnology/src/publication_events.htm).

[22] Cobb, M.D. Macoubrie, J,(2004): *J.Nanoparticle Res*., 2004, 6, 395-405.

[23] Cobb, M.D. (2002): *J. Nanoparticle Res*. 2002, 4, 561-570.

[24] BMRB international (2007), *Public perceptions about nanotechnology: risks, benefits and trust,* London (http://www.nanotech.org.uk).

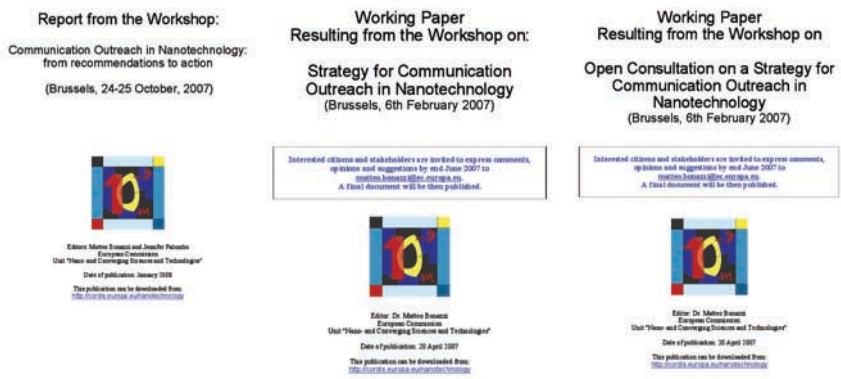
[25] Bonazzi, M. and Palumbo, J. (eds.), (2007): *quoted paper.*

[26] Bonazzi, M. (ed.), (2007A), *quoted paper.*

[27] Bonazzi, M. (ed.), (2007B), *quoted paper.*

[28] Bonazzi, M. and Palumbo, J. (eds.), (2007), *quoted paper.*

[29] Bonazzi, M. (2008): 'Communicating nanotechnology through art', in **Art and Science - creative fusion**, EC, Brussels, December 2008, ISBN 978-92-79-10879-2, pages 13-14, EC, DG RTD, reprinted in 2009.



Developing initiatives for communication and dialogue on nanotechnology requires innovative approaches

This exercise has pinpointed several recommendations for shaping future communication activities, in order to identify: (i) which audiences are crucial, (ii) which messages are appropriate, and (iii) which vehicles, techniques and outcomes are appropriate to attain target audiences, especially **young people**. An assessment of current communication and insights of desirable outcomes is following suit. This is now openly aiming to investigate how a much broader dialogue with the whole of society can work best. It is looking at what makes people tick when asked to react over specific nanotechnology issues.

With a more technical expression, it could be said this process wants to identify key audiences, key messages and communication multipliers. For instance, science centres and school teachers are identified as main recommended targets for future communication on nanotechnology addressing younger audiences. Additionally, **expressive languages** and art should be priority channels to reach selected audiences, as they stimulate people's curiosity and participation by way of visual expression, games, contests or competitions ([30]).

2.3 THEORY OF COMMUNICATING SCIENCE AND TECHNOLOGY

It now seems that the deficit model is suffering from a fundamental deficit itself. This conventional approach in communicating science and technology, developed in the 1980s, was based on the premise that negative public attitudes towards modern science and technology are caused mainly by a lack of adequate knowledge. Therefore, by providing the public with sufficient scientific information it might be possible to manage this 'knowledge deficit' (hence the name of the model) and obtain greater public support for science and technology. Although 'knowledge gap' filling is still a significant element of

[30] Bonazzi, M. (2009A), *quoted paper.*

any present day communication, it nevertheless requires packaging and delivery means that respond to real rather than perceived public information needs.

2.3.1 From public understanding of science to scientific understanding of the public

It's a fact: over the past few decades, scientific, financial or industrial actors have been making all the choices over the way scientific research and technological development (i.e. RTD) should be communicated to society. This standard pattern has recently been criticised for being too unidirectional and essentially deaf to society's willingness to get ever more involved into issues carrying a major potential impact.

It's a failing assumption that RTD systems on their own can make science and technology more accessible, friendly and close to the public. In fact, they have not been shown to produce social acceptance and a fruitful debate automatically, due to the enormous amount of information required by the public, its fragmentation and the intrinsic difficulty in motivating people to devote more of their time and skills to RTD learning. This is especially true for nanotechnology.

Overall, it seems fair to say that any communication of science, research and technology should face the fact that the actors have swapped places. Indeed, society as a whole is increasingly becoming the focal actor of communication, and the concept of ***public understanding of science*** has been turned around into that of ***scientific understanding of the public***. The **citizen** (as moral and legal entity as well as consumer of S&T outcomes) has clearly become the central point of the whole communication exercise.

The responsibilities conventionally entrusted to science are currently being re-examined, despite science's efforts to enhance the public's knowledge so far. The difficulty of communicating especially sensitive technologies, such as GMOs, human genetics and nanotechnology itself, has magnified society's perception of their associated risk, which has been seen as a major uncertainty. This perception has been shown to be mainly due to a feeling of seclusion from both information- and decision-making. Sadly, RTD systems seem to have progressively lost a significant share of society's trust and their communication with society has plunged into a crisis. This can ultimately end up causing a governance problem.

The main point is, society is increasingly calling for RTD systems to be more accountable, since the relating governance issue lies in society's perception of the **risks** associated with RTD achievements. As a consequence, society is showing a growing willingness to become more active in the dialogue with RTD systems. Obviously, this accountability should extend to all ethical and cultural implications of RTD achievements.

Indeed, 'EC policymakers working on RTD **systems have the moral duty to inform society appropriately about risks, uncertainties and opportunities** relating to their work. They openly acknowledge that **society has the right to be appropriately informed** about all these aspects, in order to provide feedback and dialogue and contribute to the decision-making process' ([31]).

The question now is, how can this principle be applied to nanotechnology, and what is the role of EU institutions, particularly the EC and its RTD services. Setting up the strategic planning framework of an EC Communication Roadmap for nanotechnology should be the first appropriate answer.

2.3.2 From strategic planning to Communication Roadmap

Strategic planning of any product development or business endeavour cannot do without communication any longer. In these times of economic, social and market uncertainties, any progress towards the established targets needs to be properly communicated, if such endeavours are to survive and grow.

As a method tool, an external communications strategy can be used for an information campaign, a Public Relations operation or image positioning. In modern times, the first patterns and models are found among those who held a mechanical approach of communication: Sender A > Information conveyed > receiver B. Post world war (WWII) cybernetic scientists started to improve this model by stressing the exchange of information between senders and receivers.

This led to the feedback theory, according to which B reacts to information sent by A, with A having to adjust its original content to B's need. At about the same time, Harold Lasswell described the communication spectrum with the '5 Ws' formula: **'Who says What to Whom through What channel with What effect'**. This multiple formula was originally applied to analyse American polling or election days. Today, it is still taught in journalism schools: it is applied to news releases, whose first paragraph is supposed to answer all five questions.

It's worth noticing that the formula is incomplete since it leaves out at least three questions: 'where', 'when' and especially 'why', the most crucial question to all strategies. Indeed, any content and media selection should be subordinate to the 'because' answer, and the efficiency of any communication campaign can only be measured by its key objective. At European Commission level, six relevant features have been singled out to be encouraged:

[31] Tomellini, R. (2009), speech at *Research Marketing Workshop*, DG Research, European Commission, January 2009 and Bonazzi, M. (2009A), *quoted paper.*

1. a more sober communication style;
2. a more rigorous budget monitoring;
3. a communication management refocusing on more strategic domains, such as lobbying and appropriate media relationships;
4. more assessment-minded practitioners;
5. more new technology-driven practitioners;
6. the use of social networks and Web community communication.

2.4 KEY NANOTECHNOLOGIES TO PRIORITISE IN COMMUNICATION

According to key policy documents mentioned in Section 2.1, it can be safely said that nanotechnology is a broad field with many potential application areas, coupled with great potential benefits and risks for society. The most influential scientific literature on nanotechnology communication has recently identified three main areas for urgent communication to selected audiences: nanomedicine ([32]), nano-energy and nano-environment ([33]), nano- and information and communication technology (ICT) ([34]).

The nano-medical area is one that all individuals can personally relate to, and this guarantees high public interest; the nano-energy/environment area clearly touches sustainability, one of the issues of major public and policy concern. Finally, nano- and ICT show a vast possibility of gadgets and entertainment to make everyone's life better, easier and fun, which should be of particular interest to all young people. All three areas involve benefits and risks and are expected to generate lively debate and discussion.

2.4.1 Nanomedicine

This area has the potential to realise significant innovation in the diagnosis and treatment of diseases and other health-related problems. Nanomedicine is defined by the European Science Foundation as 'the science and technology of diagnosing, treating and preventing disease and traumatic injury, or relieving pain, and of preserving and improving human health using molecular tools and molecular knowledge of the human body' ([35]).

It includes five principal sub-disciplines: (i) analytic tools, (ii) nanoimaging, (iii) nanomaterials and nanodevices, (iv) novel therapeutics, (v) theranostics, (vi) drug delivery systems, (vii) regenerative medicine, (viii) neuroprosthetics, and (ix) clinical, regulatory and toxicological issues. For example, nanotecnology could be used to produce small, inexpensive,

[32] Capurro, R., (2004): 'EGE Opinion No. 21: Ethical Aspects of Nanomedicine', in *EURONANOFORUM 2007*, March 2007; EC, Brussels.

[33] The Royal Society, (2004): 'Effects of nanotechnology on the environment', *Nanotechnology Applications* (http://www.understandingnano.com/nanotech-applications.html), London, 2004.

[34] NANODIALOGUE (2007): 'Nanotechnologies and Nanosciences: A discussion of ethical, legal and social aspects', *Nanodialogue final Conference*, 5th February 2007, Brussels, 2007.

[35] EURONANOFORUM (2004): *Ethical Aspects of Nanomedicine* (http://www.capurro.de/nanoethics.html).

portable diagnostic devices that are less intrusive for patients and perform the diagnosis of a suspected disease in a very short time, with the guarantee of high accuracy. Nanomaterials will lead to extremely sensitive devices that can detect, for example, pathogen agents in very small quantities, leading quickly to early diagnosis and consequently to more effective treatments. Finally, these developments can broaden the area of point-of-care diagnostics. Important advancements in the field of in vivo imaging are also expected (e.g. targeted imaging), which will also be another crucial tool for early detection of diseases. Nanotechnology also enables the development of novel imaging instrumentation to improve imaging sensitivity and accuracy.

2.4.2 Nanotechnology in tools, devices, materials, processes for sustainability

Nanotechnology can be used to enhance a wide range of energy technologies including solar technologies, hydrogen production, hydrogen storage and fuel cells. Novel batteries and super-capacitors with improved power, battery lifetime and safety properties are under study. Another area of interest is catalysis, which could allow for abundant and cheap chemical products by improving industrial catalytic processes. Catalysis is also important for the production of pharmaceuticals, for improving environmental protection, for making both production and distribution of energy more sustainable. Energy-saving is another important area, where nanotechnology could develop lightweight materials with more efficient properties for reducing energy consumption during the mechanical operation of a wide range of devices, like nanostructured insulators or coatings for windows that reduce heat in summer and limit the needs for air-conditioning.

The application of nanotechnology to the environment may also produce significant advancements, as explained below.

- Superior water and air quality: filters incorporating nanoparticles can selectively block toxic contaminants; magnetised nanoparticles of rust can be used to remove toxic arsenic from water; similarly, nanoparticles activated by light may be used to remove other contaminants from water. Filters and membranes for the decontamination of air and water can also be engineered using nanotechnology to react chemically with contaminants and convert them into non-toxic products.

- Remote environmental detection: miniature sensors developed by using nanotechnology could be utilised to detect specific pollutants into the environment.

- More environment-friendly materials: nanotechnology can be used to produce biodegradable plastics and reduce the toxicity of rechargeable batteries; especially, nano-coated glass could display self-cleaning properties by using only sunlight and water.

- 'Green manufacturing': nanotechnology has the potential of making some industrial processes more efficient in terms of energy use and material consumption, by minimising the generation of toxic pollutants and waste simultaneously.

2.4.3 Nanotechnology and Information & Communication Technologies

In the field of ICT nanotechnology is expected to improve information processing systems constantly, which will result in increasingly powerful hardware. New nanotechnology recording concepts will combine various advantages: large memory-storage capability, very fast access and conservation of data without constant power supply. These concepts are based on new technologies such as transistors based on one single electron, memory-storage in nanocrystals, and spintronics. Thanks to nanoelectronics, a single device of the size of a credit card could be used as a tape recorder, camera, video player, television, mobile telephone, GPS, translator, and, of course, as a credit card.

A second ICT area where nanotechnology could play an important role is the interface between computers and the physical world. Computer display technologies, such as screens and interfaces with humans, as well as detection devices to monitor the environment, will make widespread use of nanomaterials to improve performance. Scientists and researchers are working on the creation of 'smart' environments in which objects of daily use are permanently interconnected, which would place us amidst a so-called 'Internet of things'. In this area, Radio Frequency Identification tags (RFID) are expected to play a crucial role. Made by an antenna and an electronic chip, these devices allow for the storage and remote retrieval of data. RFID tags can be collated or incorporated in products. More advanced than the bar code, these complex chips react to radio waves and transmit their information without contact. The main uses of those sensor networks are quality control during production, consumer information and protection of perishable products and management of infrastructures such as the leakage of water distribution systems. The nanometric generation of RFID chips is developing rapidly and could reduce their dimension to the size of 'smart dust'.

2.4.4 Uncertainties, hazards, risks and associated ethical, legal and societal aspects

For all nanotechnology applications, the key concerns are focused around the potential health and environmental hazards of nanoparticles and the associated ethical, legal and social issues (ELSA). Because of the very novelty of nanotechnology, there may be real

difficulties to identify, estimate and manage the risks that may be involved, especially the long term risks which may be different from short term ones ([36]).

For example, it is possible to identify short term, medium term and long term (5, 10, and 20 years) ethical issues associated with **nanomedicine**.

In the short term, the ethical questions arise mainly from the lack of knowledge about the risks of interventions using nano-based products and tests([37]).

- In the medium term, nanodevices and nanomedical products are expected to be used in all medical fields. This raises the ethical questions of responsibility at a local and global level: sensitive issues like data protection and privacy are expected to arise, as with genetic testing.

- In the long term, nanotechnology might make the enhancement and even the transformation of the human body and human nature and identity possible ([38]). The European Group on Ethics in Science and New Technologies (EGE), an advisory body to the EC President, published an opinion document on nanomedicine in January 2007 ([39]). It recognises the '*potential of nanomedicine in developing new diagnostic, treatment and preventive methods and places emphasis on conducting research both into its safety and its ethical, legal and societal aspects*'. It proposes to set up a European network on the ethics of nanomedicine and suggests that further monitoring of the current legal situation should be carried out, although it does not call for a specific legislation at this stage.

Regarding the long term, **environmental** impacts in terms of nanomaterials, many authors assume, whether correctly or not, that nanoparticles will definitely pose a risk for the environment, especially during the processing phase, although there is no fully clear scientific evidence of this until now. They claim nanoparticles could accidentally enter into the food chain, initially causing damage to plants and animals and eventually becoming a hazard to humans. A second risk related to nanoparticles is their possible reaction with other elements producing new harmful substances in the environment.

In the area of **information and communication technologies**, the main issues are related to privacy, data protection, governance and regulation. In this light, the EC has initiated public consultation about a range of draft recommendations for implementing principles for privacy, data protection and information security in nanotechnology applications based on Radio Frequency Identification (RFID) ([40]). In addition, some national organisations such as the CNIL in France are warning stakeholders and the public at large about the potential negative consequences on privacy and personal freedom of the application of nanotechnology in information and communication technologies ([41]).

A number of other ethical, legal and societal issues are often raised with regard to nanotechnologies. These include: (i) how to balance potential benefits versus potential costs, (ii) distribution of benefits and costs among the population, (iii) concerns about

36 The European Group on Ethics in Science and New Technologies (EGE) advisory of the EC President, (2007): *Opinion on Nanomedicine* (http://ec.europa.eu/european_group_ethics/avis/index_en.htm).

37 Capurro, R. (2004): 'Reflections on Benefits, Risks, Ethical, Legal and Social Aspects of Nanotechnology', *Nanoforum* (2004).

38 EURONANOFORUM (2004) *Ethical Aspects of Nanomedicine* (http://www.capurro.de/nanoethics.html).

39 (La) Commission Nationale de l'Informatique et des Libertés (CNIL) has named its 2006 annual report: *'Alerte à la société de surveillance'* (Alert to the Surveillance Society) (http://www.cnil.fr/fileadmin/documents/La_CNIL/publications/CNIL-27erapport-2006.pdf).

40 Lemoine, P. (2006), *Nanotechnologie, Informatique et Libertés, Communication du 12 janvier 2006* - special report on Nanotechnology, privacy and data protection, CNIL, Paris, 2006. See the Internet (http://www.cnil.fr/fileadmin/documents/approfondir/dossier/technologies/Com-phl-Nanotechnologies.pdf).

41 The Royal Society (2007): *Towards an RFID policy for Europe*, London, 2007 (http://ec.europa.eu/information_society/policy/rfid/index_en.htm).

personal freedom, control of the development of nanotechnologies, and ethics of human enhancement.

Obviously, communication projects can do a great deal of good here. Stimulating the interest of selected audiences in dialoguing on all these issues means raising their awareness of this whole complexity of ethical, legal and societal issues which is bound to be tied to policy choices. Since there are clear indications that the level of challenge needs to be age-sensitive, young people need to be addressed with their own specific communication programmes.

A sum-up of the hottest societal issues follows ([42]).

i) **Safety**
Risks, especially associated with nanoparticles: overall, they can be assessed once both the associated hazard and the related exposure are identified; dealing with uncertainty is more difficult, as more research is clearly needed to identify the associated hazards. Uncertainty still surrounds aerosol nanoparticles, although researchers are defining the associated hazards better and better: these are related mainly to processing phases, although exposure effects are still not fully known nor understood ([43]). Hazards linked to nanoparticles under other forms are being studied, and some of these have already been defined. Consequently, a more advanced version of the various risk assessment methodologies is going to be adopted.

- There is definitely an **urgency** to minimise risk at manufacturer level, where employees are most exposed to nanoparticles ([44]).

- All this is connected to **risk governance**, which is the process of debating and defining risk acceptability according to a recently developed model ([45]).

- Concerns for **food safety are on the increase.** These have been expressed by different sides. The case for a moratorium on nano in food has been made by various NGOs, e.g. Friends of the Earth ([46]), and particular prudence has been also suggested by an EC project ([47]).

ii) **Self-reproduction**
The scary science fiction 'grey goo' scenario is losing importance and influential reports are distancing themselves from its sensationalist aspects ([48]), though artificial creation of viruses deserve more attentive consideration ([49]).

iii) **Privacy**
Multiple applications on everyday life could raise concerns on the restrictions to individual rights that smart environments can bring:

- **Radio Frequency Identification**, smart system storing and processing information that can be read at some distance and can

[42] Van Est et al., (2004): *Om het Kleine te Waarderen*, The Hague, Rathenau Institute, The Netherlands; Van Est, R. and Wahlout, B., 2007, *NGO and engaging naotechnology*, The Hague, Rathenau Institute.

[43] Rathenau Institute (2008): *Ten lessons for a nanodialogue*, Delft, The Netherlands.

[44] Malsch, I. (2006): *Report on expert meetings: milieu –en gezondheidrisico's van nanodeeltjes-naar een prudent beleid*, The Hague, Rathenau institute; REACH framework EC 2006/1907 (http://www.REACH.org).

[45] Renn, O. (2005): *White Paper on Risk Governance*, The Hague, Rathenau Institute; Renn, O. and Roco, M. 2006, 'Nanotechnology and the need for risk governance', *Journal of Nanoparticle Research*, **8** (2).

[46] FoE, 2008, *Out of the laboratory and to our plates. Nanotechnology in food and agriculture*, Friends of the Earth, Australia, United States, Germany. Renton, A. 2006, 'Welcome to the World of the nano-food', *The Observer, Guardian Unlimited,* 16 December; Rey, L. (2006): *Nanotechnologien in der Schweiz: Herausforderungen* erkannt, TA Swiss.

[47] NANOBIORAISE project (2008):, *Nanotechnology and Food* 2008 (http://www.nanobioraise.org).

[48] Van Ameron (2006): *Image dynamics in nanotechnology debate*, EASTT Conference, Lausanne, 23-26 August.

[49] KNAW (2004): *Hoe Groot kan Klein zijn?*, KNAW, Amsterdam.

easily involve erosion of privacy ([50]), similar to those few supermarket loyalty cards that can store patterns of consumer habits;

- **ambient intelligence**, systems to telemonitor medical applications and data that could potentially be used by insurers ([51]);

iv) Human enhancement

Converging technologies integrating nanotechnology with bio- info- and cognitive sciences can pave the way to improved human performances and raise legitimate ethical questions on the limits of human nature ([52]).

v) Synthetic biology and artificial life

Several doubts have already been expressed about the ethical legitimacy regarding the cell as a mere collection of nanomachines which can be copied, redesigned, manipulated and improved ([53]).

vi) Predictive medicine

Both privacy aspects and the doctor-patient relationship, plus the widening gap between diagnostics possibilities and possible realistic treatment are the main issues associated with the possible applications ([54]).

vii) Arms and ethics of war

Around the world, significant applications in the military field raise relevant issues ([55]); however, the EC's framework programme for research is given no remit to carry out any research for military applications. This extends to any potential dual civil and military use.

viii) Intellectual property rights and nanodivide

IPRs are expected to fall under increasing pressure, and poor countries may be negatively affected by the increasing gap in access to nanotechnologies on both manufacturer and consumer sides ([56]).

ix) Governance and dialogue

Upstream engagement promoted by various organisations e.g. *Demos* and EC projects, ([57]) discuss the role of science in public debates, although it was noticed that a few policymakers still seem to regard this more as a threat than an opportunity ([58]). With the very purpose of encouraging public debate, EC projects have identified useful tools to clarify societal assessment of a nanoproduct or application prior to its market introduction, i.e. *Nanometer* Web-based tool ([59]).

Given the necessity of this dialogue, appropriate communication should establish **what is relevant** and appropriate to say to **target audiences**, **who** should do that, **when** and **how**.

50 Van den Heuvel et al., (2007): *RFID bewustzijn van Consumenten*, The Hague, Rathenau Institute.

51 Schuurmans et al., (2007): *Ambient Intelligence*, The Hague, Rathenau Institute.

52 Roco, M. and Bainbridge, S. (Eds.), (2002): *Converging Tehnologies for Improving Human Performance Nanotechnology, Biotechnology, information technology and cognitive science*, Arlington, National Science Foundation; Miller and Wilsdon, 2006.

53 Van Est et al. (2007): *Synthetische Biologie: nieuw leven in het biodebat*, Rathenau Institute, The Hague, The Netherlands.

54 Gezondheidsraad (2006): *Betekenis van Nanotechnologies voor de Gezondheid*, No 2006/06, Rathenau Institute, The Hague, The Netherlands.

55 Van Est et al. (2004): *Om het Kleine te Waarderen*, The Hague, Rathenau Institute, The Netherlands.

56 Meridian Institute (2008): programme *Nanotechnology and the Poor.*

57 *Nanodialogue*, (2007) (http://www.ecsite-conference.net/content/user/File/guglielmo%20maglio%20nanodialogue.pps).

58 Stilgoe, (2007): *Nanodialogues. Experiments in public engagement with science*, London, Demos.

59 *Nanologue* (2007): see the Internet (http://www.nanologue.net/).

In conclusion, it is possible to predict that several issues will become part and parcel of the **future policy agenda**:

- **SAFETY**, mainly in terms of real and perceived risk for health, environment and governance;
- **PRIVACY**, addressing ambient intelligence, predictive medicine and Radio Frequency Identification;
- **ETHICS**, regarding mainly the possible applications linked to human enhancement, synthetic biology, artificial life and nano-divide, which are especially coming from the interactions between converging areas of nano-bio-info-cognitive disciplines.

Other questions such as the arms race, the ethics of war and self-replicating organisms might yet turn out to deserve more attention now ([60]).

2.5 EC-FUNDED PROJECTS ON COMMUNICATING NANOTECHNOLOGIES

The first projects funded by the EC, which are described in this chapter, were called NANODIALOGUE and NANOLOGUE. They paved the way to an exciting, current second wave of projects, which were negotiated and funded in early 2009. They are called NANOTV, NANOYOU, NANOTOTOUCH, TIMEFORNANO and EURONANOFORUM2009, which will be described in Section III.

2.5.1 NANODIALOGUE project

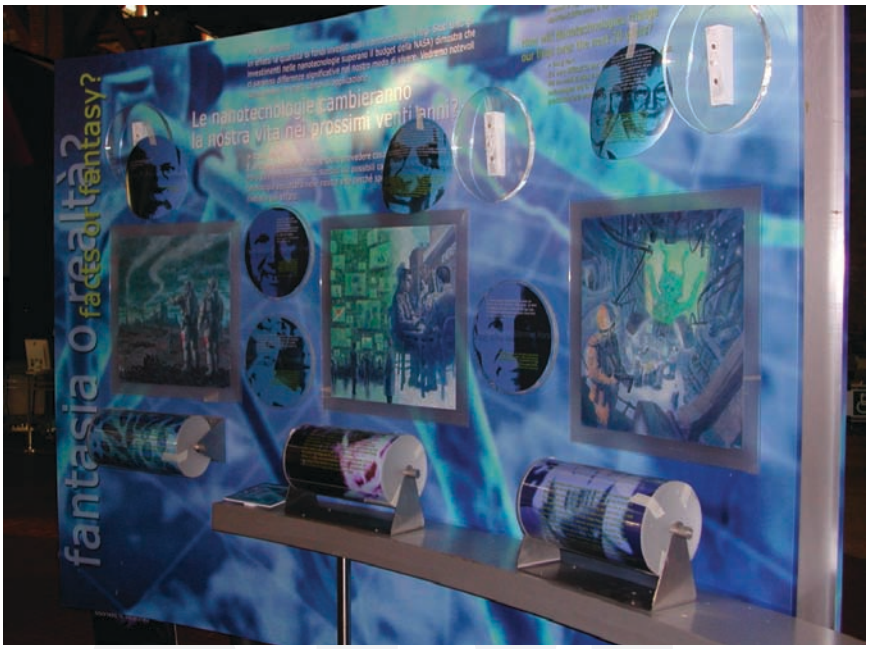
The Nanodialogue ([61]) project was all about raising curiosity and stimulating the debate on nanotechnologies and nanosciences. The main target groups were gathered in three clusters: schools, families/general public and young people related to industry/university. The project centred on an interactive exhibition module, which was displayed in eight countries. It included a programme of events and participatory activities in each location, as well as a survey of public perceptions and expectations, which developed 800 questionnaires and set up multimedia polling station on each location. The work to be developed in the following projects can certainly use the results of these surveys as a starting point for its own surveys on young people's expectations, preferences and attitudes. However, Nanodialogue was not fully focused on children and young people, but rather on a much wider audience. The Nanodialogue project organised exhibitions on nanotechnology in eight countries and chose to promote social information and dialogue in the form of focus groups and public debates. Results and recommendations were presented at a final open conference, which was held in the European Parliament in February 2007.

[60] As reworked by the Author from the interview to Noel Sharkey, Professor of Artificial Intelligence and Robotics at the University of Sheffield, 'Military killer robots could endanger civilians', *The Daily Telegraph*, 3 August 2009 (http://www.telegraph.co.uk/news/newstopics/politics/defence/5966243/Military-killer-robots-could-endanger-civilians.html).

[61] NANODIALOGUE (2007) 'Nanotechnologies and Nanosciences', *Nanodialogue final Conference*, 5th February 2007, Brussels, 2007 (http://www.ecsite-conference.net/content/user/File/guglielmo%20maglio%20nanodialogue.pps).

Modular panels enable NANODIALOGUE to become a travelling event, easily transported, assembled and displayed in various Member States (courtesy of NANODIALOGUE project)

Hands-on and minds-on experiences capture attention and challenge curiosity (courtesy of NANODIALOGUE project)

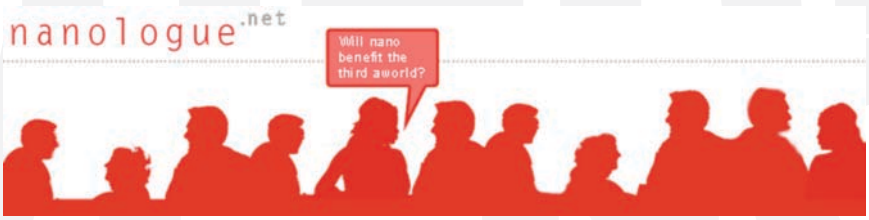


Playing with the future: nano-scenarios are sketched, stimulating imagination (courtesy of NANODIALOGUE project)

Coaching policymakers: a final NANODIALOGUE event illustrates to a high-level forum strategic recommendations on communicating nanotechnology (courtesy of NANODIALOGUE project)

2.5.2 NANOLOGUE project

Nanologue's objective ([62]) was meant to be complementary, and in fact it brought together current leading research on the social, ethical and legal implications of nanotechnology. The project provided a common ground for public discussion on the potential benefits and risks by assessing the ethical, legal and social aspects of nanotechnology with the help of studies, stakeholder interviews and workshops. The result provided guidance on how to address the issues for the greater benefit of both society and the economy. The outcomes of the project were: (i) a background paper on the ethical, legal and social aspects (ELSA) of several nanotechnology application areas (energy conversion and storage, food packaging and medical diagnosis), (ii) a study on opinions on the ethical, legal and social aspects of nanotechnologies, and (iii) the development of three detailed scenarios on the future of nanotechnology and its applications. Future projects should take into account the Nanologue Background Paper on nanotechnology ELSA in the design of their communication and outreach programme. The Nanologue project also produced a booklet sketching out three possible scenarios of nanotechnology future development, called '*The future of nanotechnology: We need to talk*' and developed a '*NanoMeter*' giving guidance to research project coordinators on potential impacts of their research on ethical and social issues.



Key questions are of essence in communicating nanotechnology: NANOLOGUE addresses some of them to outline very different scenarios (by courtesy of NANOLOGUE project)

2.5.3 Ancillary projects, web pages, workshops, products and activities from 2003 to 2008

Other projects such as NANOBIORAISE ([63]) developed a public dialogue on a set of nanotechnology applications and took care to pinpoint those areas where dialogue is expected to play a very different role in social acceptance or rejection (e.g. nanomedicine versus nano-food applications). Support for further actions in this field is expected

[62] NANOLOGUE (2006): *Europe-wide dialogue on benefits, risks and social, ethical and legal implications of nanotechnology* (http://www.nanologue.net/).

[63] See the Internet (http://nanobio-raise.org/).

in FP7. NanoBio-RAISE combined ethics research in nanobiotechnology with science communication. This interdisciplinary project brought together nanobiotechnologists, ethics and communication specialists. The aim was to anticipate the societal and ethical issues which are likely to arise as nanobiotechnologies develop and use the lessons drawn from the GMO debate to plan the response to some probable public concerns. This was a Sixth Framework Programme Science & Society Co-ordination Action, whose output were mainly groups on human enhancement, events, seminars, workshops, games, briefing papers, courses.

Dedicated activities to shape the EC strategy for communication outreach were the implementation of the principle expressed in EC key documents on communicating nanotechnology ([64]): this has enabled the identification of two main axes for communication, to match the objectives indicated in the previous sections, which will become the object for future EC-funded actions. The main outcome has been to identify, segment and characterise key audiences, vehicles and messages for communication and dialogue on nanotechnology ([65]).

Overall, this process made it possible for the EC to develop the present Communication Roadmap, whose draft version was the key to the publication of a call on communication outreach. This resulted in four projects being selected and negotiated by the end of 2008, whose overall budget is around EUR 5 million. These projects, which started between January and April 2009, are analysed in Section 5.1.7, and will contribute to developing the principles of the present Roadmap.

In addition, between 2003 and 2008 the Commission funded or directly published a wide range of information in many languages and for various age groups, using different supports, such as booklets and other printed material, event-related material, Web products, audiovisuals. The intention was to make basic information available in the EU languages, complementing the products of the communication projects. Undoubtedly there is a role for scientists here, who can explain the principles and applications of nanotechnology to the general public and the press. To support them in these public outreach activities, the Commission has made available a handbook called *Communicating Science, a Survival Kit for Scientists*. Different websites, on Europa and CORDIS servers, http://ec.europa.eu/nanotechnology/, http://cordis.europa.eu/nanotechnology/ and http://www.nanoforum.org are useful resources. Studies on social acceptance indirectly linked with communication outreach have been carried out through several dedicated projects within FP6. More details on these projects can be found in the Annex.

[64] (a) European Commission (2004): *Nanosciences and nanotechnologies: An action Plan for Europe 2005-2009*, EC; (b) European Commission, 2004, *Towards a European Strategy for Nanotechnology*, COM(2004)338; EC, Brussels, 2004 (http://cordis.europa.eu/nanotechnology/actionplan.htm).

[65] Bonazzi, M. (Ed.) (2007A and 2007B), Bonazzi, M. and Palumbo, J. (eds.), (2007), *quoted papers*.

2.6 ASSESSING THE EC-DEVELOPED COMMUNICATION ON NANOTECHNOLOGY

The communication outreach potential of all the above-mentioned EC communication products has been assessed via a survey carried out through National Contact Points of the Directorate Industrial Technologies ([66]).

2.6.1 Communication materials and methods

Future scope for improvement depends on a sound evaluation of EC communication developed so far. Nanotechnology communication products have been grouped here according to the means (i.e. the **vehicle**) by which they can get to their audience, reflecting the overall picture developed by the Directorate Industrial Technologies, Unit nano- and converging sciences and Technologies.

A. Print material: Booklets ([67]); Reports ([68]); Posters ([69]); Magazine/Newsletters (selected contributions ([70])); Project summaries & leaflets (selected ([71])).

B. Audiovisual material: exhibitions ([72]), Videos ([73]); Interactive exhibition (selected ([74])); General audiovisual presentations ([75]); Project-specific presentations (selected ([76])).

C. Participative events: Conferences, meetings, events (selected) ([77]), workshops in EU science-museums (selected) ([78]); Technology platform-related events.

D. Web-based material: web pages and forums ([79]).

Different surveys aimed at various groups of communication users (National Contact Points, EC civil servants, plus an informal network of nano-information consumers) have evaluated the quantity and quality of all the information conveyed so far. It has been suggested that the appropriate measure of outreach for EC developed communication

66 European Commission (2004): *Survey on communication outreach in nanotechnology through National Contact Points*, DG RTD G.4, revised in 2008, internal working paper.

67 (a) European Commission (2004): *Nanotechnology: innovation for a future world*; (b) European Commission (2004): *Nanosciences and nanotechnologies: An action Plan for Europe 2005-2009*; (c) European Commission (2004): *Towards a European Strategy for Nanotechnology*, COM(2004)338; EC, Brussels, 2004 (http://cordis.europa.eu/nanotechnology/actionplan.htm); (d) European Commission (2004): *Nanotechnology in the ERA*, EC, 2004.

68 (a) European Commission (2005): *EU Technology Platform on Nanomedicine*; (b) European Commission (2004): *Vision 2020:Nanoelectronics at the centre of change.*

69 European Commission (2005): *Nanotechnology in Europe: an integrated and responsible approach.*

70 European Commission (2006): *RTD magazine*, e.g. 'RTD special issue on nanomedicine', 2006 edition; CORDIS focus No 22, 2006 – *Exploring the nano-world* No 22.

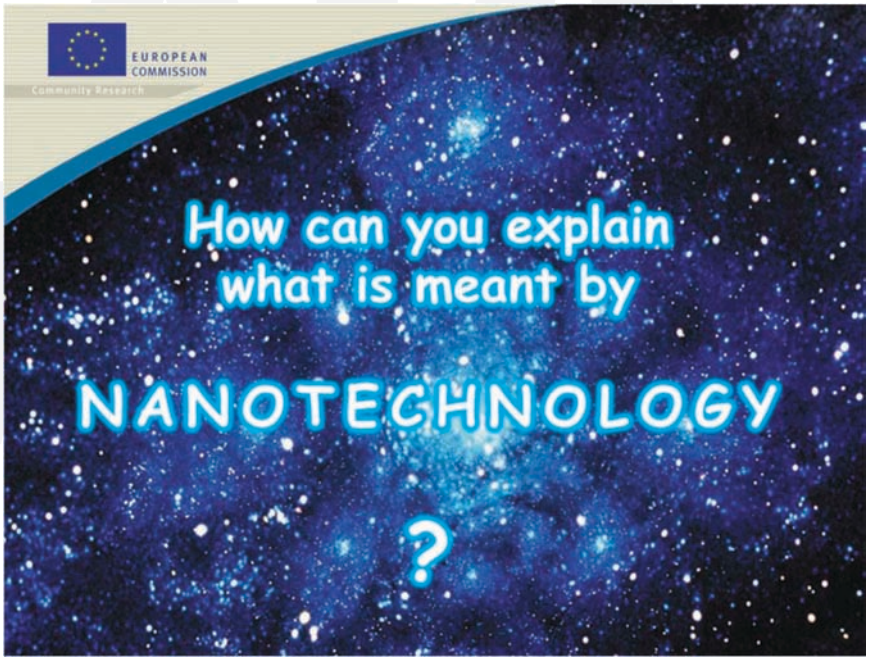
71 Selected examples: (a) *Frontiers*; (b) *Nano2life*; (c) *Nanodialogue*; (d) *Ipart-nanotox*; (e) *nanoRoad*; (f) *Nanoresearch* project scales up for commercialisation. A similar leaflet has been recently presented at ECSITE Conference (Milan, June 2009) by the *NANOTOTOUCH* project on communication outreach, presenting interesting 'hands-on' improvements.

72 *Nanodialogue* project (2005) (http://www.ecsite-conference.net/content/user/File/guglielmo%20maglio%20nanodialogue.pps) (a) European Commission (2003 and 2004): *Nanotechnology* (2003 & 2004 editions); (b) European Commission (2005): *Nanotechnology: the next dimension* (2005 edition).

products should cover all the different **communication categories**, which have been clustered as follows:

1. *information on fundamentals*
2. *general information*
3. *project & call specific information*
4. *S&T information*
5. *applications and markets.*

A general survey was carried out by CORDIS and is available at the quoted sites ([80]); a further specific survey set on the nanotechnology web page could allow to fine-tune this preliminary picture.



[73] *ibidem.*

[74] Exhibits developed by Nanodialogue project, whose outreach has been estimated around 1 million visitors over the year 2006.

[75] European Commission (2004): *How can we explain what is meant by nanotechnology?* Power Point presentation by Renzo Tomellini, HoU, distributed in selected school networks in the EU.

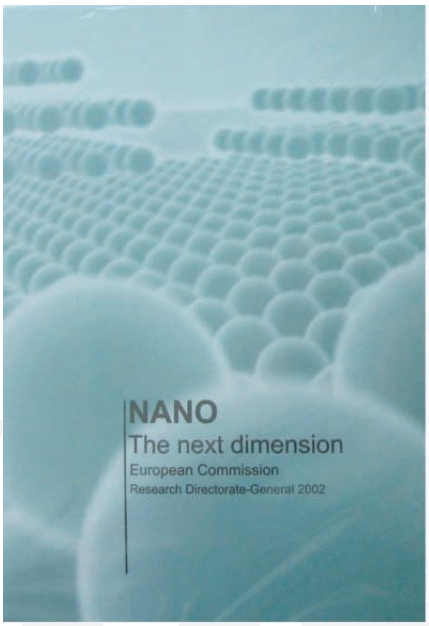
[76] On the European Commission intranet see G:\G4\PO_Work_Area\PowerPoints\Project_presentations online.

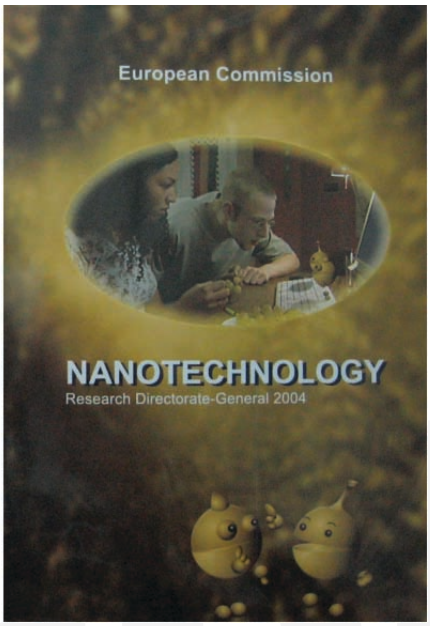
[77] Main events are considered: *Euronanoforum* 2003-2005-2007 (proceedings & posters); *Communicating European Research,* EC, Brussels, 14-15 November 2005 (http://ec.europa.eu/research/conferences/2005/cer2005/index_en.html); exhibitions in eight EU science-museum developed by the project Nanodialogue.

[78] *Euronanoforum* 2003-2005-2007 (proceedings & posters); exhibitions in science centres from eight EU Member States developed by the project Nanodialogue.

[79] (a) Nanotechnology CORDIS website (http://www.cordis.lu/nanotechnology/ and http://www.nanoforum.org).

[80] Main features of CORDIS surveys: http://user-survey.cordis.europa.eu/online. More information on the size of target audience amongst CORDIS registered users by the strings NMP and nanotechs in http://stats-cordis.mainstrat.com/logs/php/index.php?mode=day&year=2008&month=11&week=&d=20081105&section=Other Indicators online. More information on visits to FP7-NMP available at http://stats-cordis.mainstrat.com/logs/php/servicios/index.php?mode=month&d=&month=10&year=2008&week=&service=302&service=307&section=Generales (update: October 2008).





Telling scientific facts through stories and through real people, audiovisuals reach large audiences. Pedagogic presentations address school pupils, two DVDs initiate an EC video trilogy on nanotechnology targeting youngsters and the general public

2.6.1.1 A three-step method matrix

This well-tested model is meant to assess the outreach of each communication product.

And this is how it works.

1. The **information content** of any message has been scored for each communication product in terms of information points (from not relevant = score 0, to very high = score 5). All products belonging to the same communication vehicle such as print, audiovisuals, events and Web (please see Annex) are taken into account and averaged at any one time.

2. A different **sensitivity** is attributed to each audience, depending both on the message and the vehicle used to convey it ([81]), via an assessment matrix (please see Annex). The following audiences are considered: Industry, Academy, NCPs, NGOs, Nano-consumers, Media, Schools, Educated Public and General Public.

[81] Its basic pattern has been evicted from literature and field studies, see Annex (CITIZENS' DECLARATION ON THE CITY OF TOMORROW (2005); WEB LINKS: COMMUNICATION PLAN (2),(3), (5), (9), (21), (26), (30); WEB LINKS: COMMUNICATION VEHICLES for AUDIENCES, (4), (9), (12), (13), (18), (27, pp.17-19), and assessed by informal networks of governance experts.

3. The **communication outreach** is evaluated in terms of percentage message coverage for each vehicle per audience. The average outreach of main audiences is then calculated. This enables to assess the average outreach for the given audiences relating to each message conveyed via a certain vehicle, e.g. Information on fundamentals via print material. This measure gives an idea of how effective communication for a given set of audiences may be, and how effectively a message and its information content are conveyed via a given vehicle to a selection of audiences.

This analysis enables us to assess the figures for communication and dialogue outreach according to products and audience (Figures 5 and 6; more details on data and formula in the Annex).

2.6.1.2 Outreach formula

The value of COMMUNICATION OUTREACH is assessed in information points, measured in decimals (function of audience, message, vehicle); this depends on both SENSITIVITY (which is regarded as a function of audience, vehicle, message) and the INFORMATION CONTENT (which is treated as a function of message and vehicle).

2.6.1.3 Coverage

- **Messages**: Overall, the main messages of the current communication activities are expected to be focused on Project & Call specific info, Applications & Markets and S&T info, while General information is slightly less covered and Fundamentals are by far the least represented.

- **Vehicles**: Overall, printed material and the Web are expected to be the most used vehicle, while Events and Audiovisuals are less used. Print material, the Web and Events are good for coverage of Project & Call specific info, Applications & Markets, S&T info and General information. Audiovisuals are good for Fundamentals and Application & Markets.

- **Audiences**: Communication addressing schools, media, NGOs, Nano-consumers and general public appears to be less effective than the more technical one addressing scientists, industry and the educated public. Each audience can be reached in different ways, according to the vehicle used and the message conveyed.

As a consequence, different degrees of outreach are achieved. Values are calculated for each audience and then averaged. All this reflects the communication choice developed so far by the EC.

2.6.2 Results and discussion

The analysis resulting from this methodology allows us to assess the coverage figures of messages according to the vehicle (Figure 4) and of communication and dialogue outreach according to products and audiences (Figures 5 and 6; more details on data in the Annex). The following figures have been calculated on the basis of the feedback received by the multipliers (e.g. teachers), via direct downloads or e-mails. In case of videos, these are just a rough estimate, as an average number of 10 end users by multiplier are assumed. These figures show that more exhibitions and audiovisuals are effective in reaching a broad public, but much more dialogue is needed. Overall, about 2.4 million people represent the cumulative outreach from 2005 to 2008, where the exhibitions and audiovisuals take the lion's share. Most of this outreach community has been identified, and it is safe to say that the general public is the most important part of it.

[82] Data reworked from European Commission (2004): *Survey on communication outreach in nanotechnology through National Contact Points*, DG RTD G.4, revised in 2008, internal working paper.

Figure 4. Coverage of messages (in decimals) by vehicle for EC-developed communication on nanotechnology (2005-2008) ([82])

Coverage MESSAGE by VEHICLE

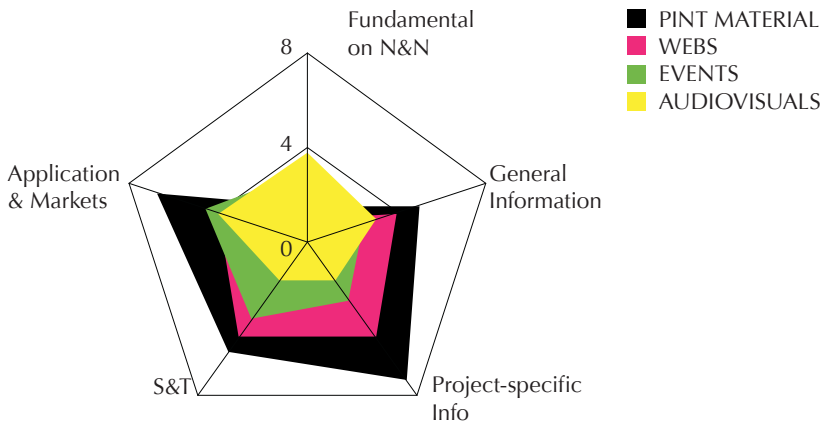


Figure 5. EC-developed communication and dialogue outreach by product ([83])

Communication Outreach by product	*2005*	*2006*	*2007*	*2008*
Exhibitions (e.g. Nanodialogue) and events	30 000 (prototype)	330 000	1 130 000	430 000
DVD (1) Videos1	210	1 820	1 920	1 020
DVD (2) Videos2	1 210	1 320	1 520	1 220
Audiovisual presentation for youngsters3	1 200	1 420	2 110	1 830
Printed material	1 245	2 459	3 520	2 890 (estimated)
Scientific and project events	23 720 (estimated)	34 115 (estimated)	27 145 (estimated)	35 606 (estimated)
web page	37 200 (approx)	42 150 (approx)	193 395	96 066 (projected)
Totals (estimated)	96 790	415 290	1 361 617	570 640
Cumulative totals years 2005-2008 (estimated)				2 444 337

Figure 6. EC-developed communication and dialogue outreach by audience ([84])

Direct communication outreach by audience	*2005*	*2006*	*2007*	*2008*
Lay public	30 000 (prototype)	330 000	830 000	830 000
Media	210	1 820	1 920	1 020
Youngsters	3 410	2 740	3 630	3 150
National Contact Points	1 245	2 459	3 520	2 890 (estimated)
Industry	3 720 (estimated)	4 115 (estimated)	5 145 (estimated)	5 606 (estimated)
Researchers	37 200 (estimated)	42 150 (estimated)	193 395	96 066 (projected)
Totals (estimated)	77 790	385 290	1 039 617	937 740
Cumulative totals years 2005-2008 (estimated)				2 440 437

[83] European Commission (2004): *Survey on communication outreach in nanotechnology through National Contact Points*, DG RTD G.4, revised in 2008, internal working paper.

[84] European Commission (2004): *Survey on communication outreach in nanotechnology through National Contact Points*, DG RTD G.4, revised in 2008, internal working paper.

Outreach on dialogue by product	2005	2006	2007	2008
Exhibition and events	310 (prototype)	3 121	8 014	1 400 (estimated)
Open Web consultation	-	-	320	145
Scientific Events	3 372 (estimated)	5 115 (estimated)	4 145 (estimated)	4 606 (estimated)
Totals (estimated)	5 687	10 242	14 486	8 159
Cumulative totals years 2005-2008 (estimated)				38 574

Figure 6.1. EC-developed communication and dialogue outreach by product

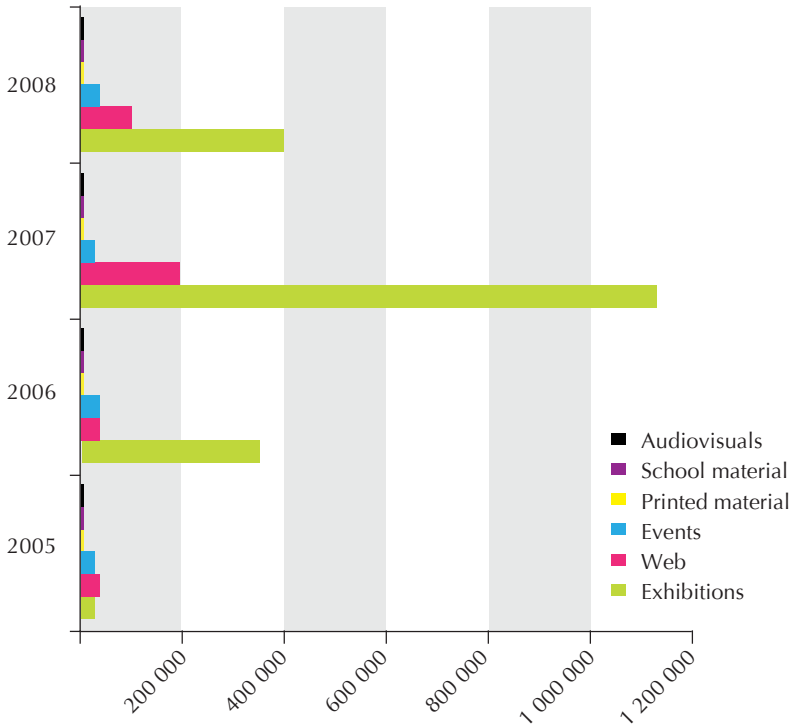


Figure 6.2. EC-developed communication and dialogue outreach by audience

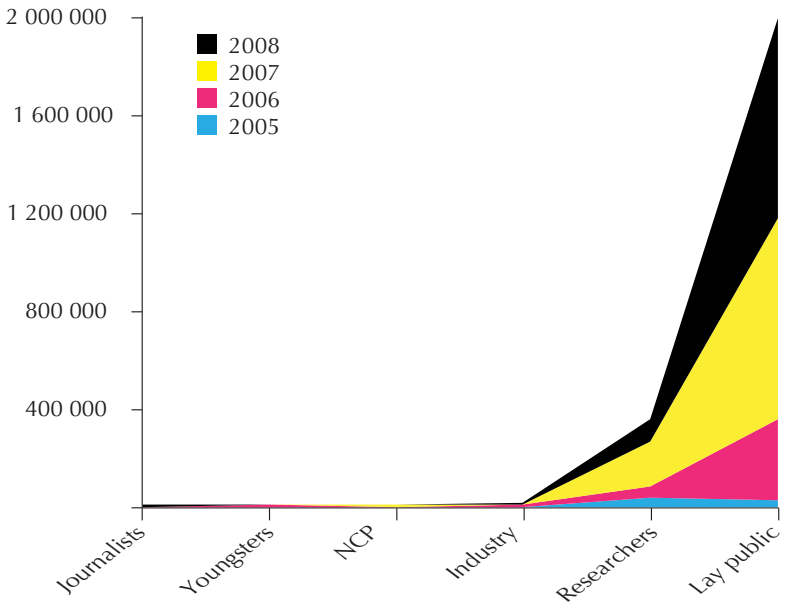
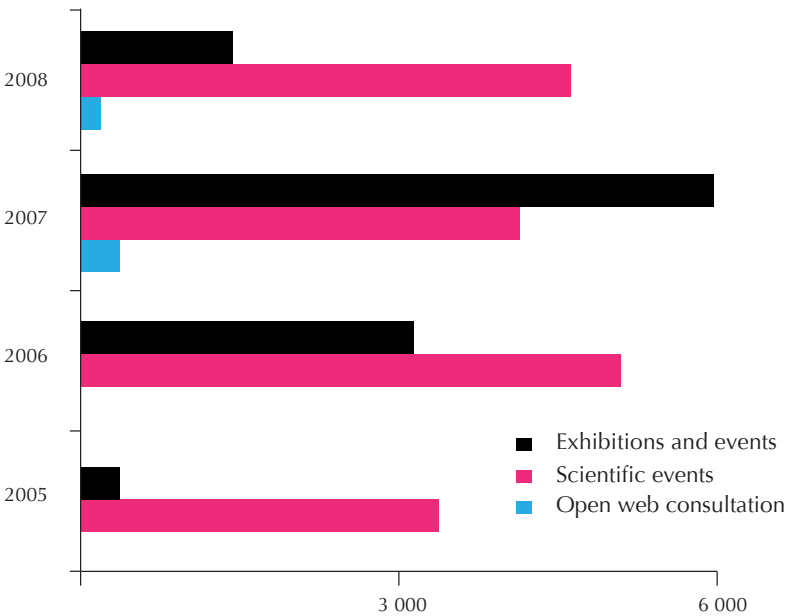


Figure 6.3. EC-developed outreach on dialogue by audience



2.7 CONCLUSIONS: FUTURE EC COMMUNICATION ON NANOTECHNOLOGY

The various assessments of these communication activities are clearly pointing to the need for more communication efforts to reach effectively selected audiences on nanotechnology. General recommendations can be drawn from these projects, especially from the outcomes from the series of workshops integrated with an open Web consultation set up by the European Commission in 2007 ([85]) (see Section 2.4.3).

Two main points of this exercise stand out.

- First, the key importance of **multipliers**, i.e. target audiences such as journalists or teachers who, in turn, have an important role in communicating with a larger public. As they have the potential to reach so many more individuals, they should be the primary audiences to reach. However, this does not rule out the need to address the broad public directly with appropriate actions.
- Second, the fact that some audiences are best reached during their 'professional' (or school) time, while others would be best reached during their leisure time ([86]).

[85] Bonazzi, M. (Ed.) (2007A and 2007B), Bonazzi, M. and Palumbo, J. (eds.), (2007), *quoted papers*.

[86] Cobb, M.D.; Macoubrie, J, (2002): *quoted paper*.

Teachers and explainers in science centres are efficient communication multipliers, so they are a primary target to attain in communicating nanotechnology (courtesy of NANODIALOGUE project)

Obviously, it would be really hard to effectively target all the selected audiences with the same accuracy, especially on a continental scale, as you would have to compete for attention in leisure time and spaces. The information deluge on any selected public is so enormous now that it takes a big effort just to break the attention barrier. Any effort by the European Commission on all these targets risks being spread far too thin to have a significant impact.

In light of this, the first solution appears to be more feasible and effective. This means concentrating resources on multipliers and people carrying an influence – (teachers, science centres communicators, who are pivotal ([87]), opinion leaders, opinion makers, media in general, scientists, reporters, policymakers).

If these people are not ready to play a role, communication projects aimed at the general public are bound to lack a key resource. It is extremely important that scientists work with multipliers, as they are: (i) competent in this extremely technical and complex field, providing reliable information, and (ii), the most trusted by the public when it comes to explaining the impact of technology on our life ([88]). So they should be more visible in the specialised and general press, providing interviews on expert panels and debates.

[87] Cobb, M.D.; Macoubrie, J, (2004): *quoted paper*

[88] BMRB international *(2004): quoted paper.*

This is a first set of recommendations for the immediate future:

- communication via media **audiovisuals, television and the Web** should be improved;
- **games, competitions and contests** should be promoted as an effective tool to challenge young people's imagination and engagement;
- **hands-on, hearts-on, minds-on approaches, expressive languages and art** should be strengthened as appealing ways to dialogue effectively with selected audiences;
- the growing interest for selected audiences as main target of communication efforts points to the fact that **segmenting** of selected **audiences and knowing more** about them becomes a crucial issue;
- bringing **researchers to science centres** and schools is necessary to complement the conventional approach of bringing schools to the laboratories.

Future communication projects should start by choosing a specific **target audience** in professional/school time: the more specific the targets, the better, as all subsequent decisions depend on that. Appropriate **segmenting** of selected audiences will be a crucial issue in shaping any project. Additionally, **expressive languages** and art should be a priority channel. An excellent way to stimulate the curiosity and participation of selected audiences should be based on **games, contests or competitions**. ([89])

All sources of the 2007 EC communication exercise agreed on the need to guarantee high quality of information to begin with, in order to create attention and awareness. Since the young target groups are overwhelmed and 'spoiled' with an abundance of information ([90]), advertisements, immersive games and virtual worlds every day, all communication actions should be chosen very carefully (e.g. the attempt to compete with a multimillion dollar professional PC or 3D-console immersive game for communicating nano is likely to fail). The focus should be set on an outstanding quality in design, implementation and content of each project/action ([91]) rather than creating a large quantity of output with an average appearance that does not stand out.

Finally, this analysis allowed us to identify clear recommendations for communication activities addressing selected audiences in both professional/school and leisure time, although the first line of action should be prioritised.

89 European Commission (2009): *Art and Science: creative fusion*, EC, Brussels, 2009.

90 Stares, S. (2003): *quoted paper.*

91 TA-Swiss project (2006): *Swiss publifocus on nanotechnologies*, (2006), TA-SWISS, the Centre for Technology Assessment.

Interacting with nano-objects inspires intellectual curiosity (courtesy of Brida)

Hands-on, minds-on, hearts-on: artistic languages can trigger emotions to spark off intellectual comprehension (courtesy of Brida)

Expressive languages such as theatre can put on show crucial questions to engage with nanotechnology (courtesy of NANODIALOGUE project)

WHERE
WE NO

EC POLICYMAKERS´ FORUM

INTERVIEWS WITH HERBERT VON BOSE AND CHRISTOS TOKAMANIS

Herbert von Bose
Director of Industrial Technologies,
Directorate G, DG Research of the European Commission

'We need to take the people with us about nano'

Q. To the best of my knowledge, this is the first ever Communication Roadmap about nanotechnology by an institution such as the European Commission. It goes well beyond a strategy document. It's striking that the same Research & Technology Directorate is also very much involved with funding projects aimed at public engagement about nanotechnology. What are the reasons for this?

A. We have always founded our approach on two pillars: we said right from the start we would not only look into the promises of nano, but at the same time we would also look at its potential risk and risk mitigation. We have always had a responsible approach to nanotechnology, which means we have always done the two things together. But this is not enough: we have to take the society, public opinion, with us. We must have the societal dialogue, a very early idea which you actually find in the 2005 Action Plan for nanotechnology. This is the third element we need.

If people don't know, they have a tendency to be afraid; instead, they need to understand what the promise and the potential risk of nanotechnology are, and to talk about it. At the very beginning we started mainly by taking the informed community with us: we had this exhibition travelling through universities or academies of science. Now we see that nano is becoming increasingly industrial, or heading into applications. So, the more our daily lives are touched by it, the more we have to see how risks that might be involved can be controlled and make sure that we include a broader public in this debate.

You see it also if you look around in the Commission's services. You now have many other services, be it in health, environment, employment, enterprise, who are asking questions: what are the health advantages and potential risks; what will happen to the products with nano content which one day will have to be recycled; what happens to the workers on

the production site; and how can we measure nanoparticles, e.g. for the chemical directives and REACH. It is one thing to say we want to control it and another thing to say by which tools to control it, so we have to look at the whole life cycle of nano. We are getting more and more interest from the other parts of the house to protect the citizens, the consumers, the workers, in order to make sure that nano delivers its promises and does not do any harm.

It makes absolutely no sense to hide things, because then you would be blamed for not being transparent, so it's better to say everything you know right from the beginning and inform the public, as we are trying to do with this initiative. This is a very important thing because sometimes researchers have a tendency to believe that what they do is good anyway, and don't see the need to communicate it. But there could be resistance from an uninformed public, if it perceives that the potential risks might have been insufficiently addressed, or that not enough research or money might have been put into nano.

Q. This Communication Roadmap mentions 'a moral duty' by EC policymakers working on research and technological development to inform Europeans about nano in an impartial way, with the wellbeing of citizens and sustainable economic growth of EU society first and foremost in mind. Will this document contribute to good governance?

A. Governance is a very important issue in this whole nano debate. At this moment, perhaps the most visible governance part we have regards the Code of Conduct for nano research and development. At the moment it's still voluntary but we have a close relationship with the Member States: how we should behave, what we should do, who is responsible. With respect to products, regulatory issues are dealt with by the respective competent Commission services that are part of the inter-service group which supervises the implementation of the Nano Action Plan. For example, aspects of worker protection are the concern of DG Employment, while those of consumer protection fall under the responsibility of DG SANCO.

With the 'Nano Action Plan' 2005-2009 having come to an end, we will submit another report in the autumn and propose a new one to the new Commission. I can tell you now the new Action Plan will have a very strong regulatory element as well. We first establish where we need regulation in one area or another, then we target research to make sure we get that regulation right, after which we can control it.

Q. Since public knowledge about nanotechnology is still so scarce and you aim to build public trust with this formidable communication exercise, will such an effort go forth into FP7 with further communication projects, about dialogue perhaps?

A. We would be very interested to do this. We would certainly like to see the dialogue going on, but also involve the Member States, particularly since at this moment we are a big player and are responsible for one third of public funding and research in Europe, keeping in mind that Member States are really major players, too. Besides, should some risk materialise with nano, this would destroy public trust in the technology considerably. It would

be in everybody's interest if Member States cooperated on this question, in order to boost public opinion in this respect and create confidence in this whole new technology. We are obviously very pleased to take our responsibility but it would also be important that Member States also adopted this philosophy and strategy.

Q. I can see this concept of dialogue running throughout the Communication Roadmap. After your latest big effort, around EUR 5 million dedicated to nano communication projects which started this year, it seems to me the Commission wants to involve people in an ever more direct way.

A. This is true, but of course it's not so easy. We are now getting nano further out into television and broader media, and we would be very interested in any new ways of communication: the aim is to have a much more interactive model. Should there be any fears about nano, they should be addressed. If an individual nano particle turned out to be dangerous, it would have to be embedded into a bigger structure to make it safe for the consumer, then we would have to make sure that the production site is also safe and finally look into recycling it safely for the environment. On the other hand, if it is simply thrown away, we must still make sure that it does no harm to the environment. If there is a health promise, like fighting cancer, public opinion responds very positively and most people see it's worth taking a risk. If nano involves, for instance, a cosmetics application, people would like to be reassured of the safety of the product for both themselves and the environment. We really have to look at the whole picture. It's an issue of credibility.

Q. You mentioned the word 'interactive'. How would you use the feedback from that dialogue, presumably in FP7?

A. We would use that feedback in order to adapt our own communication strategies. If we find that somebody is hesitating or has a bad feeling, we have to give a credible answer. Of course we would take it into account and deal with it. As far as regulations are concerned, we believe at this moment it's not good to regulate technologies and even better to regulate applications. In a way, the technology itself is innocent. It could also be developed anywhere else in the world and you might end up having to face a problem coming from somewhere else anyway. So, this is where the responsibility lies: how nanotechnology is being applied, because there can be so many totally different applications of the same technology.

Q. In this Communication Roadmap it is clear that you want European research to be driven responsibly, openly and accountably by taking public concerns into consideration; but at the same time you also want the best scientific standards and maximum creativity.

A. Absolutely. We should allow researchers freedom. But there must be limiting conditions. There is already the Code of Conduct, which is not a limitation, but a set of rules about how to behave with nano. So they have limiting conditions for their research activities and they know they are themselves accountable. Research normally knows no boundaries because only in this way can you cross borders of knowledge and reach new

frontiers, provided it's been carried out within the appropriate EU legislative framework. But the question must be asked: if there is a risk is it too high – in which case we stop – or can we control it and go ahead?

Q. Do you intend to do this through the media?

A. The media are the perfect multiplier for a large public. Schools and universities have a more targeted public and in-focus information. The Internet could give us even more interaction. I would be open to any solution as far as we can capture the views of the people. As policymakers we have to ask ourselves: if people are afraid, what are they afraid of? If these worries are justified, you would perhaps have to do more research. But I think in many cases these fears are just due to a lack of knowledge.

Q. And you have a whole cluster of projects which is dedicated to assessing risks.

A. That is true. Sometimes the application risks might have nothing to do with nano, but the problem could lie with the product itself. Nano should not become an enemy; nano should be the promise or the solution to many problems. People will only believe it's more of a promise than a threat if they understand it first and also become aware that any potential risk is taken care of. There is still a long way to go, as far as knowledge about nano is concerned. In the end, I am sure it will come down to any individual's informed decision, whether to be treated with nanotherapy or not. But the biggest present danger for the whole nano debate is that somebody might hear about nano for the first time with a negative, a priori connotation.

Q. Without engaging the lay public about nano, do you think the whole discourse risks being left to the extreme positions representing those who are absolutely favourable and those who are relentlessly contrary to nano?

A. That's right, and it would be unfair. We from the public authority have to tell the truth on both sides. I'll give you an example. The Austrians are very keen on nano, but they have given all the risk and ethical assessment to the Austrian Academy of Science as an independent body with a very high reputation, so that public opinion can be assured that they are going to look into all the different angles of nano. I think this is quite an interesting approach, from a national perspective.

Q. Will this direct communication with the public take place within FP7?

A. We will use FP7 money to do this. We can do it because with the agreement of the Member States we have been allowed to spend public money not only for the hard research but also for support activities like communication projects. We would like to build on this communication effort as an integral part of our research activities during FP7. The societal debate will be part of the forthcoming Action Plan 2010-2014, which will overlap with FP7. We will very much insist on having the societal dialogue in this very important document again, so it will become part of the Commission's policy, as it was in the past.

We'll have to see what the next Framework Programme brings, but I have no doubt that this question will continue to be of high importance in the longer term, so it's not a one-off. As nano moves increasingly beyond the laboratory into applications, we need to see what the people's new questions are going to be, and provide appropriate answers.

We are going into the full life cycle of the product, which needs to be dealt with responsibly, and carefully planned at the very moment of the production. In this respect we would rely on the experience of many industries which are already doing a good job today.

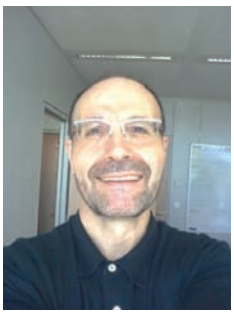
Q. Quite a few scientists themselves, such as some physicians, admit to being rather out of their league about nano.

A. All the more reason why with nano you need the full multidisciplinary scientific picture to be well in place for the next generation. If you have a new chemical product, for instance, you would need to look at the economic and ethical implications of it at the same time. I'm sure young people would be very able and keen to pick all the different aspects up at the same time, and do fantastic things.

Q. Coming, as it is, out of the cutting edge of EU nano research itself, this is a truly novel communication approach for Europeans.

A. He who brings the positive message first has a certain advantage. Then it becomes clear that it's always a trade-off. By developing innovative neuronal nano-engineered biochips we can help people with amputations, neurological and neurodegenerative diseases, spinal and brain disabilities (such as spinal injury, dystonia, epilepsy, Parkinson's disease, eating disorders) to repair or replace the altered or damaged functions. Or we can treat cancer patients with nanoparticles targeting tumour cells more efficiently and bearably than by using chemotherapy, so we can improve their quality of life; but we would just need to make sure that the applied nano-engineered chips and nanoparticles enclosed in the innervations or flowing in the bloodstream are so well embedded and controlled that they cannot produce harmful side-effects.

So, let's try to be the first to communicate.



Christos Tokamanis
Head of Unit for Nano- and Converging Sciences and Technologies
Directorate G, DG Research of the European Commission

'Maintaining the people's trust about nano'

Q. You have said that 'the EC has the trust of the people about nanotechnology, and we should keep it'. Does this Communication Roadmap set out with such a purpose?

A. Nanotechnology has been communicated in different media, from science fiction to scientific magazines, sometimes by people who do not really know what nano is. People listen attentively and have an idea, but they don't really understand the real essence of nanotechnology. Even researchers conducting research at the atomic level stay in their domain and may not fully realise the implications of it, let alone how to communicate the results of their research to the wider public.

When people think about nanotechnology, they tend to believe the benefits will emerge in 20 years' time. But again, this is just speculation about the benefits. In the short-term, society experiences marginal improvements in product performance. Let's not forget it's the promise of radical change that brings all the funding and politicians wanting to support it. Our intention is to put a system into place that will really deliver on that promise.

We have a huge task in our hands: we have been given a lot of money to invest for something which it has to be quantitatively defined for its end-point. Our job is, first of all, to put the development process into context; be it for environment, health, energy or manufacturing. The whole outline of such roadmap needs to be signposted, and as part of the Communication Awareness campaign, this includes signposting the opinion of the people. We need to know public opinion from all walks of life, social, professional, interests, and understand what nanotechnology means to them and identify their real expectations.

We started this campaign knowing that people have vastly different perceptions about science. But if we take the spin away from the marketing of science and technology, the reality is that we are still far from that promise. Bringing all the benefits to everyday life will take long years of very hard work. But we should always bear in mind that, in terms of Science and Technology, Europe is in a very good position. It has outstanding scientists

and centres of excellence and has very strong companies in the chemical industry, which makes the nanomaterials; aeronautics, automotive, construction industries. This means we have world class users of such nano-technologies. We need to put all these people together to bring the outcome of research to fruition by reaching the industry that is going to turn it into a competitive product, fulfilling what the consumer wants.

For me, what nanotechnology represents to consumers is the ultimate, tailor-made product: a medicine designed to be taken in the morning or in the evening to treat some person's medical condition; every household being turned into an energy production, storage and distribution entity; distributive manufacturing with versatile machines producing items according to the latest customer specifications. This would mean a really responsive society which would not waste materials and/or energy so everyone would benefit from these savings. But we are still too far away from such applications, and at the moment what makes the headlines is the 'easy part' of nanotechnology. But we are really talking about here is something totally different, namely the ability to design, engineer and produce things at a nanoscale, with nano objects in a new production environment and with markedly different consumer patterns and behaviour. The Commission has always been very vigilant, so why not reflect this better and make it clear? We have been invited to open our labs, and the scientific press really loves it. Why not broadcast conferences from time to time, for instance with respect to huge problems such as water treatment?

Q. What are the main ethical reasons and social responsibility concerns underlying this Communication Roadmap?

A. We have an obligation first of all – as outlined in the Nano Action Plan (2005-2009) – to include all activities necessary to promote nanoscience and nanotechnology to the wider public. We knew the problems with asbestos and GMOs and we are aware that for consumers, food, clothing and environment are very sensitive topics. How do you measure it and how do you communicate, for example, red-blood cells' function, which occurs within 2 to 5 nanometres in diameter? Here, we are discussing objects which are smaller than a red blood cell. But, as we say in the Communication Roadmap, since our funding seeks to investigate such scientific facts, it would be appropriate that the facts are communicated to people by those who generate them, yet with the help of the media using language familiar to the public.

Society sometimes seems to lose confidence in science and technology, but people keep using it every day, because the positives are bigger than the negatives. However, with nanotechnology we have to be really careful, because the impact will be huge. We don't want to be in a position to be criticised. Think of what asbestos was in the 1960s: it was considered a good, useful material and nobody thought about the threat it represented. In 10 years' time, what happens if something we produce is suddenly proven to be unsafe because the science was rushed? We don't want to make this mistake. This is our ethical and social responsibility as the Commission. The other thing is, to be able to progress with the right level of funding as well as people's confidence; people need to make an informed decision based on the most up-to-date facts. At the moment, we are talking

about products such as sunscreens. People would want to be assured that the nanoparticles used therein are safe and they are not diffused through the skin and accumulate in the body. Such are the present concerns that lead us to examine guidelines for responsible Nano-developments not only as Europe, but as an international community through, for example, the Organisation for Economic Co-operation and Development (OECD). The sponsored projects by members, target the analyses of exposure and risks and aim at reaching consensus on how to assess and manage risks for 14 families of manufactured nanoparticles that you would usually find in consumer products. And this is only the beginning. Such international efforts are not known by the wider public. We are talking here only about the first generation of nanomaterials, which are passive. But the complete story is that we are already working at research level on the third generation of nano-systems, which are active nanosystems, in which the nanoparticles as entities are lost and you have the functions you expect to see from a nanodevice. The safety and health implications of such devices have not been considered yet.

Q. How are you going to keep the public engaged in this, in the future? Do you want to build on the present communication projects, which are aimed to give balanced information about nano to different target audiences, with a further communication effort?

A. This is just the beginning. It's about informing people about things which are correct, based on facts. We want to create a dedicated Internet platform for continuous dialogue. What we need to establish is an Observatory for Nano-dialogue which continuously monitors consumer opinion about nanotechnologies, the same way we conduct market surveys to understand trends in public opinion. The socioeconomic part of the research has been developing the tools that will give people the opportunity to get involved and express their opinion about a message or a product. Then we will have what we call technical democracy. It means that public opinion will be monitored on a continuous basis through Web-based measures that could be picked up by other media. Now is the appropriate time to monitor what people really think about nanotechnologies and promote an evidence-based dialogue.

Q. This technical democracy Web platform promises to become a highly valuable media resource, too. Is this one of your aims?

A. We want the right cognitive tools to monitor and capture public opinion, structure it, correlate it and transfer it into messages that policymakers would use for more effective policymaking. We can have regular conferences where we invite NGOs and the media to express their opinion, but this is limited to a point in time; it doesn't give you a trend. On the Web we could monitor how these opinions change, according to which socioeconomic group and geographic part of Europe. We know from demographic tests, for instance, that Europeans to a large extent are very favourably disposed towards nanomedicine. On the other hand, there is a risk of people becoming polarised over hypothetical questions and hypothetical answers. It's what is called speculative ethics: you ask a hypothetical question, and the speculative answer is taken as **the** answer to the hypotheti-

cal problem, which then makes the headlines, propagated by the media, and is quickly turned into sensational news.

What do we have to offer instead is our good intentions, our honest, unbiased research, which we want to make available to open review. We exist because we disseminate the results of research for the benefit of our society; so why shouldn't we disseminate these results, not only for researchers or industries, but also for consumers? This is a very important branch of a tree, which will provide protection for people under it. It means that: we are responsible; we do not hold back on anything; we monitor public opinion continuously. If we have technical democracy, we want to get the pulse of what people really think. Then, if we are doing something inappropriate, we could correct ourselves. If it turns out that people are favourable to other areas of nano but do not want nano in, say, their food, we will have to take heed of such an opinion.

Q. If you had a dialogue through dedicated Web resources and other media in order to bring young people on board as well, this wouldn't be of course a formal consultation. But wouldn't it come rather close to being an informal one?

A. If we knew something was very controversial, we would have to undertake a consultation from a formal point of view. But now the smart thing to do is to start the dialogue and outreach at the same level as the research and keep them at the same level, balanced. Common sense dictates that with publicly funded research the public should always be consulted. You should not leave it for later. The public can give us informed feedback if we inform it correctly. For example, through our three-minute audiovisual teasers people will get at least the right message, and if they are curious and interested, they will come back and look for more information and start talking to each other online.

Q. Your new 'Nano Action Plan' is starting next year and will be going on until 2015, and it is bound to include a lot of strong regulatory work. Will this be part of the dialogue?

A. We are already doing research on the third generation of nano-systems, but we are now talking about the regulation of the first generation of nano, which is about passive systems. We are already two generations down the road in terms of research. We must find ways that regulatory aspects are developed in parallel with the introduction of innovative nano-enabled products.

Risk assessment and management is assured via REACH but the implementation framework specific for products containing manufactured nano-particles has yet to be developed. There is a problem: you only register chemicals above 1 ton. For Nano-materials tonnage considerations for registration seem not to be sufficient; additional metrics have to be devised and put in place. What kind of metrics are you going to use? Before asking or informing the public for such issues we must first clarify for ourselves all policy making options and implications that have to be considered. The new Nano-Action Plan would be strategic in so far as it would deepen the degree of integration of all elements of Nanotechnologies development forging strong links between research and innovation

on one hand, and delivery of benefits to society with a fact-based regulation and overall responsible governance on the other. Getting the policy mix right is essential in rewarding the fast take-up of the latest nano-developments without biasing economic competitiveness or downgrading health, safety, environmental, social or ethical issues.

Q. As you go along, this open communication exercise will take care of all these aspects, too.

A. Exactly. The promise is continuity: in sending the message out, receiving the feedback, analysing what it means and deciding how we should behave. Things are changing so fast, that people might have stayed with the impression of what they heard a couple of years ago, so how do we inform them of the latest developments? There is this tree of promise of nanotechnology. The fruits of this tree will be better healthcare, more renewable energy sources, a much more versatile manufacturing system, and all kinds of benefits. All these fruits are hanging from the same tree. There could be big branches and small branches of communication. We want these branches to grow and feed from the same roots.

Q. There seems to be an overlap between the Action Plan, which goes up to 2015, and FP7, which ends in 2013. Is the setting up of the Observatory Nano-dialogue included in this time-frame?

A. Yes. We are proposing this platform, whose target will be continuous dialogue with everybody, in 2011. This would be based on already developed tools that monitor public opinion. Now we have the means: Internet and online media have become mainstream. We will have to kick-start the platform, but then the Member States will have to be involved. We would like to have associations in each Member State that would be part of the system, to which all the Member States will contribute. Member States will have their own monitoring posts and they will conduct their own continuous surveys of public opinion. The unique thing about that is that the questions will be the same for everybody. If there are any local trend differences, they will be part of the system but they will not change the initial architecture and aims.

Now we have a new call, and I am thinking of something substantial to set up this dialogue platform. I hope that in the end we will agree to have it as part of the new Nano Action Plan for continuous monitoring of public opinion, where people will be able to record what they think. This will be our online dialogue. We will initiate it, but once it's there, it will belong to the public. We have tools for mapping controversy; we will have to have a system of analysis in place to capture random remarks in order to discern trends. For us, this strategy should be part and parcel of the whole nanotechnology development. It needs to be established as an ongoing process providing continuous feedback of what the public thinks of Nanotechnology.

Q. Such a system would really break the mould of established institutional communication models.

A. This is exactly what it would try to do. If public opinion has been misguided by a bad event, or by false assumptions, it can be also rightly guided towards understanding the right things which are based on facts. So we can answer all these searching questions, such as whether we have considered this risk or the other, and so on. The EU's framework programme for research is investing yearly EUR 600 million on Nanotechnology, but in comparison very few reports are produced that bring these results to the attention of the public. We have excellent results that have not yet been communicated. This time we aim to have objectivity, rather than subjectivity, in this dialogue exercise. The beauty of it is we can also feed the outcome of all this communication work back to researchers so as to increase their appreciation of what their work really means to the public.

PART III. WHERE DO WE WANT TO BE?

TARGETING, STRUCTURING AND DESIGNING THE COMMUNICATION ROADMAP

Policymakers recognise that it is crucial for them to develop an appropriate Communication Roadmap in order to foster good governance and appropriate social dialogue on technology. In fact, as science and research achievements can affect society deeply, it is reasonable to group all the dynamics, forces and achievements associated with nanotechnology into an all-inclusive perspective.

The famous 'Five Ws' strategy seems to be of paramount importance at this stage, as the nanotechnology debate is becoming increasingly sensitive for both society and EU funding institutions, such as the European Commission, DG RTD, Directorate Industrial Technology. It's a classic case of identifying why, who and how to communicate what to whom about nanotechnology.

3.1 AT A GLANCE: THE 'FIVE Ws' OF NANO-COMMUNICATION (PLUS THREE WELCOME ADDITIONS)

This Communication Roadmap is all about (i) **increasing the consensus between stakeholders, the whole of society and policymakers to support EU decision-making on integrated, safe and responsible nanotechnology** and (ii) **enhancing the image of the EC as an impartial, transparent and trustworthy communicator on nanotechnology**.

In order to get there, **appropriate communication** promoting knowledge and awareness in target audiences comes first; **dialogue and engagement** are the next indispensable steps.

There is a 'Five Ws' method to this framework, with three further, welcome additions:

WHY? The Goal: *What does success look like?*

WHO? The Actor: *Who has the mandate to communicate?*

WITH WHAT EFFECT? The Impact: *What is it for?*

TO WHOM? The Audience: *Which audience should or could be reached?*

HOW? The Vehicle: *What is the appropriate support?*

WHAT? The Message: *Saying what?*

WHERE and WHEN? The Schedule: *What is the appropriate moment and place?*

HOW WELL? The Score: *What is the appropriate moment and place?*

3.2 GETTING DEEPER INTO THE BIG QUESTIONS OF NANO-COMMUNICATION

1. **WHY? The Goal.** *What does success look like?*

   Increasing consensus-based support to EU policymaking on responsible nanotechnology

2. **WHO? The Actor.** *Who has the mandate to communicate?*

   In this case, the European Commission, thus shared by DG Industrial Technologies, Unit G.4, Nano- and converging Sciences and Technologies, in coordination with all other relevant institutional services relevant for communication. The EC has adopted the Communication *'Towards a European Strategy for Nanotechnology'* ([1]) and the *'Nanosciences and nanotechnologies: An action plan for Europe 2005-2009'* ([2]). Within this framework the Unit has identified that communication and dialogue on nanotechnology research is also a key part of its mandate, which includes the full legitimacy for launching a Communication Roadmap on nanotechnology and implementing its associated actions.

3. **WITH WHAT EFFECT? The Impact.** *What is it for?*

   (a) increase consensus among stakeholders, the whole of society and policymakers on EU decision-making in nanotechnology;

   (b) **enhance and build on the image of the EC as impartial, transparent and trustworthy communicator on nanotechnology.**

   This can be attained by: (I) **an ATTITUDE CHANGE** with these **expected effects**: (i) increase of **knowledge** and **awareness** of nanotechnology in civil society; ([3]) and (ii) build-up of **confidence and trust**, enhancing the EC's **image** as a reliable, transparent and trustworthy communicator on nanotechnology; (II) **BEHAVIOUR CHANGE** with

[1] COM(2004) 338 (http://cordis.europa.eu/nanotechnology/actionplan.htm).

[2] COM (2005) 243 (http://cordis.europa.eu.int/nanotechnology/actionplan.htm).

[3] Recent social science literature, corroborated by the conclusions of different recent international events, e.g. Communicating Science, panel sessions 3 to 5; Gover & science, conclusive session; Citizens' declaration on the city of tomorrow, p.2-4, shows that **two main axes** are crucial for developing socially sustainable governance for S&T systems: (i) **appropriate communication** and (ii) **participatory mechanisms fostering dialogue with society**. These actions are expected to promote in civil society both awareness and engagement on nanotechnology.

these **expected effects:** promoting **dialogue and engagement** with stakeholders, and **increasing consensus** to support EC policies on nanotechnology. Each result should be judged by an assessment of current situation, the design of the desired situation, identification of Calls to Action, each one SMART, i.e. Specific, Measurable, Achievable, Reasonable, Timely. Accordingly, **two clusters of Calls to Action** are proposed here: (i) developing **appropriate communication** (i.e. actions towards the information society needs to know) and (ii) setting up relevant mechanisms for **dialogue and engagement** between civil society and RTD policymakers for consensus-based support to policymaking on responsible nanotechnology.

4. **TO WHOM? The Audience.** *Which audience must, should, could be reached?*

Selecting audiences is pivotal. Audiences should be homogeneous enough to be successfully attainable. Homogeneous audiences are made of people who could meet on the same market, i.e. sharing common needs and level of awareness. We should be looking carefully at the people we have already reached, and single out the audiences we are going to reach soon and those we should strategically reach further down the line. Each communication activity by Unit G4 will start by identifying appropriate target audiences which might be homogeneous enough to be considered an effective target (i.e. young people, scientists, industry, business, policymakers, NGOs, media), and messaging may vary accordingly. Tuning into our audience's basic level of understanding will help us to select appropriate messages and shed light on how to deliver them (e.g. media for the public, Web and videos for schools). Some basic questions should be framed beforehand: (i) have they heard the message before? (ii) is there previous knowledge of the message? (iii) what is the audience already thinking?

5. **HOW? The Vehicle.** *What is the right support?*

How is the information expected to be shown (e.g. cartoon, video, broadcasted on television, schools, the Internet)? This choice will give Unit G4 a better way to hit the bull's eye. Vehicles may range from organising large communication events to publishing a leaflet or newsletter on a web page, according to each message and frequency.

6. **WHAT? The Message.** *What should we get across?*

Which **relevant** and **appropriate** information will we be giving, e.g. nanotechnology offers opportunities and risks? Balanced messages are modulated according to audiences and possibly selected through SWOT analysis (*S*trengths, *W*eaknesses, *O*pportunities, *R*isks), e.g. *nanotechnology can deliver better quality of life but as it involves possible drawbacks it must be driven conscientiously, and this is precisely what the EC is doing.* Complete, impartial and accurate messages will be woven through all of the communications materials produced as well as any speeches given. It is obviously up to the audience to decide what to do with each message. This, at the end of the day, is more important than what each message does to the audience at the moment of delivery.

Turning a message into a real story is the only way to have a winner here. But possible conflicts of interest should be explained, and any omission of facts, risks and uncertainties avoided. Additionally, it is important to examine the **sensitivity** of the audience with respect to both vehicle and message. Generally speaking, a certain audience shows different reactivity depending on the message and the vehicle used to convey it. In fact, specific sensitive issues should be addressed properly, and particularly (please see: Nanotech, Risk and sustainability, executive summary, 2005): (i) who is going to **benefit** from this innovation; (ii) **safety** on potential toxicity of nanoparticles on environment and nature, concerns about possible irremediable interferences of nano man-made with natural systems; (iii) **privacy** concerns about the capabilities of nano-devices to affect democratic freedom; (iv) **decision-making:** elitism of information/intervention and access to nanotechnology and related socioeconomic nano-divide, who is deciding and how citizens can influence decision-making; (v) **ethical** and religious **debate, life-related issues** (e.g. production of 'better humans'). It is useful to look into anything that may be adversely affecting the communication, e.g. disagreement with the approach, missing information, and previous knowledge of the audience.

7. WHERE and WHEN? The Schedule. *What is the appropriate moment and place?*

This is about the space and time location of the communication actions. They depend on the vehicle selected for the distribution channels, e.g. orientation and educational sessions in science museums or on the Web during specific activities of FP7 projects, such as providing a fact sheet to the '*Nano Kit*' highlighting prototypes and marketable products, success stories, learning modules, scenario-building games (e.g. on different nano-based future societies). The combination vehicle/channel performs differently with respect to the audience to be addressed (e.g. video on television or Web or during school lessons).

8. HOW TO ASSESS? The Score. *How well has it been done?*

How effective is the Roadmap and associated actions? There are many ways to determine a communication campaign's success. Information can be gleaned in the meantime by tracking visits to our Intranet or Internet site, to see if we are receiving more compliments and fewer complaints. We will need to make sure that the combination of message, vehicle and distribution channel with respect to the target audience is very effective. Integrated indicators are difficult to use, and the reliability of their information is variable, mainly qualitative. However, we have tailor-made some of them to better synthesise the overall performance of communication in terms of the sensitiveness of the audience to a certain message conveyed through a specific vehicle using appropriate channels, i.e. **outputs (**how many news releases lead to stories; distribution, circulation, contact figures)**, outtake** (what the audience takes home) **and outcomes** (change of attitude or behaviour), as described in Figure 7.

Figure 7. Outputs, outtakes and outcomes for the Communication Roadmap on nanotechnology

The 'Ws'	*OUTPUT*	*OUTTAKES*	*OUTCOMES*
WHY Specify what the **goal** of communicating is	■ Gain in EC image ■ EC transparency, credibility and accountability	Perception of EC as: ■ **transparent** ■ **impartial** ■ **trustworthy** communicator on nanotechnology	**Increasing consensus-based support to EU policymaking on responsible nanotechnology within society**
WHO Select who has the **mandate** to communicate	Identify in the **EC** policy documents the legitimacy basis for communicate and through what **services**	■ Strengthen the role of **EC** as a major reliable and trustworthy communicator in nanotechnology	Design and implement the **EC's Communication Roadmap** and associated activities
WITH WHAT EFFECT Identify the major **impacts** of communication	(I) ATTITUDE CHANGE in the whole of society (II) BEHAVIOUR CHANGE	■ Improve society's **knowledge** and **awareness** on nanotechnology and EC role and actions ■ Increase society's **confidence and trust** in the EC ■ Promote **dialogue and engagement** with stakeholders	(i) **Enhancing the image of the EC as impartial, transparent and trustworthy communicator on nanotechnology** (ii) **Increase the consensus among stakeholders, civil society and policymakers on EU decision-making on responsible nanotechnology**
TO WHOM Address **target audiences**	**Identify** strategic, appropriate and homogeneous segments of society to communicate with	**Attain** homogeneous, appropriate and strategic key audiences	Targeted audiences act as both **multipliers** and **influencers** to the whole of society
HOW Specify what **vehicle and channel** are to be used	Select and use: ■ media techniques ■ professional communicator tactics ■ marketing tools ■ information gatekeepers, influencers, multipliers, opinion-makers	Set up appropriate: ■ targeted surveys (e.g. Web) ■ specific workshops ■ open Web consultations ■ targeted calls for proposals ■ events ■ publications ■ creative-based tools ■ light-hearted techniques	Implement accordingly: ■ **most appropriate** tools/activities for communication ■ **tailor-made actions** to engage stakeholders

The 'Ws'	*OUTPUT*	*OUTTAKES*	*OUTCOMES*
WHAT Express the **real messages**	■ Transparency ■ Accountability ■ Trust and confidence ■ Awareness/ feedback/ dialogue	Identify **key messages** for communication Identify **key issues** for dialogue and engagement	■ Nanotechnology is a **new phase** of technology ■ It deals with **markets** but impacts on **safety**, **privacy, ethics** ■ It must and can be controlled **conscientiously and the EC is fully equipped to do this** ■ **Society can and should engage** in supporting the policymaking process
WHERE & WHEN Allocate actions into **space and time**	Identify strategic **venues** to attain audiences	Sets **attractive** techniques to promote strategic venues for key audiences	■ Plan details on appropriate **frequency** and venues of events
HOW WELL Set up and implement methodology	OUTPUT assessment **Outreach coverage** by communication product, by audience, by message	OUTTAKE assessment **COMMUNICATION** 1. **Information needs assessment** (questions after communication so a response can be drawn up) 2. **Analysis of news clippings** (to single out stakeholders' concerns, developing their 3. specific knowledge) 4. **Public opinion sampling** (to assess historical series of opinions on perception of key problems, issues and events) 5. **Qualitative methods** such as questionnaires, discussion meetings, focus groups **ENGAGEMENT** 1. **Smog readability grading formula** (to evaluate the level of issue comprehension) 2. **Message pre-test questionnaires** (to get feedback on pilot materials) 3. **Theatre testing** (to get feedback on visually presented pre-test materials) 4. **Focus groups** (to get a 'feel' for the attitudes and beliefs of stakeholders)	OUTCOME assessment I. Establish what audiences **do with the message**, i.e. change of attitudes and behaviours 1. **Public opinion polling and surveys** (before and after surveys of attitudes and behaviours) 2. **Focus groups** (to get qualitative feedback) 3. **Behaviour observation** (to determine whether behaviour changed) 4. **Cost-benefit analysis** (to examine stakeholders' relative benefits from communicating) 5. **Experimental** (to isolate the effects of the communication on stakeholder behaviour by setting up experimental groups) II. Draw up **recommendations** for future communication and engagement

3.3 A CLOSE-UP LOOK AT THE BIG QUESTIONS OF NANO-COMMUNICATION

3.3.1. Step 1: Science communication as part of the research process (The Goal)

Successful science communication depends on being planned **as part of the research process itself.** This point is particularly important for communication on nanotechnology, as uncertainty, risk, social perceptions, concerns and expectations play a crucial role for building social acceptance or rejection of nanotechnology.

The first step in organising any communication activity must be defining the reason and the ultimate effect of the communication action, the nature of the audiences, how to attract them, the structure of the communication actions and how to evaluate them.

Ask the questions:

'Why are we doing this? What do we want to achieve? What does success look like?'

The answer has already been given: it is about achieving a certain degree of consensus to support to EU decision-making on nanotechnologies, enhancing the image of EC as an impartial, transparent and trustworthy communicator on nanotechnology.

3.3.2. Step 2: In charge of both nano research funding and communication (The Actor)

The mandate given to the European Commission, thus shared also by DG RTD Unit G.4, Nano and Converging Sciences and Technologies by the EC communication 'Towards a European Strategy for Nanotechnology' ([4]) and by the 2005 'Nanosciences and nanotechnology: an Action Plan for Europe 2005-2009' ([5]) clearly outlines this double role for the Unit. The fact that communication about nanotechnology should come from the very core of research is a source of added strength for the EC.

4 COM(2004) 338 (http://cordis.europa.eu/nanotechnology/actionplan.htm).

5 COM(2005) 243 (http://cordis.europa.eu/nanotechnology/actionplan.htm).

3.3.3. Step 3: Be 'SMARTA' and attitudes will change (The Impact)

3.3.3.1 Choosing the method

Expressing objectives in terms of performance makes it easier to determine whether we have achieved them, so we need to use performance indicators. They can be a quantitative (numbers, monitoring, surveys), or qualitative (description, informal feedback, discussion) assessment of success of communication. Communication objectives and their performance indicators are pinpointed by using the ***SMARTA*** formula: ***S***pecific, ***M***easurable, ***A***chievable, ***R***esults-orientated, ***T***imely, ***A***ction-implicit.

3.3.3.2 Choosing the objectives

The objectives are chosen to attain the goal of *achieving a certain degree of consensus as support to EU decision-making on nanotechnologies, enhancing the image of EC as an impartial, transparent and trustworthy communicator on nanotechnology.* As a consequence, it is pivotal to enhance **confidence and trust**, i.e. the image of the actor who communicates. Image is to organisation what popularity is to an election, when a general attitude change is likely to trigger a behaviour change. That is why most theoretical models of attitude change are skewed more towards the importance of the mnemonic side rather than being keen on objective scientific answers. The first model is called the 4P's, which was proposed by the American psychologist Henry Hocke: ***Picturing*** a situation, ***Promising*** a benefit, ***Proving*** the benefit, ***Pushing*** to action.

A second model complements this previous pattern, i.e. the ***AIDA*** model:

Attention: to draw attention
Interest: to arouse interest
Desire: to provoke desire => an attitude change
Action: to trigger action => a behaviour change

In this light, objectives related with attitude changes are examined: (i) those aiming at raising knowledge and awareness on nanotechnology and the associated EC role; (ii) those focusing on image formation. Then, objectives related with behaviour changes are analysed: (i) engagement and dialogue; (ii) consensus building as support for policymaking.

Goals, objectives and expected effects can be organised according to their importance in this showcase (Figure 8). This will allow the identification of the necessary Calls to Action (Sections 3.3.3.3 through 5).

Figure 8. Goal, objectives and effects of EC communication on nanotechnology

Main GOAL	
Increasing consensus-based support to EU policymaking on responsible nanotechnology: positioning the EC as value promoter within society, building on EC credibility to establish it as a trustworthy communicator on nanotechnology	
OBJECTIVE (I): ATTITUDE CHANGE	
EFFECT (1)	(i) increasing **knowledge** and **awareness** on nanotechnology within society
EFFECT (2)	(ii) enhancing **confidence and trust** in the EC, acceptance of the EC's **image** as trustworthy, impartial and transparent actor and communicator on nanotechnology
OBJECTIVE (II): BEHAVIOUR CHANGE	
EFFECT (1)	(i) promoting **dialogue and engagement** with stakeholders and society at large
EFFECT (2)	(ii) promoting both **consensus building and support** to EC policies on safe, responsible and integrated nanotechnology

3.3.3.3 Attitude change

3.3.3.3.1 Knowledge and awareness objectives

Before gaining a good image (what the constituencies think of the organisation), good awareness is essential (the constituencies' consciousness that the organisation does exist). Since nobody likes what he or she does not know, the issue is that the European Commission should make itself known as a hands-on communicator about nanotechnology.

Four types of awareness are suggested (from the weakest to the strongest).

1. *Aided recall*: the recipient knows the identity of the organisation quoted to him or her.
2. *Unaided recall*: the recipient spontaneously quotes the organisation name and identity.
3. *'Top of mind' recall*: the organisation is quoted at the top of the list of the recipients' priorities.

4. *Qualified recall*: the recipient is able to quote a series of specific activities tied with the organisation.

3.3.3.3.2 Confidence and trust: the image objectives

In order to produce the desired effects on the EC's image as a trustworthy communicator on nanotechnology, we need to get the best out of public awareness of the EC's institutional identity, reputation and relationships.

As is the case with awareness, an image needs to be refined continuously to stay close to an organisation's real identity. Four kinds of image can be envisaged:

1. the **real** image, as close as possible to the organisation's identity;
2. the **perceived** image, as it is conveyed by public opinion;
3. the **desired** image, ideal, best-wished for, according to the pre-defined goals;
4. the **possible** image, limited by environment constraints.

The EC's reputation is made of the EC public's beliefs and judgmental opinions. The quality of its administration, financial strength, innovative skills, services, and civic actions are all components of the organisation's reputation, as well as its ability to listen and inform citizens and its participation in the cultural, social and environmental life. But this real identity needs to be fully understood and appreciated, so there should be no image gap giving way to misperceptions (Figure 9).

Figure 9. Specificities of the EC as communicator on nanotechnology

Institutional Identity	Institutional Reputation	Institutional Relationships
What **is** the actor: EC DG RTD is a funding body, funding RTD on nanotechnology	What to **bring** to key audiences: transparent/trustworthy communication & dialogue	The **bonds** to form: with other stakeholders
What the actor **wants to be**: become a credible communicator	What to bring **to the EC**: increase visibility and credibility	The **stand** to take: impartial, transparent and trustworthy communicator on nanotechnology

3.3.3.4 Behaviour change

3.3.3.4.1 The engagement and dialogue objective

If science and society were really a **marriage** of two actors with different priorities but with a common goal of mutual support, this would allow the achievement of mutual benefits and prevent technocracy or populism. In fact, society's quality of life is heavily affected – positively or negatively – by scientific achievements, while science and technological systems need societal support (i) to get funded, (ii) to create marketable products, (iii) to receive moral legitimacy and gratification ([6]). As in any happy marriage, science and society have to communicate mutually and fruitfully to achieve a common agreement, feedback and take responsible decisions, producing a dialogue mechanism. It is quite clear that social acceptance could come solely from this ***dialogue and engagement*** process, which is based on the development of ***appropriate communication***. But what does this concept really mean?

Again, just like in any marriage, mutual trust, transparency and consensus are the foundations of appropriate communication and dialogue. This construction is difficult to build and easy to be shaken at the first tremor, but there is no other way: only appropriate communication can bring about and nourish mutual trust.

It works like this: first comes the information system that addresses ***what society needs to know*** to participate in the debate and the decision-making process on nanotechnology systems. Dialogue ensues: this is a communication system between several emitters and receivers of information, whose interaction is a ***variable, complex feedback pattern***.

The bottom-up approach represents societal needs and concerns. The *top-down* approach details what nanotechnology systems can offer and which are their main constraints. The underlying idea of appropriate communication is to set up a new social governance model for nanotechnology systems based on dialogue, rooted in the concepts of trust, transparency and consent, sparking new relationships between all the societal forces involved in the nanotechnology debate. Prior understanding is required for being understood, so the point is no longer to make society understand nanotechnology mechanisms but to identify which information it needs in the first place.

3.3.3.4.2 The consensus building objective

Efficient participatory mechanisms are required if society is to get more deeply involved into consensus-building dynamics with a major impact on governance. A better management of the negotiation about risk is crucial here. Society should be made able to feed its fears, expectations and concerns back to the EC appropriately. It is expected that certain sensitive issues will come to the fore again and again, especially those involving risk and

[6] Tomellini, R. (2009), *quoted source*, and Bonazzi, M. (2009A), *quoted paper*

uncertainty. These should be dealt with by **sound science,** according to the **precautionary** and **responsibility** principles. There can be, of course, different levels of scientific evidence, risk or uncertainty to be managed.

Appropriate systems balancing the principles of representativeness (e.g. subsidiarity) with others based of direct democratic approaches (e.g. multi-actors) also need to be set up. Dedicated measures should be aimed to implement this task among EC-funded communication activities.

3.3.3.5 Conclusions: Calls to Action

In the old world of the public understanding of science, there was often a monologue top-down approach where non-expert opinion had no role to play. However, with the increasing recognition that dialogue and multiple inputs are crucial factors in underpinning sound decision-making in science, it has become accepted that two-way communication is a more robust way to address all of these objectives. In fact, one of the most enlightening phrases is:

'… science is too important to be left to scientists. Their knowledge and their assessment of risks is only one dimension of the challenge for society. When science raises profound ethical and social issues, the whole of society needs to take part in the debate.' (Science and Innovation White Paper 'Excellence and Opportunity', 2000)

We suggest:

1. the promotion of **awareness** on nanotechnology as 'part of the fabric of society';
2. the promotion of **confidence and trust** by enhancing the EC's **image** as a reliable actor and communicator on nanotechnology;
3. the promotion of **dialogue and engagement;**
4. the promotion of public social **consensus** to **support decision-making** in EC nanotechnology policies.

If appropriate communication and engagement are the two phases of the overall communication process, respectively associated with a change of attitude and behaviour in audiences, two sets of calls to action can be identified (Figure 10).

Call to Action I: Appropriate communication

It targets the objective **ATTITUDE CHANGE**, clustering improved knowledge and awareness on nanotechnology and EC, with a gain in EC image and credibility.

i) *To whom* should we communicate? This section explores ways of knowing key audiences in order to determine whether or not there are special needs to be filled in certain groups, and if so which groups they concern.

ii) *What* should we communicate about? This section is concerned with identifying crucial messages that need to be included in communication activities about nanotechnology.

iii) *How* should we communicate? This section deals with developing appropriate tools to address issues and audiences effectively.

Effect 1

Knowledge and awareness

- To give them the data needed to understand relevant nanotechnology-related issues, problems or management better.
- To inform them of what nanotechnology and EC has done, is doing and plans to do, and what it cannot do, and why.
- To answer questions that have arisen and respond to their concerns.

Effect 2

Confidence and trust

- To raise image for building and maintaining the credibility of the EC on nanotechnology in the minds of stakeholders.
- To coordinate actions with EC staff and with collaborators so communication is consistent and effective.
- To maintain efficiency by avoiding unnecessary conflicts with stakeholders.
- To advance proactive approaches.

Call to Action II: Dialogue and engagement

It targets the objective **BEHAVIOUR CHANGE**, feedback, engagement and dialogue, as well as consensus-building process as support to EU policies.

i) *Whom* should we engage? This section proposes groups that are particularly important when it comes to engagement.

ii) *What* are the relevant topic for engagement? This part examines different subjects and situations in order to single out which are most important or even urgent in engaging audiences.

iii) *How* should we engage audiences? This section is centred on identifying appropriate participatory mechanisms to initiate, develop and maintain dialogue.

Effect 1
Dialogue & Engagement

- To involve stakeholders as early as possible.
- To find out the perceptions, concerns and communication needs of stakeholders.
- To provide opportunities for their input, including input into key decisions.
- To keep them routinely informed throughout the process.
- To build a relationship that incorporates feelings (such as trust) as well as data.
- To develop a common vision and agree on it.

Effect 2
Consensus-building

- To increase practical support to EC activities on nanotechnology.
- To change planning/management practices.
- To increase the use of new practices.
- To change EC policies.
- To increase social and cultural debate on acceptance or rejection of nano-related products and lifestyles.

Figure 10. Goal, objectives, actions and effects of EC communication on nanotechnology

Main GOAL			
Achieve a **certain degree of consensus in EU decision-making on responsible nanotechnology** within society (i.e. EC is a shared value-promoter) by building on the **EC's credibility as a nanotechnology communicator**			
Call to Action	*Objective*	*Effect 1*	*Effect 2*
APPROPRIATE COMMUNICATION	ATTITUDE CHANGE	■ Improve **knowledge** and **awareness and EC role and actions**	■ Improve **confidence and trust in EC as communicator in this field**: enhance EC **image** in civil society
DIALOGUE & ENGAGEMENT	BEHAVIOUR CHANGE	■ Promote **dialogue** and **engagement** with stakeholders and civil society	■ Promote **consensus building as support** to EC policies

3.3.4. Step 4: Getting to know our many publics better (The Audience)

Dialogue needs active and reactive audiences, also called 'stakeholders': these have a vested interest in the performance of nanotechnology and also wield the greatest *influence over the long-term role and nature* of their organisation. They include staff, advisory committees, government and the public, industry, government departments, special interest groups, universities, science centres and science museums, science councils and other research bodies. Stakeholders are people who might want to actively hear and tell things. They tend to resent decisions that are made without their input, as this will virtually guarantee their opposition.

3.3.4.1 Identifying audiences

Identifying audiences is largely a process of thinking through as specifically as possible who should be involved in a dialogue. So the question is who must participate in order to achieve the objective?

The combination of communication objectives and the audience required to achieve them is crucial. The increasing sophistication of communication in general means that many science communicators now actively plan to communicate with very specific audiences at specific times. In fact, the increasing recognition that the public is not just one homogeneous mass is causing much more careful analysis of intended audiences.

Recent studies in science communication have proven that *there is not one public, there are many publics*;

Identifying groups of public and segmenting audiences according to their common needs and interests, knowledge and relationship to nanotechnology is bound to be a key factor of our communication. Singling out mechanisms to learn more about the public and their relevant divisions comes first ([7]); key target audiences and their needs and expectations can be then achieved in the following way ([8]):

- studying the *habits* of special audiences, e.g. youngsters, tough-to-reach, not-responsive, media, NGOs;
- carrying out surveys, studies and activities to get an insider's viewpoint on the audiences' *perceptions, concerns, expectations;*
- taking into account *prospective* studies on social and cultural impacts of nanotechnology on different audiences.

3.3.4.2 Basic questions to identify key audiences

The following questions can help identify key groups and individuals: those sensitive to more than one question are particularly critical to reach.

1. Which audiences have previously been involved in the communication activities?
2. Which audiences may be directly affected by nanotechnology, policy, or action?
3. Which audiences may be angry if they are not consulted about nanotechnology activities?
4. Which audiences may have useful information, ideas, or opinions for nanotechnology communication?
5. Which audiences should be involved to ensure a balanced range of opinions?
6. Which audiences need to know what nanotechnology is doing, though they are not providing input yet?

3.3.4.3 Prioritising key audiences

It is necessary to determine which audiences are most important. Often the audiences **most difficult** to deal with, as they seem hostile or problematic, are those with whom communication is **most needed,** as these are often the most likely to raise issues if they

[7] Bonazzi, M.(ed.), 2007 (A), *quoted paper.*

[8] Bonazzi, M. and Palumbo, J. (Ed.), (2007), *quoted paper.*

are not consulted early. Indeed, communication efforts could be more vulnerable to criticism if it has failed to address those audiences' concerns.

So it is particularly important to reach those audiences that:

- **might benefit** from the research;
- **might 'lose out'** from the research;
- have **relevant expertise;**
- are crucial to secure **cooperation** or funding during the implementation phase.

Prioritising audiences can be achieved by dividing them into three categories:

- those we MUST communicate with;
- those we SHOULD communicate with;
- those we would LIKE to communicate with;

The key questions to answer regarding each of these audiences are:

***Perceptions**:* What do they already know, believe and understand about nanotechnology?

***Concerns**:* Do they have any concerns about nanotechnology?

Expectations: What information do they wish to know? How do they wish we communicate such information to them? How do they wish to interact with us?

Although this is the most time-consuming phase of planning, it is also the most important to the purpose of developing and implementing successful communication.

3.3.4.4 A checklist of questions we should try to get across

A checklist of questions is provided here by which audiences could **self-examine** their perceptions, concerns and communication needs in more detail, and get their answers back to us. We should try and forward these questions to audiences through all our actions.

Perceptions

- What do we already know about nanotechnology?
- Do we know about the benefits of nanotechnology?

Concerns

- Do we have any comments and suggestions that we want to put on record?
- What sort of response to these comments/suggestions would we like to receive?
- Do we have any concerns about nanotechnology activities?
- What objections do we have about the way nanotechnology operates?
- What else can we tell you that will help you to be more responsive to our concerns?

Expectations

- What type of interaction would we like to have with nanotechnology?
- How do we feel about our interaction with nanotechnology so far?
- What questions do we want answered?
- What kind of information do we want to know?
- How do we like to receive information on nanotechnology?

3.3.4.5 Key audiences for communication and dialogue

This challenge already inspired the European Commission back in 2007 to set up a specific sequence of workshops integrated with a Web consultation ([9]) (see Section 2.4.3). Their main outcomes have been to identify, segment and characterise key audiences (as well as vehicles and messages) for communication and dialogue on nanotechnology, i.e. ***young people, scientists, industry, business, policymakers, NGOs, media***. Results are presented in the following sections. This process has allowed the launch of a dedicated call for proposals targeting some of these audiences in 2008, enabling the funding of four projects starting from 2009, and budgeted with about EUR 5 million.

3.3.4.5.1 Specifying key audiences for communication

Target audiences should be as homogeneous as possible to be effectively attained, via appropriate communication activities. Main target audiences are underlined.

[9] Bonazzi, M. (Ed.) (2007A and 2007B), Bonazzi, M. and Palumbo, J. (eds.), (2007), *quoted papers*.

3.3.4.5.1.1 Young people

Youngsters can be considered a final target audience, whose multipliers are mainly teachers, and/or parents to a lesser extent. Still, young people themselves can also act as multipliers or influencers with respect to their peers belonging to their own environment (in both school and leisure spaces). This is a difficult target, since it is fairly broad: therefore a segmentation of the group into subgroups was proposed based on age and needs. The most pragmatic approach is to divide them into groups according to their age and developmental stage, with different objectives and messages tailored to each one. Some actions could also be gender-specific, as girls tend to lose interest in science and technology subjects at a certain point in time. The main goal is to stimulate young people's curiosity in order to spark their desire to choose a career in science. Two more general objectives should be pursued: (i) raising the level of knowledge about nano and fostering the understanding of science and the way it works, (ii) promoting awareness of controversial issues (such as ethical, legal, and social implications of nano) in order to create responsible citizens. Some effort should also be made to insert nano into school curricula at various levels, in order to ensure a basic level of knowledge on the subject.

Multipliers are identified as important target groups; so the important divisions within the public should be linked to their age, activity and role in society rather than to their attitude towards nanotechnology. Major outcomes are:

- the specificity of objectives, means and messages to each target audience;
- the needed balance between large-scale events and long-term action, the latter being often more appropriate when dealing with multipliers' audiences;

These are the general recommendations for communication projects in this area.

- Ask the question: are the key messages communicated effectively to the target audience identified by the project as a priority? Are the objectives clearly defined and met in the project's lifetime?
- Special attention should be paid to differences in the target audience, which can result in important variations to the way messages are received.
- Additional specific actions should be targeted at the multipliers with special outreach for each group e.g. tools for teachers/parents (e.g. in the case of young people).

Following the recommendations mentioned in previous sections, communication of nanotechnology should address various young audiences. Among these special attention should be given to 'children and younger people' ([10]). Various age segments are chosen on the basis of the cognitive theories of Piaget ([11]) and Kohlberg ([12]) on cognitive and moral development. The theory of Piaget on the philosophy of science concerns the growth of intelligence, by which Piaget means the 'ability to more accurately represent the world and perform logical operations on concepts grounded in interactions with the world'.

[10] European Commission (2004): *Nanotechnology: views of the general public* (2004), EC, Brussels; European Commission (2007): *Strategy for communication outreach in nanotechnology*, EC, Brussels, 2007.

[11] Piaget, J. (1932): *The moral Judgment of a Child* (http://www.archive.org/details/moraljudgmentoft-005613mbp).

[12] Crain, W.C. (1985): *Theories of Development*. Prentice-Hall. pp. 118-136.

This theory concerns the emergence and construction of schemata – which are schemes of how one perceives the world – in the 'developmental stages' when children learn new ways of mentally representing information.

Piaget identified four stages in cognitive development. We are not concerned with the first two here (sensory-motor period between years 0-2 and preoperational period between years 2-7, when logic sets in but there is still a tendency to focus on just one aspect of an object). We want to focus on the concrete operational period that spans between years 7-11, when children gain a better understanding of mental operations and begin to think logically about concrete events, yet still have difficulty in understanding abstract or hypothetical concepts.

The formal operational period would cover year 11 and over, and would be defined by the acquisition of the ability to think abstractly, reason logically and draw conclusions from the information they have gathered.

The theory of Piaget on moral judgment is framed in two stages:

- children younger than 10 or 11 years regard rules as fixed, absolute and that cannot be changed;
- children older than 10 or 11 are more relativistic and they understand that rules are not absolute but are tools that people use to live cooperatively.

On the other hand, Kohlberg proposed a theory which goes beyond the view of Piaget. It has three levels, which are therefore divided into six stages.

Level 1: 4 to 10 years old (stage 1 and stage 2): at stage 1, children think of what is right is what authority says is right: doing the right thing is being obedient to authority and avoiding punishment. At stage 2, children are no longer so impressed by any single authority: they see that there are different sides to all issues.

Level 2: 10 to 13 years old (stage 3 and stage 4): here young people think as members of conventional society with its values, norms and expectations. At stage 3 they emphasise being helpful towards people that are near to them. At stage 4 they show more preoccupation about obeying laws to maintain the society as a whole.

Level 3: 13 and over (stage 5 and stage 6): here young people are more concerned with the principles and values that can make a good society. At stage 5 they emphasise the basic rights and the democratic processes that give everyone the right to say his/her opinion, and at stage 6 they define the principles by which agreement will be obtained as the best thing to do.

In this light, the communication activity of nanotechnology to young audiences should focus on ages that correspond to stages 3 to 6 of the theory of Kohlberg, and will provide

them with dilemmas adequate to their developmental level. For example, a role playing exercise will give young audiences an opportunity to learn how points of view are different and how to coordinate them in a cooperative way. As the participants show their differences, they will develop concepts of what is fair and just. Two variations of the role play should be developed: one for 11 to 13 year olds, who are in stages 3 and 4, and one for 14 to 18 year olds, corresponding to stages 5 and 6 of the theory of Kohlberg.

Other authors have addressed the importance of gender in moral development. For example, Gilligan observed that for males, the moral thinking is about rules, rights, and abstract principles and on an ideal of formal justice, in which claims are evaluated in an impartial way. The morality of women is more about the context; it depends on real, current relationships rather than abstract solutions to hypothetical dilemmas. As a consequence, the activities to be set up in communication projects will take into account these findings and try to address both ways of thinking of females and males on moral reasoning.

3.3.4.5.1.1.1 The youngest segment to address: children aged 5 to 13

Children of that age are typically not yet interested in nano, but are generally interested in knowing more about the world; in order to reach them more easily, multiplier groups (such as teachers and parents) can be targeted through special training programmes and activities. The objective of communication activities for this age should be to stimulate the children's curiosity about science and nano and influence teachers and parents so that they will continue activities at home or expose the child to further information. The message for this group should be simple, such as 'Nano is cool/fun/interesting'. The following list collects some suggestions about possible measures to be taken and channels to be used in reaching out to young children and to gather feedback.

3.3.4.5.1.1.2 The middle segment: teenagers aged 14 to 18

This group is getting ready for university. Therefore, it requires information about the possibilities nano offers in the academic and professional world, as well as basic information on nanotechnology and why teenagers should be interested in it. Objectives of communication activities should also be to stimulate interest in scientific subjects and approaches as well as to foster a critical attitude and stimulate dialogue to make them into responsible citizens. The general messages could be summarised as follows: 'Nano is trendy-fun-intellectually stimulating', 'Nano is an exciting and attractive field for further education and a future job opportunity', as well as 'You can make a difference'. Multipliers to be targeted to reach this group are both teachers and celebrities (such as singers, pop-stars, football players and famous scientists).

Studies show that in youngsters of this age group, gender differences start appearing in their attitude towards science and technology. Therefore, measures should be taken to minimise any budding imbalance. For this purpose and to maximise impact, feedback should be collected during activities.

3.3.4.5.1.1.3 The upper segment: young people aged 19 to 22

Youngsters in this age group are getting ready to choose careers and seek reliable information about their options. Multipliers can include celebrities such as famous scientists; politicians; journalists/media; industry (aiming at attracting young people as future professionals); teachers, scientists, professors; NGOs targeting youngsters sensitive to green issues. Gender differences continue to be an issue and require special attention. The messages that should be communicated are e.g. 'Nano is already part of our life'; 'It can represent an important part of the future'; 'Nano is interesting and it represents a challenging professional opportunity' and 'You can make a difference' (to encourage active participation and engagement with science). These actions are about stimulating interest in science careers and increasing knowledge of opportunities in science, creating responsible citizens by enhancing critical thinking.

3.3.4.5.1.2 Scientists and research communities

Scientists can have two different roles in science communication. They can be taken as a target audience in its own right since science has a high degree of specialisation, meaning that scientists are not experts in all fields of scientific knowledge. Therefore, training activities can be envisaged to give access to useful information in realms where they are not specialists. For example, communication training may be beneficial for both natural and social scientists, as well as training on the awareness and basic knowledge of societal consequences of research and connected products.

3.3.4.5.1.3 Media

Journalists are a diverse group of professionals with different needs and specifications, although they should perform as independently as possible. The media they work with have their own requirements, ranging from newspapers to television to the Internet. As a category, journalists tend to be quite busy and hard to reach. So, as with all communication activities dedicated to a specific target audience, actions directed towards them must be based on their true needs in order to be considered useful and appropriate. The time pressures and deadlines that journalists typically work under must be recognised and taken into account. A need that is routinely expressed by journalists is images. Possible ways of providing appropriate and tailor-made images to serve various media needs could be put into place, for example a database. Furthermore, reliable information on nano is required in an appropriate format; both from the point of view of basic/scientific knowledge and on the context and social implications it has or could have in the future. Communication with journalists could possibly start off from the fact that nanotechnology is already out there in the marketplace, therefore it may have potential positive and negative implications from a societal, ethical and legal point of view (for example through its applications in water purification, medicines, food, cosmetics). When talking to journalists, it should be emphasised that the public needs to be more informed about nanotechnology in order to increase their awareness of both potential opportunities and risks.

Credibility of the information provided and *building media relationships based on trust* are key values to reach journalists as multipliers, while the messages can be (i) *Nano is already happening, (ii) It has implications on a societal level, (iii) Audiences need to know more and have their say.*

Press officers from public research institutions seem well placed to organise and manage the information exchange between journalists and different groups of scientists, whereas care should be taken in dealing with the press offices of private companies, which could have special interests.

3.3.4.5.1.4 NGOs

In communication activities directed to NGOs, the main objective is to involve them directly in building links and information. NGOs can help build a mechanism to share information constantly, rather than just for crisis management. Particular attention should be driven towards:

- Big NGOs already engaged in both communication and debate on nanotechnology (e.g. Greenpeace, Friends of the Earth);
- Small NGOs whose action and sensitiveness is focused on the local scale;
- Consumer associations.

3.3.4.5.1.5 Business / Industry / Funding Bodies / Insurers

There are two major categories of businesses or industries concerned with nanotechnology, and each has its own needs and motivations.

- SMEs and start-up companies in nano-related industries and corporations are motivated by the search for a market in nano – they have strong motivation to seek out information on opportunities and risks associated with the nano-business.
- Nano-using and nano-producing industry, including SMEs, on the other hand, are working with staff that manipulate nano materials and components, producing goods that have to do with nanotechnology and will be bought by customers on the market, but they may not be as keen to devote a lot of resources to the communication activities. There are two different considerations in this case: what do the producers dealing with nano need to know and what should they be telling consumers about concerns regarding safety and security of staff working with nanoproducts? And what do the workers, associations and such need to know? Trade unions and employers' organisations are important multipliers when dealing with this kind of target.

- SMEs and start-ups are more likely to require support in communication activities, as well as dealing with safety and security issues and regulation – this should not be left to their own resources and initiative.

- The funding and insurance sector and NGOs pressure companies for sustainability, while the main objective for this group is to make 'nano' a business success.

3.3.4.5.1.6 Policymakers

For this target group, the main objective is to focus on policymakers' needs at all levels (European, national, local, etc.). Several actions should be carried out to meet the needs of decision-makers and to build a mechanism to ensure this happens on a continuous basis. It seems important to build ongoing channels of communication to inform and advise decision-makers, rather than have large one-off events.

3.3.4.5.2 Preparing key audiences for dialogue and engagement

Communication should enjoy continuity to build on results and contribute to develop an EU integrated, safe and responsible nanotechnology. Appropriate communication on nanotechnology has been the focus of a first set of funding EC actions addressing key audiences, such as young people, scientists, industry, business, policymakers, NGOs, media. This is to prepare the initiatives for engaging the complete range of appropriate audiences (the so-called stakeholders) on dialogue about key societal issues associated with nanotechnology: researchers, scientists, industry, media, funding bodies, insurers, NGOs, policymakers, opinion makers, influencers, information gatekeepers, and the general public. Specific research is still needed to study their profile, vehicles and messages to engage them in dialogue, thus future EC calls on this issue will be launched.

3.3.5. Step 5: Bring them in: how to prepare for dialogue (The Vehicle)

Dialogue is a critical feature for the appropriate communication of science. Within the most traditional of formats, such as a lecture, it simply needs time and space: although this would probably be a monologue, questions and comments could help turning it into a dialogue. Another kind of event could be shaped, where different speakers present a topic and associated issues from various perspectives, allowing the audience to break up into small discussion groups and identify comments and questions to be shared with everybody and commented on by the speakers. Effective formats involve a face to face exchange, but these need to be balanced against the cost.

3.3.5.1 Communication and dialogue tool checklist

The following tactics are meant to provide some thinking prompts rather than to be comprehensive. In many cases, there will need to be more than one tactic for achieving communication objectives. It is useful to re-visit the communication objectives to make sure the chosen tactics fit in with them.

Written or audio-visual Materials
Leaflets, Letters, Postcards, Newsletters, Periodic updates, Articles or announcements, Displays, Fact sheets, Curriculum materials, Comics/cartoons, Handouts, Question-and-answer sheets, Posters, Videos, Slide shows, Audio tapes.

Electronic Communication
e-mail, Bulletin boards, on-line tools (e.g. contests), Faxes, person-to-person and peer-to peer approaches, Presentations, Informal meetings, Open-door days, Workshops, Advisory committees, Networking, Information telephone lines, Events, Celebrations, Field days/tours, Breakfast/lunch/dinner functions, Conferences, Training courses, Mass media approaches, Local/suburban media, Media releases, Letters to the editor, Talk shows, Call-in shows, Advertisements, Feature articles/contests.

Tactics for eliciting input
Informal meetings, Market analysis, Questionnaires, Advisory groups, Brainstorming, Interactive workshops, Consensus groups, Opinion polls and surveys, Evaluations, Small group meetings, Open space, Interactive field days, Focus groups.

Commercialisation-like tactics
Promotion planning, Selection of and liaison with stakeholders, Intellectual property management, Contract negotiation, Pricing and costing, Presentations/exhibits in malls, Hands-on/hearts-on/minds-on approaches.

3.3.5.2 Tools for appropriate communication

There are no real rules for choosing the right tools each time, but it is useful to keep in mind relevant facts about needs and expectations of each stakeholder or group of public in order to reach tit effectively. The same set of exercises launched by the European Commission in 2007 (Section 2.4.3) enabled us to identify a number of desirable approaches

to communicating nanotechnology effectively ([13]). Using some of them simultaneously is likely to increase overall effectiveness:

- employ the three-fold **hands-on, hearts-on, minds-on** approach;
- implement a cooperation model between **school, science centre and lab;**
- develop **imaginative** ways to allow citizens to experience nano;
- set up **databases** for copyright-free access to experiments on nano;
- promote **openness of research centres** to the public as a mission, through scientists-communicators;
- foster communication on **applications**, then **benefits and risks;**
- consider need to use **emotions**: how/why do we fall in love with nano: different rationalities, e.g. theatre, arts, game, role-play;
- involve **passionate** people.

The results coming from the mentioned studies are focused on two different aspects of science communication about nanotechnology. The first relates to **multipliers**, meaning target publics that have an important role in communicating with a larger public, such as journalists or teachers. As they have the potential to reach so many more individuals, they should be the primary groups to reach, without however excluding the need to address the broad public with appropriate actions. Secondly, it was recognised that some groups are best reached during their '**professional' (or school) time**, while others would be best reached during their **leisure time**.

Therefore the importance of multipliers and influencers is emphasised, e.g. scientists, journalists, opinion-leaders, influencers, information gatekeepers, policymakers, and if possible also teachers. Clearly, if the multipliers and influencers are not ready to play their role, communication projects aimed at the general public will lack a key resource. Additionally, scientists are particularly important for two reasons: (i) Nanotechnology is an extremely technical and diverse field, whose reliable and updated information can only come from scientists in the first place; scientists are the first link in the communication chain (they publish in the professional and the lay press, they give interviews, they are asked expert opinions, they are invited to debates), and therefore their role is critical. If they won't or are not able to communicate, most other communication projects are doomed to fail, even if just for lack of information (or correct information). (ii) According to Eurobarometer and other surveys, scientists are the professionals most trusted by the public when it comes to explaining the impact of technology on our life ([14]). Accordingly, two clusters of Calls to Actions are outlined, addressing target audiences during their 'professional' and 'leisure' time.

[13] Bonazzi, M. (Ed.) (2007A and 2007B), Bonazzi, M. and Palumbo, J. (Ed.), (2007), *quoted papers.*

[14] *Nanotechnology: views of the general public* (2004): BMRB international (http://www.nanotech.org.uk); 'Public perceptions about nanotechnology: risks, benefits and trust'. Cobb, M.D.; Macoubrie, J, *J.Nanoparticle Res.*, **2004**, *6*, 395-405; Gaskell, G.; Allum, N.; Stares, S. (2003): *Europeans and Biotechnology in 2002*: *Eurobarometer 58.0*; Methodology Institute, London School of Economics, London UK 'Public attitudes towards nanotechnology' (2002): Bainbridge, W.S., *J.Nanoparticle Res.* **2002**, *4,* 561-570; *Swiss publifocus on nanotechnologies*, (2006), project TA-Swiss, TA-SWISS, the Centre for Technology Assessment.

3.3.5.2.1 Call to Action on communication during 'professional time'

It is crucial to be as specific as possible in targeting each audience.

3.3.5.2.1.1 Youngsters

- art festivals, theatre, movies, games
- exhibitions and activities in science museums.

3.3.5.2.1.1.1 Children aged 5 to 13

- exhibitions in cultural centres, science museums
- events in schools
- games (including computer games), cartoons
- nano fairs, theatre, festivals
- the Internet, TV, radio media
- developing a friendly guide, mascot or attractive figure to show children the nano world.

A.2 Youngsters aged 14 to 18

- Internet platforms, podcasts/trendy media
- organised debates
- celebrity testimonials on science issues
- bringing famous scientists to schools
- festivals
- contests for video and creative art productions
- theatre productions and art contests
- edutainment interactive applications – hands-on activities and open labs
- visit to labs/experimenting/stage experiments/dialogue.

A.3 Youngsters aged 19 to 22

- open labs, out-of campus events, real lab guided tours contact with scientists
- Internet chat platforms

- professional information-orientation fairs and case studies, presence of EC stands
- informal activities to familiarise students with concepts of nano
- conferences/shows
- internships
- debates.

3.3.5.2.1.2 Scientists

Possible interventions through their research institutions to meet 'scientists as communicators':

- presence and activities at festivals and other events;
- presentations for senior scientists;
- real hands-on communication experiences;
- Internet platforms where scientists can communicate directly with the general public online;
- open labs or events where young scientists can meet high school students;
- collaborations with communication professionals, e.g. journalists, press officers, science centres;
- collaborations with artists and designers;
- science café programmes, or informal cocktail, dinner events – with the objective of providing a meeting ground with the public, also for creating feedback and dialogue with the public;
- meetings where natural scientists meet social scientists and professional communicators;
- closed-door meetings with NGOs and other professionals, e.g. industry, to build trust.

3.3.5.2.1.3 Media

Some mechanisms of appropriate communication with media reached via journalists include initiatives aimed at building relationships between journalists and those with a specialist expertise and views, such as ethicists, social scientists, NGOs.

Possible relationship building mechanisms could include the following.

- Tutorial work, shadowing work.
- A neutral 'resource centre' providing a focus for proactive briefing, highlights, images, movies, clips, in order to offer tools for relationship building and generate scenarios as a trigger for discussion. It could be a science centre or museum, since they are generally viewed as neutral by the public. Activities could be organised in collaboration with press officers, since science centres and museums do work with journalists on a fairly regular basis.
- The media becoming a sponsor of an event where they are involved might bias the credibility of the event itself, but local organisers could make up their own mind about this point.
- Social and informal activities involving journalists and scientists together.
- Person-to-person contacts between journalists and scientists is a good practice that needs to be expanded as a way of providing journalists with reference people in the domain of nano, to call up for information or interviews in the event of nano news.

3.3.5.2.1.4 NGOs

- Creation of platforms, forums and debates linking scientists to NGOs, built with their direct involvement, in particular around issues of research into risk and legislation/regulation.
- Green quality markers for laboratories that reach pre-defined standards of safety in handling nano-products. These labels should be developed by appropriate entities and communicated to proper NGOs, whose own communication target is to watch over the credibility of this information.

3.3.5.2.1.5 Business/Industry/Funding bodies/Insurers

The insurance sector and NGOs pressure companies for sustainability, while industry's main objective is to make 'nano' a business success. Several actions should be taken to provide reliable information answering the needs of business, for instance:

- ratio of benefits/risks and facts/fiction
- long-term perspective
- regulation
- financial expectation.

Industry has to know the needs of customers in order to develop products that are relevant to customers' needs and values, which in the case of nanotechnology are as follows.

- Know the product risks and what risks are studied, known or unknown; consumers should find this information easy to understand. There could be an Internet and product labelling system with a special logo indicating the presence of nanotechnology treated products, also word-of-mouth marketing and product demonstration.

- Understand the impacts (both positive and potentially negative) of nanotechnology in daily life.

3.3.5.2.1.6 Policymakers

The following topics have been identified as potentially relevant for policymakers:

- potential risks and benefits;

- broad perspectives including economics;

- what regulation is being made at EU level for national policymakers;

- international comparisons;

- what people/citizens think.

Implementation mechanisms:

- platforms of information and exchanges on an ongoing basis, including information about initiatives taken by other policymakers in EU countries;

- build channels of communication as well as tools;

- communication exchanges between scientists and policymakers;

- taking into account language issues and cultural differences especially when dealing with local policymakers, creating channels on various levels so that information doesn't come across as a directive from Brussels;

- briefing on future scenarios before a crisis comes;

- direct actions for policymakers;

- theatre/plays in City councils (professional settings of the targeted audience) on nanoscience.

3.3.5.2.2 Call to Action on communication during 'leisure time'

Appropriate actions, best focused on leisure time, should be aimed at stimulating the general public's curiosity and awareness, and at collecting feedback from people. Unusual settings and cross-cultural approaches are favoured in order to include groups that do not usually take part in activities concerning science, without discounting the 'usual' approaches that are known to work. In particular, art is an instrument well suited to the task of catching people's attention and stimulating their curiosity. Public events on nanotechnology should be planned by groups including experts from different fields such as scientists or artists, for example.

- Reach people who are usually not involved and stimulate their curiosity, either by providing stimuli through perception, dance and art. It's important to adopt a user-oriented approach, answering the question 'Why should I be interested?'

- Provide basic information about nanotechnology, what it is and what implications it has, keeping it simple and realistic without oversimplifying. Stress the fact that nanotechnology is not magic, it's a science that has methodologies and interdisciplinary work behind it, and that it is not static knowledge acquired once and for all but an evolving technology where new information is gained every day and new perspectives may emerge.

- Nano is a **cross-section technology** covering a large range of sciences and branches/markets. So the hopes and fears about nanotechnology may vary depending on the branch, and this must be taken into account when communicating different aspects of the research and technology, e.g. nanotechnology in food is more likely viewed as a risk/danger than nanotechnology in automotive industry

- Ensure honest communication on known and unknown risks of nanotechnology and its products, with an open approach to the ethical implications. What benefits are to be expected? Facts and figures should be presented, e.g. by including a timeline for applications. This kind of information could be drawn from the observatory on nanotechnologies. Communication projects must include social implications of nanotechnology, along with questions such as potential environmental, health, food problems. It is necessary to open a debate between different disciplines, people and stakeholders.

The following cross-over themes should be considered in science communication activities as shown below.

- **Interdisciplinarity** is important to communicate nano – scientists can interact with communication professionals, artists and designers to maximise impact, ensure quality of information and fine-tune approaches to different needs.

- **Feedback** from the public is essential and needs to be collected through appropriate means in every activity.

- **Debate** should be stimulated and encouraged in the public – an exchange of views is important and enriching both for the public and for the other groups involved, such as scientists or policymakers.

- **Interactivity** with the public is crucial to ensure engagement. Appropriate measures must be implemented to ensure that the public is involved in activities.

As a consequence, the following activities should be considered.

3.3.5.2.2.1 Games about nanotechnology

Games are a recognised way of providing informal learning environments for a wide variety of people, since they can be made with tailored messages and in ways suitable to reach different audiences. The objective is to create fun and educational games within a realistic scope/budget:

- video games
- table games
- strategy games
- role play games
- educational and hands-on games
- group or multi-player games
- card games.

Construction games, such as nano building blocks like molecular models especially designed for molecular machines or tactile games, like building with boxers' gloves to give an idea of limited movement, instrumentation for small object handling and such.

3.3.5.2.2.2 Virtual Internet environment activities

This may include a virtual guided tour of a nano-environment to give the idea of scale and nano-dimensions. A guide or mascot (such as a made-up, appealing nano-character) could be used to show the visitor around the virtual environment. A funny character such as 'Super-Nano' and edutainment tools should be made available. This kind of media can also be designed to work both for leisure and for professional/school time. Learning is also fun and schools should use state-of-the-art tools/media for complementing the lessons.

'Second life' and other similar virtual environments where the nanoworld can come alive could be used:

- interactive experiment with user generated output involving a virtual or real nano-lab where the user can choose variables and perform experiments, verifying outputs and experiencing scenarios;

- Internet platform or portal connecting different interest groups carrying different competences – for example scientists with artists, journalist or youngsters.

3.3.5.2.2.3 Contemporary art Nano-Festival

A few day-long festivals joining various forms of contemporary art could be a possible activity, where nanotechnology is interpreted using visual expression and other disciplines. This event can and should be adapted to target different audiences. The event should include policymakers to maximise impact and media coverage.

Events should be planned by groups with mixed competences, such as scientists, artists and designers together. Interactivity with the public is a particularly important aspect of this kind of event and input from the public should also be welcome. In order to reach out to people who usually go to art exhibitions or have some affinity to contemporary dance or art performance, the audience on a nano festival could be addressed in various ways including indirect/interpreted (artistic expression) and direct communication (e.g. explanatory, edutainment).

- Art exhibition with installations that introduce the public to the creative processes by offering the possibility of interacting with the artworks, which may be designed to change the way users behave. Introduction of nanophysics laws in the design of the artwork itself, for example self-assembling application in art performance, installation, theatre, etc.

- Conference or talk by a scientist connected to an artist interpreting the words visually or a performance where dancers translate what the scientist says into movement. Artists should collaborate with scientists in writing the script.

- Dance performance using movement or choreography to give an idea of the nanodynamics (Feynman's famous quotations, interpreted by dancers could represent the void between atoms. A dancer with limited movement compared to a puppet or a robot which can move any way it likes, either through the physical presence of both or using electronic imagery gives the ideas of quantum levels of energy).

- Performance inspired to the laws of quantum physics, for example with a self-assembling structure, to give the public an intuitive perception of the physical laws at nanoscale.

- Workshops involving school groups or selected groups of specific publics.
- Short movies about nano – a competition could be launched to ensure the audience's participation.
- Connections to the outside world, through the Internet, webcams, media connections.
- Writing and performance of nano-songs, acoustic voyage into the nano-world, symphony about the nano-scale interactions, music written and performed using ideas from physical behaviours at the nanoscale.
- Also take advantage of other mainstream nano-events. For example, if Hollywood releases a movie involving nano, to have a public debate or discussion after showing the movie. If there is a major news item on nano, have a science café discussion around the event.

3.3.5.2.2.4 Travelling event

Means of transport such as a train, a caravan or a truck disguised as a spaceship could be designed to reach any destination, including developing countries. Different activities can be packed into them: they should be interactive, involve artistic media and interactive artistic applications, an exhibition, a moving laboratory with experiments and demonstrations. Schools, villages and public spaces are some of the possible locations for such an initiative, along with stations and airports.

3.3.5.3 Tools for dialogue and engagement

Dialogue with key stakeholders on nanotechnology should be centred around all these needs ([15]). But more research is required to expand on them to develop a more complete picture by building on the results of the actions to be developed in appropriate communication (Section 3.3.5.3.2).

The proposed actions are those more urgently needed, and should aim at engaging stakeholders (e.g. researchers, scientists, industry, funding bodies, insurers, NGOs, opinion-makers, influencers, information gatekeepers, nano-consumers, lay public) on debate and dialogue on key societal issues associated with nanotechnology, by devising and implementing the most appropriate tools to attain consensus on both issues and their urgency. Nanotechnology and related societal issues should **always** be addressed in a balanced way, in order to: (i) open a sound, science-based dialogue by way of appropriate media-based public engagement tools, e.g. television, radio, Web, blogging, citizen conferences, dedicated public events; (ii) provide the EC services with insights and recommendations to improve governance by ***building on awareness and responsible dialogue*** on nanotechnology; (iii) providing inputs to be included into any forthcoming EC Action Plans on nanotechnology.

[15] Bonazzi, M. and Palumbo, J. (Ed.), (2007), *quoted paper.*

To open a sound dialogue, stakeholders could start picking any nanotechnology social issue or application which is the closest to them. It is expected that stakeholders e.g. industry, funding bodies, insurers, NGOs, opinion-makers, influencers, information gate-keepers, nano-consumers and general public will endorse such a dialogue, in a way that can be measured and used to build consensus to support the EC's good governance and contribute to the EC future Action Plans on nanotechnology.

3.3.5.3.1 Designing the tools for dialogue and engagement with stakeholders

There are a number of methods that have been specifically developed, within market and social research, to support consultation and dialogue. A number of techniques are described in detail. A draft classification can be built according to whether or not a nano-technology topic is controversial:

1. issues that are **currently causing public controversy**;
2. issues with a clear **potential to cause** public controversy;
3. issues where the **impact on society is not yet established**;
4. issues that are interesting but **not controversial**.

- The first category, at the top of the scale, recognises the 'hot topic', possibly identified by the fact that it is being covered in news in both printed and audiovisual media. Addressing these topics is one way of providing a way for people to express themselves and their hopes and concerns.

- The second broad category includes issues where scientists may well know that there is the potential for significant controversy. For example, a nanoparticle technology may be considered to be extremely useful but emerging research might suggest unforeseen problems. It is important to have dialogue activities on these issues, as they will help to build mutual understanding that might ultimately maintain control on any controversy that might erupt. It will be important to identify appropriate policy forums where information gathered in these sorts of activities can be fed into.

- The third category is one where horizon scanning and scenario development will be critical in opening any dialogue. It could turn out to be hard to engage public audiences on issues like this that might not seem real.

- The fourth category may seem unsuitable for a dialogue at a first glance, but the lack of any present controversy does not mean that people have nothing to say.

3.3.5.3.2 Call to Action on dialogue and engagement

More inputs are needed to complete the picture of engagement, to be developed along this pattern.

i) A first initiative (e.g. participatory workshop) will gather selected experts from the media, engage the public engagement, and represent communication to shape operative recommendations for future European funding on **innovative approaches** to engage European society into a dialogue on nanotechnology. Experts in the field of science communication share success, best practices and challenge stories, with a view to giving different audiences a 'voice' in the policymaking process. Out of such a dedicated workshop on public engagement on nanotechnology, a set of recommended activities for Europe should be outlined, which can be commented on in the dedicated forum on the EC's website.

ii) Starting from these results, a second initiative will identify key actions to be developed through future European funding schemes on stakeholders' **public engagement** on nanotechnology, setting up the scene for dialogue on nanotechnology within European society. Experts in the field of industry, media, NGOs and investors, should share success and best practices as well as challenge stories to shape the consensus-making process in societal dialogue. The main proposed activities aim at:

- **surveying** targeted stakeholders to identify their position, values, concerns and expectations, communication models, cultural features and motivations;
- developing **new models and tools** for communication, dialogue and engagement (especially those 'light', unconventional and fun, e.g. theatre, art, fairs);
- encouraging appropriate new audiences to participate in **choice-making,** as well as exchanging views, scientific cultures and best practices in communication;
- ensuring appropriate **access and engagement** on ethical, social and legal dimensions of nanotechnology, by focusing on ways to mitigate the nano-divide in communication and developing a free database on best practices by funnelling the identified tools and techniques for public engagement on nanotechnology.

These initiatives are bound to bring all major inputs coming from (i) the **research community**, (ii) **industry**, (iii) the **Member States,** and (iv) **society** into a much bigger picture**.** Then everything should click into place to set up the continuous communication and public engagement cooperation model that we want, with the aim to foster an '*integrated, safe and responsible nanotechnology*'.

3.3.6. Step 6: Nano revolution coming (The Message)

Major key messages, key audiences and key vehicles came from the sequence of EC workshops integrated with a Web consultation ([16]) (quoted in Section 2.4.3).

3.3.6.1 Balancing messages out

Scientific communication usually implies communication about 'uncertainty'. Much of the information generated by research is not absolute and may change with new information. This uncertainty can make it difficult to communicate with stakeholders, and this is especially true for communication with commercial stakeholders or decision-makers, and for communication to the general public through the media.

But there is a way out. ***Relevance*** is crucial in designing messages, while scientific ***rigour*** is very important too. Then messages should be able to convey what it is currently known and the degree of ***confidence*** in this material. It is crucial to emphasise what the development of nanotechnology can bring to daily life, expanding on benefits and drawbacks, specifying risks, uncertainties and hazards in an honest, scientifically sound and balanced way. ***Balance*** is indeed of the essence here. Only balance can: (i) spark a sound, science-based dialogue via appropriate media-based public engagement tools, e.g. television, radio, Web, blogging, citizen conferences, dedicated public events; (ii) provide EC services with insights and recommendations to improve governance by building on awareness and responsible societal dialogue on nanotechnology; (iii) shape the inputs to both design and implement the EC Action Plans on nanotechnology fairly. This approach makes it possible to single out a set of **messages** as the starting point of any appropriate communication on nanotechnology:

- nano is **not** magic;
- nano is **a new phase of technology** exploiting nanoscale effects;
- it deals with new **beneficial applications and markets**, impacting on **health, safety, privacy, ethics and the socioeconomic divide;**
- it **must and can** be controlled and driven conscientiously.

[16] Bonazzi, M. (Ed.) (2007A and 2007B), Bonazzi, M. and Palumbo, J. (eds.), (2007), *quoted papers.*

3.3.6.2 Singling out issues for dialogue and engagement

It is not easy to anticipate the kind of concerns or questions the various audiences may raise. Still, attention should be focused on the issues clustered around groups of crucial questions to provide a balanced view.

1. **BENEFITS:**
   Are there any real improvements to the needs of citizens, consumers, society and not just those of manufacturers?

Do we really need these products? How does this stuff improve my quality of life? How could it help achieve societal needs?

2. **SAFETY: Health, lifestyle and environmental concerns**
   Are we and our environment affected?

   - What is the potential danger to my health and that of my family, especially due to nanoparticles and more specifically on cosmetics?
   - Can I drink the water, eat the food, and breathe the air?
   - What can I do to find out if my health has been affected?
   - If the damage is already done, what can I do to reduce it?
   - If there are any risks, what can I do to prevent any further damage?
   - What about my children and future generations?
   - We are already at risk because of certain emissions: will these increase our risk?
   - How will this affect my quality of life and property values, if the 'nano' label is attached to our community and local environment?
   - How will this affect environmental health and our bodily integrity and image?

3. **PRIVACY: Data and information concerns**
   Is my freedom affected?

   - How sure are we?
   - What is the worst case scenario?
   - Will the applications of nano-properties increase surveillance and jeopardise civil liberties?
   - What do these figures mean and how did you get them?
   - How do we know your studies are correct?
   - What about other expert opinions on this issue?
   - How does the level compare to international standards?
   - You say this scenario can't happen. Why not?

4. **ENGAGEMENT & DECISION-MAKING: Involvement concerns**
   How will I be treated?

   - How will we be involved in decision-making?
   - How and who will communicate to us?
   - Why should we trust you?
   - How and when can we be reached?
   - Who else are we talking with?
   - When will we get any feedback?

5. **ETHICS: Risk management concerns**
   What are we going to do about this?

   - What ethical, moral and religious implications are involved?
   - If there is a problem, when will it be corrected and how?
   - Is our reaction to these issues ethically appropriate?
   - What are the other options? Why should we favour the nanotechnology option?
   - Why are we moving so slowly to correct the problem?
   - Is it possible some kind of oversight may happen?
   - Will the government be able to use this information to legislate against our will?

3.3.7. Step 7: Sequencing nano-communication (The Schedule)

Once the main guidelines of the Communication Roadmap are completed, the time/space/budget coordinates need to be implemented.

Setting a timeline for communication activities is pivotal. We need to sequence all our steps carefully. A timeline is the key to getting from a list of things we hope to accomplish to a realistic, feasible plan. The more thoroughly we work through the other parts of this workbook or the more ambitious the communication programme, the more precise the time line will need to be.

- Any timeline should clarify what needs to be done, when and by whom, and fix at least the most important deadlines.

- It will facilitate the assignment of tasks to particular team members, so everyone's responsibilities are clarified.

- It is helpful to spot times of work overload (suggesting a need for extra staff, rescheduling, or some other solution) and slacker times (when additional communication efforts might perhaps be packed in or there might be a loss of momentum).

- It makes gaps in the Communication Roadmap easier to spot, such as particular stakeholders that may not have been reached yet.

- It speeds up the response to changing conditions (elements can be added or moved around to meet new concerns, as needed).

3.3.8. Step 8: Measuring the sea change (The Score)

Measurement and evaluation of communication is a constant process, keeping communication flexible and dynamic. Obtaining feedback on communication activities is also essential to ensure effectiveness. However, ex-post assessment is often neglected, especially if it has not been planned in advance. Evaluation can be done at the same time as the communication process (*Formative evaluation*) to check and fine-tune activities during their development and delivery. Otherwise it can be postponed until all communication products are delivered (*Summative evaluation*). Both can address communication outputs, outtakes and outcomes equally well. In either case there should be much opportunity for an ex-post evaluation. These techniques could allow future ex-post evaluation of the communication efforts, though it is advisable to do this during the implementation of the Communication Roadmap to fine tune and/or correct the communication actions.

- **OUTPUT EVALUATION: How far does the communication product go? (The Coverage)**

Assessment of communication and dialogue outreach is carried out in terms of **coverage** by product, audience and stakeholder, promoting attitude and behaviour changes.

- **OUTTAKE EVALUATION: What do audiences do with the communication product? (The Feedback)**

What is the **change of attitude** and perception of audiences with respect to the EC's image? What is their improvement in knowledge, awareness and trust? What is their change of attitude about dialogue?

Identify the current **change of attitude**, perceptions, concerns and new communication needs of audiences and stakeholders with respect to the output.

1. ***Information needs assessment*** (gathering questions after communication to draw up a response).

2. ***Analysis of news clippings*** (spotting concerns and knowledge in progress to plan future communication).

3. ***Public opinion polling*** (assessing opinion or reaction on key issues and how responses from social and political institutions are evaluated).

4. ***Qualitative methods*** (e.g. devising questionnaires, discussion meetings, focus groups with those people who have already been involved in communication).

Message pre-testing: how did audiences react to the communication product? What did they learn?

1. ***Smog readability grading formula*** (evaluating the level comprehension needed to understand an issue).

2. ***Message pre-test questionnaires*** (getting feedback on pilot materials).

3. ***Theatre testing*** (getting feedback on audiovisually presented materials).

4. ***Focus groups*** (getting feedback on and generating ideas about issues; getting a 'pulse' of attitudes and beliefs).

❍ OUTCOME EVALUATION: What do audiences do with the message? (The Dialogue and Engagement)

What are the **changes of behaviour** of audiences with respect to EC? Have stakeholders applied new knowledge to dialogue and engagement? What is the change of behaviour of audiences when it comes to consensus-building around the EC's policy approach? What is the improvement in dialogue behaviour?

Identify the current **change in behaviour** of audiences in terms of dialogue and engagement.

1. ***Public opinion polling and survey*** (organising a before and after survey of attitudes to determine the relative success of communication).

2. ***Focus groups*** (getting qualitative feedback on whether the communication tactics worked).

3. ***Behaviour observation*** (determining whether behaviour changed as a result of a communication activity).

4. ***Cost-benefit analysis*** (examining the relative benefits of communication)

5. ***Experimental*** (isolating the communication effects on behaviour by setting up experimental groups).

PART IV.

HOW DO WE GET THERE?

IMPLEMENTING THE COMMUNICATION ROADMAP

In promoting an integrated, safe, responsible and socially acceptable strategy for the development and use of nanotechnology there is a real need for fresh ways of informing audiences about nanotechnology and its implications for society. At the same time, it is necessary to learn more about public opinion on what it perceives as 'nanotechnology' and build mechanisms that will allow open and accessible channels of communication to connect different groups of stakeholders. This Communication Roadmap is meant to be a theoretical framework to create new ways of promoting an integrated, safe and responsible approach to nanotechnology, addressing both benefits and risks of nano research and its applications. We now need to see how it can be turned into reality by specific Actions.

Some recommended '**Communication & Dialogue Recipes**' with a view to implement the EC's communication and dialogue from 2009 to 2011 (Section 4.1). The operational **Calls to Action** to translate these recipes into a '**Communication – Dialogue Menu**' are fully described later on (Section 4.2): this is the whole portfolio of the EC's communication projects, events, products, activities and publications expected to be delivered between 2009 and 2011.

Additional summary tables are meant to describe the following.

- COMMUNICATION & DIALOGUE RECIPES: the recommendations for applying the 'Five Ws' (plus three additional questions) of the EC's nanotechnology communication method (addressing key audiences in their professional and leisure time, conveying appropriate messages through specific vehicles) (Figure 11).

- COMMUNICATION & DIALOGUE MENU: the synthetic description of the EC's Calls to Action, expressed in terms of communication projects, events, products, activities and publications expected to be delivered between 2009 and 2011, complete with timing, venues and outreach figures for each one (Figure 14).

The implementation of the present Roadmap feeds on both philosophy and principles of the European Year of Creativity and Innovation ([1]) and enriches it at the same time. It aims to raise awareness of the importance of creativity and innovation for personal, social

[1] See http://www.create2009.europa.eu/about_the_year.html online

and economic development, disseminating good practices and stimulating education and research, within the wider perspective of promoting a policy debate on these issues.

As creativity and innovation contribute to economic prosperity as well as to social and individual wellbeing, most communication projects, actions, activities and events have corresponded to this all-inclusive approach, targeting different audiences which include young people, educators, business and policymakers, as well as the general public, and encouraging society organisations to get involved at European, national and local levels.

4.1 EC 'COMMUNICATION AND DIALOGUE RECIPES' ON NANOTECHNOLOGY

On top of the 'voice of theory' communication recipes which should guide implementation of the Communication Roadmap, we have already described the outcomes of dedicated EC-funded events reflecting the 'voice of experience' of experts in science communication, media and art ([2]), who have been also discussing the recommendations emerging from major studies on communicating nanotechnology ([3]). As a consequence, a set of operational recommended recipes for EC communication on nanotechnology has been outlined.

i) Whom to talk to? **Identifying, surveying and segmenting target audiences** to get to know their values, perceptions, concerns and expectations, communication models, cultural specificities, devoting special attention to youngsters, scientists, journalists, business and industry, NGOs and decision-makers.

Choosing, knowing and segmenting the right audiences are of key importance to effective communication. This must be carefully driven, attentively studied and transparently addressed via the appropriate vehicles.

ii) Saying what and how? Developing **new models and tools** for communication, dialogue and engagement, including spontaneous, unconventional and fun forms of expression, such as art, media, audiovisuals, television, radio and Web that should be encouraged. Games, competitions and contests should also be promoted as an effective tool to challenge young people imagination and engagement. The triangle approach **hands-on, hearts-on, minds-on** should be strengthened to stimulate both curiosity and engagement. Bringing researchers to science centres and schools should complement the conventional approach to bring schools to the laboratories. High quality and science-sound information is an essential point, but should be effective for communication purposes to create attention and awareness to begin with.

[2] Bonazzi, M.(ed.), 2007 (A) and (B), *quoted papers*; Bonazzi, M. and Palumbo, J. (Ed.), (2007), *quoted paper.*

[3] Reworked from *Ten commandments on communicating nanotechnology: protest, profit and perception* (http://www.nanoregulation.ch) and at the site of the International conference on regulatory issues (2005) (http://www.nanoeurope.com).

Appropriate approaches to attain effectively target audiences should be based on what is relevant for them.

iii) Where and When? Some audiences are best reached during their '**professional' (or school) time**, while others would be best reached during their **leisure time**.

Diversifying communication and dialogue strategies in different time-windows could attain different audiences or similar audiences under different vehicles, providing various standpoints.

iv) Who informs? Ensure **access** to reliable and high-quality information on ethical, social and legal dimensions of nanotechnology and their potential implications for daily life; additional focus is examined on ways to mitigate the nano-divide in communication and developing a free database on best practices by funnelling all information towards an **international body.**

Reputation and credibility of information providers is crucial. The possibility of establishing a 'super-partes' agency should be addressed, which could funnel the major credible actors, e.g. NGOs, scientists, selected media.

v) Who distributes the information? The role of **multipliers** such as journalists, teachers, opinion-makers and influential people is pivotal as they have an important role in communicating with a larger public. They should be the first targets to reach.

It is necessary for scientists to work together with multipliers as the public trust them most.

vi) Who decides? **Choice-making processes** need to be developed with appropriate new audiences, exchanging visions, scientific cultures and mobility of practitioners in communication.

Individual choices are becoming more relevant in decision-making processes. They are crucial to consumer acceptance or rejection of nanotechnology. Dialogue should encourage ways to make personal choices on the basis of reliable and trustworthy information.

vii) 'High tech needs high public trust' Behind any debate about modern technology the question of trust features prominently, all the more for sophisticated and complex nanotechnology. This appears to be the golden rule for dialogue here. Citizens wonder how can they be sure politicians, industry or scientists are telling the truth? Can they ask for any guarantees so that their confidence is not misplaced? In general, trust in industry, politicians, and governments seems to be at an all-time low. At most, consumers appear to put their trust into NGOs and, to some extent, into scientists. Public trust does not come out of the blue. **Regulators and regulations do not create public trust automatically** and many people don't seem to know much about them anyway. As for industry, the public can sometimes be outright suspicious of it.

Policymakers have to improve their communication strategies to gain public trust, and communication is the key. It should be targeted, honest, transparent and open, covering benefits and risks in a balanced way.

viii) 'People, not just science, create public trust'

Scientific arguments about the potential benefits or threats of a technology do not create trust for their own sake. On the contrary, listening to experts contradicting each other can often trouble people or put them off in the long run. In the worst case, this can lead to technology rejection and boycott. People do not believe scientific arguments per se, but are more inclined to put trust into specific persons or organisations who are believed to act in the same way as the people would.

Reputation and credibility are more important to the public than sophisticated arguments.

ix) 'Media love a good nano story'

After all, the media are positively fascinated by nano. More that 70% of media coverage about nano tends to be favourable. And if one of the strongest effects of media coverage is due to the way contents are presented, nano can rely on the media being intrigued and looking for possible nano applications in the nearest future with seemingly genuine curiosity.

Media love nanotechnology. So it is important to give them good stories before somebody else does the opposite.

x) 'Technology acceptance is based on individual values'

Consumers can easily be overwhelmed by information when coming to grips with complex technologies. When uncertainty prevails, information is scarce and decisions still need to be made, shared personal values can provide something to hang on to. Such values tend to be consistent over time and can be communicated to justify decisions. Personal intuitions are increasingly shaping consumers' decisions – and these are usually based on personal attitudes and values.

Individual values are becoming more relevant in decision-making processes. They are crucial to nanotechnology acceptance or rejection by the consumer.

xi) 'Communication goes well beyond information'

The presumed equation: 'More information leads to more acceptance' has been proven to be wrong. The same mistake can occur by thinking that a better educated public may warrant a more favourable attitude towards nanotechnology. Piling up on additional informa-

tion to get acceptance is quite possibly useless, especially when information campaigns by the industry are perceived as being manipulative and PR-driven.

Lack of dialogue about acceptance or rejection of nanotechnology is not a problem of information, but of communication.

xii) 'Technology risk perception becomes reality'

Human risk perception seems to be complicated and often irrational. These patterns, which include the perception of everyday threats, are very hard to manipulate because, more often than not, they are the result of an evolutionary process. It's important to keep this in mind before setting out to communicate nanotechnology, whose risk perception patterns are still unclear because of the subject's very nature.

It is no use trying to manipulate risk perception. It's much more useful to try and understand it and deal with it.

xiii) 'Nano hype is bound to create frustration'

Utopian nano-scientists are known to claim from time to time that nanotechnology will clean up the environment, eradicate world poverty and free the human race from disease, ageing and probably death further down the line. If nano expectations are blown out of proportion, it is quite inevitable the media will lap it up and hype it up. People will then believe that these 'nano-dreams' are about to come true, creating disappointment which is toxic to public trust.

Avoid any hype to prevent disappointing citizens and consumers.

xiv) 'Balancing nano benefits and risks'

If the public needs to weigh the risks and benefits of nanotechnology, it must know and understand both in a realistic way. If any risks are to be taken, then the product needs to have tangible benefits for consumers, and the industry has to show it can produce useful products with remarkable benefits.

One-sided information breeds suspicions.

xv) 'Is there any nano in here? Consumers want to be told'

Consumers want to be informed about the ingredients, contents, composition and even the packaging of the products they are buying.

Tag nano-products with a nano-label to build trust and good public relations.

Table 11. EC 'Communication and Dialogue Recipes' on nanotechnology
TABLE 11.1 Activities targeting 'professional time'

ACTIONS AUDIENCES

	Youngsters	Scientists	Media	Industry/ businesses	NGOs	Decision makers
WHY	**AUDIENCE: Children 5-13** • are not interested in nano • trust multipliers (can be reached with special training programmes) • trust/mistrust teachers, parents **AUDIENCE: Teens 14-18** • aim at choosing university • need information • consider gender differences • need feedback Associated Multipliers: • teachers, celebrities (singers, pop stars, football players and famous scientists) **AUDIENCE: Youngsters 19-22** • aiming at choosing careers • require information • sensitive to gender differences Associated Multipliers: • celebrities, famous scientists; politicians; journalists/media; industry; teachers/scientists/ professors; NGOs	• sensitive to training to communicate basic scientific facts • motivated as influencers in communication with the public	• sensitive to key values: • neutrality • relationship building • Pro-activity • sensitive and linked to associated Audiences • business • NGOs • scientists (can provide briefings) • ethicists	• industry shows a strong motivation to seek out information because they know there is a market for nanotechnology • nano-production companies aims at manipulating nano materials and components (they might require information, support and help – particularly SMes)	• aiming to exploit different needs according to the organisation and target of the group	• aim to act on sensitising different levels of decision makers, local, national, supranational • aim to exploit and address cultural differences and language issues (which must be taken into account especially when dealing with local policymakers)

ACTIONS AUDIENCES

	Youngsters	Scientists	Media	Industry/ businesses	NGOs	Decision makers
TO WHOM (Audience) **WITH WHAT EFFECT** (Objectives) **WHAT** (message)	**AUDIENCE: Children 5-13** **OBJECTIVES:** • stimulate curiosity • influence parents **MESSAGE:** • nano is cool/fun/interesting **AUDIENCE: Teens 14-18** **OBJECTIVES:** • stimulate interest • foster a critical attitude and stimulate dialogue to make them into responsible citizens **MESSAGE:** • nano is trendy/fun/intellectually challenging • you can make a difference **AUDIENCE: Youngsters 19-22** **OBJECTIVES:** • stimulate interest in science careers and increase knowledge of opportunities in science • create responsible citizens **MESSAGE:** • nano is the future • nano is interesting and it represents a challenging professional opportunity • you can make a difference	**OBJECTIVES:** • **Become more involved** **MESSAGE:** • stimulate the desire to communicate with laypeople • promote awareness and basic knowledge of societal consequences (for natural scientists) • foster motivation to spread awareness and basic knowledge of scientific facts (for social scientists)	**OBJECTIVES:** • **Search/find/ sell news (bad/good)** **MESSAGE:** • nano is happening now • crucial societal implications of Nanotechs • care about basic scientific facts	**OBJECTIVES:** • **Make profit** • provide accessible information on product risks • show the benefit of nanotechnology in customers' daily life • advise small businesses on nanotechnology regulation and on the financial expectations regarding nano **MESSAGE:** • crucial societal implications of nanotechs • care about basic scientific facts	**OBJECTIVES:** • **Fulfil mandate** • involve NGOs in building permanent channels of communication • involve NGOs in ongoing information sharing • involve NGOs in communication on risk, legislation, regulation **MESSAGE:** • EU is addressing ELSA of nanotechs • EU is promoting communication	**OBJECTIVES:** • **Achieve good governance** • awareness of risks and benefits • broaden perspectives including economics • regulate on EU level for local policymakers. • make international comparisons on regulation and policy **MESSAGE:** • care about what audiences/citizens/ stakeholders/ media think and say

ACTIONS AUDIENCES

	Youngsters	Scientists	Media	Industry/ businesses	NGOs	Decision makers
TO WHOM (Audience) **HOW** (Vehicle)	**AUDIENCE: YOUNG PEOPLE** • art festival, theatre, movies, games • exhibitions and activities in science museums **AUDIENCE: Children 5-13** • exhibitions in cultural centres, science centres, edutainment • events in schools • games, cartoons • nano fairs, theatre, festivals • the Internet, TV-radio-media • friendly guide, mascot or sympathy figure to show children the nano world **AUDIENCE: Teens 14-18** • Internet platforms, podcasts/trendy media • organised debates • celebrity testimonials on science issues • bringing famous scientist to schools • festivals • contests for video and creative art productions • theatre productions • edutainment interactive applications – hands-on experiments • visits to labs/experimenting/stage experiments/ dialogue **AUDIENCE: Youngsters 19-22** • open labs, out-campus events, real lab guided tours contact with scientists • Internet, movies • internships, orientation fairs, EC stands • theatre, games, conferences/shows	• communication training for natural and social scientists trough seminars, courses, summer schools • meetings between natural, social scientists and communicators • presentations for senior scientists – interview coaching • real hands-on experiences	• set up an image and film database on nano • develop a neutral resource centre on nano • develop person-to-person relationship building initiatives between journalists of all specialities and nano scientists, ethicists, social scientists, NGOs. etc. • set up tutorial, shadowing work, placement opportunities • set up events/ discussion events developed in partnership with media	• provide viable and smart Internet resources • develop product labelling with a special logo indicating the presence of nanotechnologytreated products • develop word-ofmouth marketing and product demonstration: longterm perspective	• promote the creation of platforms and forums linking scientists to NGOs • develop pairing schemes to provide permanent connections between groups • guarantee green quality markers for laboratories who reach pre-defined standards of safety in handling nano-products	• create continuous channels of communication outside times of crisis • provide info on different levels for local, national or specialised decision makers

TABLE 11.1 Activities targeting 'leisure time'

WITH WHAT EFFECT (Objectives)	WHAT (message)	HOW (Vehicle)
Stimulate curiosity using perception, body language, dance and art **Foster user-oriented** approach answering the question: why is this interesting for me?	**Interdisciplinarity:** scientists interact with artists and other groups to maximise impact, ensure quality of information and fine-tune approach to different needs	**Games** about nano targeted to different groups of public using appropriate media and carrying differentiated messages: • Video games • Table games • Strategy games • Role play games • Educational games • Group or multi-player games • Card games Construction games – e.g. nano building blocks like molecular models especially designed for molecular machines or tactile games: building with boxers' gloves to give an idea of limited movement, instrumentation for small object handling, etc.
Provide simple and realistic information: what is nano? It is a science, not magic Knowledge is growing and evolving, nothing is fixed	**Debate:** it needs to be stimulated and encouraged – exchange of views is important for public and other groups involved	**Virtual** Internet environment activities: • Virtual guided tour to a nano-environment, to give the idea of scale and nano-dimensions. A guide or mascot (made-up funny character) can be used to show the visitor around the virtual environment. 'Super-Nano' for example or a user-generated character or a combination of the two. Edutainment tools can be made available • Second life virtual environment where the nanoworld comes alive • Interactive experiment with user-generated output involving a virtual or real nano-lab where the user can choose variables and perform experiments, verifying outputs and experiencing scenarios • Internet platform or portal connecting different interest groups, different competences – for example scientists with artists, journalists or youngsters

WITH WHAT EFFECT (Objectives)	**WHAT** (message)	**HOW** (Vehicle)
Consider social and ethical implications, emphasising openly and honestly both benefits and risks using facts and figures, timelines, scenarios	**Interactivity** with the public is crucial to ensure engagement, by creating artistic works together, launch competitions, Web-based methods such as blogs, Web cameras and media-based platforms	**Contemporary art nano festival** – a large event for everyone, lasting 3-4 days with nano interpreted though various disciplines, particularly contemporary art. Some possible features (which can be isolated to form a project in their own right) are below. • Art exhibition with installations that introduce the public to the creative processes by offering the possibility to interact with the artworks, which change following actions carried out by users. Introduction of nanophysics laws into the design of the artwork itself, for example self-assembling application in art performance, installation, theatre, etc. • Conference or talk by a scientist connected to an artistic means of expression interpreting the words through a visual aid or an artistic performance where dancers interpret what the scientist says through movement. Artists should collaborate with scientists at script writing • Dance performance using choreography to give an idea of the nano-dimensions ('There is plenty of room at the bottom', for example, from Feynman's famous quotation, interpreted by dancers to give an idea of the void between atoms • Performance constructed according to the laws of quantum physics, for example with a self-assembling structure, to give the public an intuitive perception of the physical laws at nanoscale • Workshops involving school groups or selected groups of specific publics • Short movies about nano – a competition can be launched to ensure the public's participation • Connections to the outside world, through the Internet, webcams, other media • Writing and performance of nano-songs, acoustic voyage into the nano-world, symphony about nano-scale interactions, music written and performed using ideas from physical behaviours at the nanoscale
	Feedback from the public is essential through appropriate means in every activity	**Travelling** event • Means of transport such as a train, caravan or a truck disguised as a spaceship designed to reach every social destination, remote places and developing countries too • Different activities can be packed into the nano-train or truck: they should involve artistic media and interactive artistic applications, an exhibition, a moving laboratory with experiments and demonstrations • Schools, villages and public spaces are some of the possible destinations, along with stations and airports

4.2 EC 'COMMUNICATION AND DIALOGUE MENU' ON NANOTECHNOLOGY

The 'Communication Recipes' are translated into reality here. This section provides a description of the EC communication projects, events, products, activities and publications expected to be delivered from 2009 to 2011, complete with scheduling, venues and outreach figures.

4.2.1. EURONANOFORUM 2009 Project

The **EURONANOFORUM 2009** conference was launched by the Czech Presidency as a milestone in the history of nanotechnology communication. It was the fourth of a series of top-level international nanotechnology conferences organised within the framework of rotating Presidencies of the European Union, and it was held in Prague at the beginning of June 2009 under the auspices of the Czech Ministry for Education, Youth and Sports with the support of the Industrial Technologies Programme of the European Commission.

Focusing on 'Nanotechnology for a sustainable economy', this prestigious event addressed the contribution and challenges of nanotechnology research to a sustainable development of European industry and society. Different sessions, workshops, and several award-winning exhibitions were organised. A unique set of communication activities for the general public and especially aimed at young people underpinned this conference. EuroNanoForum 2009 helped to address several crucial related issues, such as the need for a dramatic reduction in carbon emissions and fossil fuel dependence, a substantial increase in energy and material efficiency, pollution control, clean water management and a sustainable quality of life for European citizens through a whole range of nanotechnology applications ([4]).

EC nanotechnology events on such a scale are held once every two years. The previous ones took place in 2003 ([5]), 2005 ([6]) and 2007 ([7]). Euronanoforum 2009 had the added challenge of including art as a major tool to communicate nanotechnology to the general public. A specific cross-fertilisation workshop was set up to gather the coordinators of EU projects on nanotechnology communication and public, artists and designers. This workshop was aimed at putting together business, artists, EU project coordinators and journalists in the context of the NANOSCOPE event, which was organised by the Czech Tesla Union, and run in parallel to the Conference with the specific objective of communicating nanotechnology through visual (painting, sculpture, architecture, design, audiovisuals, Web games) and expressive arts (dance, music, body language) ([8]).

[4] http://www.euronanoforum2009.eu/.

[5] http://www.euronanoforum2003.org/.

[6] http://www.euronanoforum2005.org/.

[7] http://www.euronanoforum2007.de/.

[8] http://www.utesla.cz/, http://o----o.info/519/nanoskop/, http://www.doxprague.org/cs/press-releases.

4.2.2. Ad hoc Industrial Advisory Group

An ad hoc advisory group on industrial nanotechnologies was set up in the autumn of 2008 with the aim of debating, assessing and advising the industry about the direction nanotechnology research and innovation are taking across Europe. The group advises on the measures that are best suited to promote a strong European nanotechnology industry, by taking special care of future industrial developments and trends. In particular, the group's findings are expected to provide industrial reasoning and targeting for an extended 2010-2015 plan to be used in preparation of future FP7 calls for proposals in the field of nanosciences and nanotechnologies. The working group brings together industrialists from various application sectors, business-to-business suppliers and equipment manufacturers. In order to keep the group dynamic and efficient, several participants are also stakeholders in one of the European Technology Platforms (ETP)s relevant to nanotechnology (e.g. suschem, construction, manufuture,nanomedicine, textile and clothing, forest-based industries, nano-electronics, micro-nano manufacturing – MINAM). Five ad hoc group meetings have been convened in Brussels to date and the group is expected to complete its work under the current structure in October 2009.

4.2.3. Workshop on public engagement in nanotechnology (NANO4YOU)

As an updated follow-up of the two previously mentioned workshops and open Web consultation on strategy and recommendations for action on communication outreach ([9]) (EC, February and October 2007), this workshop is expected to be held in Brussels around February 2010 and will focus on dialogue and engagement on nanotechnology, i.e. second Call to Action (Section 3.3.3.5 and 3.3.3.5.3.2). It will gather selected experts in media, public engagement and communication to come up with operative recommendations for future European funding on those innovative approaches that might be most suited to engage European society in a lively dialogue on nanotechnology. Experts in the field of science communication will share success, best practices and challenging stories, and will concentrate their effort on giving different audiences a 'voice' in policymaking that is capable of shaping the environment in nanotechnology development.

[9] Bonazzi, M.(ed.), 2007 (A) and (B), *quoted papers*; Bonazzi, M. and Palumbo, J. (Ed.), (2007), *quoted paper.*

4.2.4. New CORDIS nanotechnology EC web page and leaflet

A new website and a leaflet will be devoted to nanotechnology, starting from March 2010. This will be integrating the information currently available in various EC nanotechnology websites ([10]). Fundamental science, nanomaterials, nanomanufacturing and industrial integration will be addressed. Information on funding procedures in FP7, getting local support,

[10] http://cordis.europa.eu/nanotechnology/, http://cordis.europa.eu/fp7/cooperation/nanotechnology_en.html, http://ec.europa.eu/nanotechnology/index_en.html.

finding partners and calls will be the major focus, but success stories will be featured as well. A further dedicated survey could take place to identify the key profile, expectations, concerns and suggestions of the current users of the EC's nanotechnology website in order to have a clear picture of the extent and limits of the current outreach via the EC's Web tools and see what can be improved. This should be aimed at identifying the audience, the information content, the degree of satisfaction and the expectations of current and potential users.

4.2.5. EU Member States High-Level Experts Group on nanotechnology

A High-Level Experts Group of EU Member States and FP7 Associated States has been formed and held meetings in Brussels during February and June 2009. It has been agreed to give further high priority to research in the area of risk management, in particular the study of the impact of nanoparticles on health safety and environment (HSE). The objective is to harmonise all research work on nanotechnology that is taking place in the Member States and the FP7 associated States and the Commission's Framework programme, maximising synergy and effectiveness among these programmes. In the case of HSE Research projects in the domain, both EC and nationally funded projects are clustered into a single nanosafety cluster including other relevant projects. In the immediate future, it will consider infrastructure requirements, foresight as well as investigate bringing together industry and research laboratories to resolve 'knowledge gaps' with respect to regulatory activities. Following this pilot case, other areas such as the EU innovation framework, education and skills will be targeted.

4.2.6. ECSITE Conference

The ECSITE Annual Conference of science centres and museums, which was held in Milan at the beginning of June 2009, gathered about 2,000 multipliers ranging from science communication professionals to the media. As museums and science centres regard education as one of their very reasons to be, they know they need to offer ever-engaging choices to their visitors in order to have an impact on society. This top international forum was particularly interesting in the way it put together key multipliers in science communication. The European Commission took this opportunity to present here its own philosophy, policy and related strategy for communicating nanotechnology at this Conference by way of four recently EC-funded European projects with an overall budget of EUR 5 million within the Seventh Framework Programme for RTD.

Both the outline and the initial activities of these projects were discussed with the audience, so was setting up a dedicated workshop for discussion between the speakers and the audience. Science museums, science centres, media, research institutes, NGOs, business and artists from about 25 countries are involved in these projects, which are described in great detail across the following chapters. They will surely contribute to the improvement of quality of European life on the basis of knowledge, tolerance, respect and democracy.

A dedicated workshop was set up during the conference to discuss nanotechnology communication between journalists, science centres, schools and policymakers. It was openly recognised that the job of communicating nanotechnology now aims to find stimulating fresh suggestions by venturing into non-conventional domains and 'languages', and by using new perspectives and skills. It means that art, music, theatre, filmmaking, Web and design can give nanotechnology communication a completely new spring in its step.

4.2.7. Projects on communication outreach and education

Four projects focused on communication have recently been launched under the EC's Seventh Framework Programme for Research funding scheme. They are called **NANOTV, NANOTOTOUCH, NANOYOU** and **TIMEFORNANO**. Stakeholders from science centres and foundations, business, research institutes, NGOs, and television networks from about 27 EU Member and Associated States are involved in these projects.

Different sets of science centres and schools from these countries will benefit from specific project activities.

NGOs: ORT, Israel; EUN European SchoolNet (EU, Belgium); Fondazione IDIS (Italy).

Art Collectives: BridA Collective Art, zavod za sodobno (Slovenia).

Research institutes: University of Cambridge (UK); iNANO (Denmark); Centre for Social Innovation (Austria); Institute of Nanotechnology (UK); Politechnika Warszawska - Warsaw University of Technology (Poland); Observa (Italy); Ludwig-Maximilians-Universitaet München (Germany); Università degli Studi di Milano University of Milano – Interdisciplinary Centre for Nanostructured Materials and Interfaces (Italy); Chalmers Tekniska Hoegskola AB (Sweden); Universiteit Antwerpen (Belgium); TARTU ULIKOOL University of Tartu – Institute of Physics (Estonia); Consiglio Nazionale delle Richerche (National Research Council) – Institute of Cybernetics 'E.Caianiello' (Italy); Technische Universitaet Muenchen (Germany).

Science Centres and Science Foundations: Barcelona Science Park (Spain); Association Européenne des Expositions Scientifiques, Techniques et Industrielles ECSITE (EU, Belgium); ECSITE UK (England); Grenoble Science Centre (France); Cité des Sciences et de l'industrie (France); Cittá della Scienza (Italy); Deutsches Museum von Meisterwerken der Naturwissenschaft und Technik (Germany); Ciência Viva - Agência Nacional para a Cultura Ciêntifica e Tecnológica (Portugal); Centre de culture scientifique technique et industrielle CCSTI (France); Turkey Science Centres Foundation (Turkey); Technopolis®, the Flemish science centre (Belgium); Tiedekeskussäätiö – Heureka (Finland); The British Association for the Advancement of Science (ECSITE-UK); Fondazione Museo Nazionale

della Scienza e della Tecnologia Leonardo da Vinci (Italy); Universeum AB (Sweden); SIHTASUTUS TEADUSKESKUS AHHAA - Science Centre AHHAA Foundation (Estonia).

Businesses: iCons s.r.l. (Italy); Leonardo Films GmbH (Germany); Gedeon Programmes SA (France); CUEN s.r.l. (Italy); ARTTIC (Israel).

Television networks: forty major television networks from Andorra, Cyprus, Czech Republic, France, Germany, Italy, Latvia, Lithuania, Luxembourg, Malta, Monaco, The Netherlands, Norway, Poland, Portugal, Romania, San Marino, Slovakia, Spain, Sweden, Switzerland and the UK are participating, in addition to EuroNews and Eurovision.

4.2.7.1 NANOTV Project

The **NANOTV** project (http://www.youris.com) will raise public awareness of the very best of European nanotechnology research across all European countries through a new communication model joining television media and the Internet ([11]). In particular, NANO-TV will create a series of 14 high-quality free-of-rights Video News Releases for the general public and young people on the basis of the key results of such research.

Each of these Video News Releases (VNRs) will be produced in such a way as to adapt easily to the needs of a wide range of European TV channels. They will fit nicely into the mainstream science and news TV broadcasting of around 40 major national TV channels in Europe and beyond. Among the 27 Member States, networks from Cyprus, Czech Republic, France, Germany, Italy, Latvia, Lithuania, Malta, The Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Spain, Sweden, Switzerland, UK and others, as well as some international channels like Euronews and Eurovision are expected to broadcast these audiovisuals from 2010 onwards.

All of the project's VNRs will be published into the European independent research media portal http://www.youris.com, which hosts and supports NANO TV project, where they will be permanently available in streaming mode. Each VNR will pick success stories at the cutting edge of European nanotechnology research as the starting point on which to 'peg' a much wider picture of the major nano issues, with the purpose of providing a balanced view of the potential advantages and risks of nano applications.

A careful editorial plan, drawn up by the editorial manager, will identify some of the very best European stories after a thorough evaluation of all the science and applications cross-overs between the different nano domains, each carrying its own issues to be portrayed in a balanced way. These will focus on the associated benefits and any ethical, legal, social possible bottlenecks.

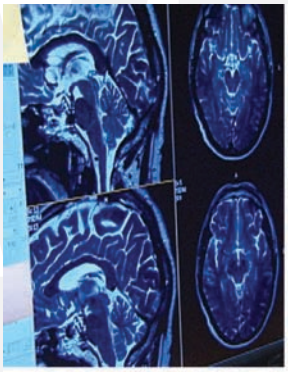
The project's coordinator iCons (Italy) is a media and market consultancy based in Milan. Two European science film producers, Gedeon Programmes (France) and Leonardo Film (Germany) will deliver the films. The scientific partner is the Institute of Nanotechnology in Glasgow.

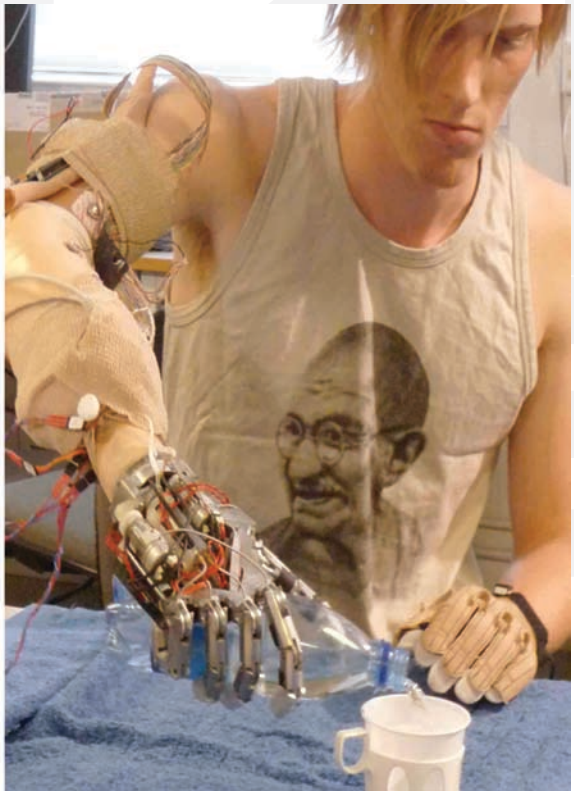
[11] NANOTV *Annex I, Description of Work*, contract No NMP-CSA-2-233486, EC.

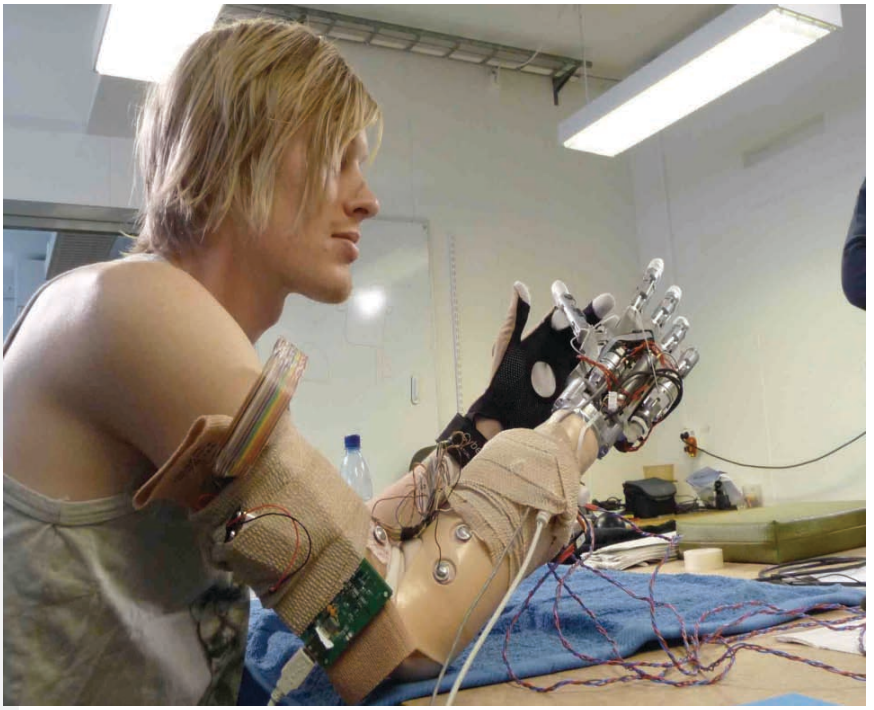
In order to give the audience a broader perspective about the bigger nano-debate out there, each VNR will be supported by original articles and interviews on the above-mentioned Web portal, which will develop each nano issue into a range of in-depth features and interviews branching out far beyond the selected TV projects. This will allow the establishment of a sound science-based dialogue on nano issues by introducing all released videos and the associated written materials, such as articles and press releases, into a series of acknowledged media platforms, nano-centred Internet resources, and selected European online newspapers.

A dialogue with readers and viewers will be also opened through another original feature on the same Web portal, where a carefully chosen 'scientist of the month' will reply to selected questions about each nano issue tackled by the VNRs.

A first, provisional clustering of the major nano research areas could group early diagnosis, regenerative medicine, theranostics and neuroprosthetics; energy, environment and ICT will obviously be covered. In any case the editorial plan will be giving full attention to 'crossover' issues as well, such as nanoparticles, biosensors, biomimicry and nanomembranes. Four VNRs out of 14 will specifically be aimed at a young audience.







Nanotechnology can provide new diagnostics and prosthetics: television networks can disseminate effectively these innovative prospects, avoiding misleading messages and hypes (courtesy of SMARTHAND project)

4.2.7.2 NANOTOTOUCH Project

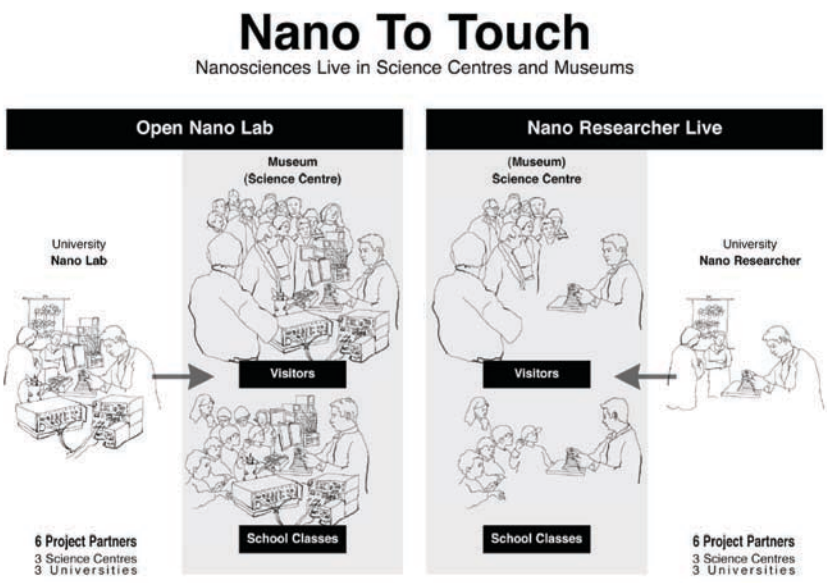
The **NANOTOTOUCH** project (http://www.museoscienza.org/english/projects/nanototouch.asp) aims to create innovative environments for the general public to learn about nano research and get involved into a discussion about it by directly involving the actors of research themselves ([12]).

It proposes 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 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 general public and nano-researchers

[12] NANOTOTOUCH *Annex I, Description of Work*, contract n°, NMP-CSA-2-233473, EC.

not only creates a bidirectional feedback, it also minimises the expert-to-lay bias ('top-down' approach) inherent in current science communication processes with authoritative top researchers. These experiences will be uploaded to the websites of other projects (NANOTV, NANOYOU, TIMEFORNANO) reaching at least 10 EU Member and Associated States. This process 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 of it 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. This project aims at pushing 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.

The NANOTOTOUCH project encompasses different main activities in two clusters, i.e. sustainable infrastructures and events.



Innovative approaches are crucial to trigger the dialogue between young people and scientists on nanotechnology (courtesy of NANOTOTOUCH project)

4.2.7.2.1 Sustainable infrastructures

4.2.7.2.1.1 Open Nano Labs

These are designed to test the need and viability of establishing a sustainable infrastructure of public sites ('Open Nano Labs' and 'Nano Researcher Live' event areas) where the general public will be informed about nano research on a regular, day-to-day basis and will be able to engage personally with the researchers themselves.

4.2.7.2.1.2 'Nano researcher Live'

The objective here is not only to inform the public about recent nano science achievements but also to let the public experience hands-on, hearts-on and minds-on 'live' the day-to-day practices and processes of nano research. The project answers the recognised need for a Public Understanding and Engagement with Research rather than a Public Understanding of Science.

The Open Nano-Lab enables young people to work together with researchers on nanotechnology (courtesy of NANOTOTOUCH project)

4.2.7.2.2 Events and infrastructures

They will offer a peer-to-peer dialogue on an even basis between general public and nano researchers, which encourages bidirectional feedback. In order to minimise 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.

As a result, the academic discourse about the ethical issues and societal implications of nano technology will focus much more on the everyday problems and questions personally experienced by people, as expressed in the discussions initiated by the hands-on everyday lab practice in the Open Nano Labs or the Nano Research Live events.

4.2.7.2.2.1 School programmes

These will make sure that an interested public, especially students and teachers, is going to profit from the strength of Science Centres and museums through a direct encounter with nano researchers and their activities. These specially tailored school programmes will allow for a more thorough dialogue and feedback.

They will also provide both research and educational institutions with a model for strong and effective links and collaboration. Experiences will be documented and described in detail in several handbooks or 'cookbooks'.

4.2.7.2.2.2 Open Campus Days, Science Festivals, 'Meet the Scientist'

Dedicated events will be set up to bring the public into direct contact with scientists. By providing a training infrastructure for the scientists involved and enclosing elements of authentic research, the 'Nano Researcher Live' format of this project will complement these formats.

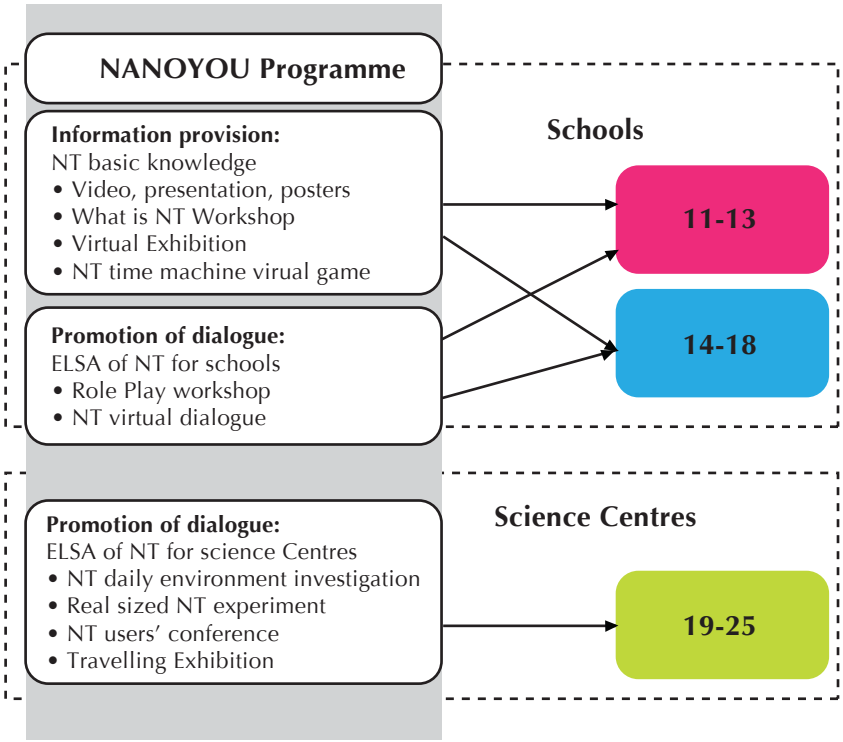
A true premiere, the Nano Researcher Live Area allows visitors of a science centre to experience directly a permanent research installation, interacting with the scientists (courtesy of NANOTOTOTUCH project)

The timing of these activities is different according to their location: the 'Open Nano Labs' in Milan and Gothenburg will be ready and open to the public from March 2010, whereas the 'Nano Researcher Live Areas' will be up and running from January 2010. These activities are expected to be displayed in various other European locations, which will increase their outreach potential. However, the 'Open Nano Lab' in the Deutsches Museum (Munich) is already fully functioning, except for about three or four weeks in November 2009 when it will be moved to the brand new Centre of New Technologies inside the Deutsches Museum, which is scheduled to open on November 20. An extraordinary number of visitors and a powerful press coverage are expected, starting from the centre's opening date.

4.2.7.3 NANOYOU Project

The **NANOYOU** project (http://www.zsi.at/en/projekte/5206.html) will design and carry out a communication and outreach programme in nanotechnology aimed at young European generations ([13]). The project will reach teenagers through school programmes to take place in hundreds of pilot schools from at least 20 EU Member and Associated States (AS). Additional schools from other 7 Member/Associated States are expected to be encouraged by pilot schools to join the project's activities. Specific additional programmes aimed at young adults over the age of 18 will be also offered in science centres. There are plans to involve at least 400 schools and reach more than 25,000 students through the school programmes. The science centres programme is expected to reach an initial 4,000 young adults and many more subsequently as more science centres adopt the programme. The expectation is to raise understanding and awareness on nanotechnology, and its potential benefits and risks. So effective programming will be shaped to meet the educational capabilities and interests of the target young population. This will combine temporary exhibitions, innovative computer games, experiments and other online content, with workshops aimed at promoting dialogue that will raise the participants' awareness of ethical, legal and societal aspects of nanotechnology. The contents will be balanced and up-to-date, and teacher training materials will be prepared to equip science teachers and other staff accordingly. Three main areas of nanotechnology (i.e. nanomedicine, nano-and energy/environment, and nano- and ICT) will be addressed and presented to different age audience groups.

[13] NANOYOU *Annex I, Description of Work*, contract n°, NMP-CSA-2-233433, EC.



Pioneering approaches are pivotal for young people to understand nanotechnology: schools and science centres are trained to activate ground-breaking instruments for communication and dialogue (courtesy of NANOYOU project)

4.2.7.3.1 Activities in schools

- In the first audience group, outreach will be implemented by delivering information on nanotechnology in schools; this will be followed by a phase based on the promotion of dialogue. In these activities both the 11-13 and 14-18 age segments will be addressed.

Schools and science centres play complementary roles to trigger communication and dialogue on nanotechnology (courtesy of NANOYOU project)

4.2.7.3.1.1 Information provision

In an initial phase, a set of computer-based **virtual tools** and activities, a **short video**, an **exhibition** area, and **creative workshop** sessions will be developed. The project's ambitious goal of reaching a wide audience (over 400 schools and over 25,000 students) requires a 'light' and flexible Communication Roadmap that will use Web-based activities and face-to-face workshops.

4.2.7.3.1.1.1 Virtual tools, online experiments, role-play workshop

A second phase will develop tools and activities designed to inform young people about nanotechnology and raise their interest, including **online experiments** and a comparison of pre-Nano and Nano solutions for particular needs. Tools and activities will be designed to engage young people in dialogue about the social implications, for example a **role-play workshop** according to various cognitive abilities of the three target age groups. Activities and dilemmas will allow to develop teacher training materials that will enable science teachers and other staff to guide and tutor outreach activities. Major outreach activities will take place in schools across 20 or more EU Member States/Associate States. Schools may choose a **one-day programme** or use a number of **lesson modules**, allowing teachers the flexibility of integrating the material into the curriculum according to their preferences. Outreach activities will be organised and implemented in at least two major science centres, aiming at 19 to 25 year olds.

In order to this broad and complex topic effectively, the tools and activities will be state-of-the-art interactive and engaging tools, making extensive use of a 'hands-on' approach. Computer-based **virtual activities** have been found to be highly effective in engaging young people's interest and conveying information. Two virtual knowledge activities are planned: a nanotechnology time machine virtual game and a virtual exhibition with on-line experiments. Also, a **face-to-face workshop** will stimulate discussion and debate on nanotechnology. In addition a video, presentation and posters will be developed to provide a general introduction to nanotechnology and the three sub-areas. All materials and activities will take into account age groups differences in knowledge, expression and cognitive abilities, and decision-making capabilities. All materials developed will be accessible, Web downloadable, modular, flexible and translated for use across different countries. A user guide will be prepared for each tool and activity.

4.2.7.3.1.1.2 Videos, presentations, virtual exhibition

A short **video**, slide **presentation** and four **posters** will be developed. They will explain the nano scale and show how nanomaterials and nanotechnologies usually alter the properties of other materials they are applied to, and this is the key to the resulting performance and cost breakthroughs. The presentations and the posters will be designed to be displayed in the exhibition areas with textual and graphic information about nanotechnology, including its related risks and benefits.

A following phase will see the development of a **virtual exhibition** containing animations and simulations as part of the virtual experiments that show the essential aspects of nanotechnology in the three chosen sub-areas, visualising current nanotechnology research projects and applications. Simulations could allow participants to act as laboratory researchers and investigate nanoparticles with an electronic microscope. Through the virtual experiments the connections between the three sub-areas will be demonstrated, as the results of an experiment from one sub-area will become the basic knowledge for an experiment or an application from another sub-area. All simulations, animations and virtual experiments will be developed at two levels of difficulty and abstraction according to the two school age groups.

4.2.7.3.1.1.3 Time Machine game

A subsequent phase will develop a **Time Machine virtual game** in which participants will 'travel in time' while investigating applications and products. Approximately three human needs will be presented in the game. After choosing a need the student will first travel back to certain times in the past and see solutions for this need that were formerly used 50, 100 or more years ago, looking at materials, knowledge, scale and energy aspects of each solution. Then the student will 'travel' back to the present and explore a current or planned nanotechnology solution for the same need, again looking at materials, knowledge, scale and energy aspects. Students will be able to use an 'e-portfolio' for recording their ideas and impressions during their Time Machine travels. They may be asked to compare the different solutions that they have seen. The Time Machine game will be designed at two levels suited to the target age groups, with more complex and abstract applications chosen for the older age group. The game could be used both in class lessons and during the one-day programme. A Web-downloadable instruction kit will be developed for the game, to enable teachers to use it effectively during outreach.

4.2.7.3.1.1.4 'What is nano' workshop

A following phase will develop a 'What is nanotechnology?' **workshop** to provide young people with the basic concepts of nanotechnology and its applications, let them understand the nano scale, and empower them to use this knowledge for discussion and decision-making. In order to achieve these aims two group games will be developed: NANO memory game and a jigsaw puzzle. The games in this workshop will relate to the three nanotech sub-areas, developed according to the differences in cognitive abilities of the two target groups.

4.2.7.3.1.2 Promotion of dialogue

4.2.7.3.1.2.1 Nano role play, Nano-Hyde Park

A following phase will develop **Nano Role Play** using cards to enable small groups to become engaged with complex public policy issues. It will include 10 different nano dilemmas from the three chosen sub-areas. Each student will choose one of the stakeholders' roles (e.g. entrepreneur, worker, consumer, environmental protection advocate, governmental regulatory agency manager, politician, religious leader, media writer). Each participant will study the dilemma and the stakeholders' opinions through the designed cards. Presentations about the various small group role plays will be shared with the full group and an open dialogue will be undertaken on how to resolve dilemmas and find common solutions. The outcome is not to find the 'right' solution to any dilemma but rather to gain a better appreciation of the legitimate differing viewpoints of the various stakeholders, which is an important element in reaching reasonable decisions. There will be an option to present the discussions at the end of the workshop in the form of a '**NANO Hyde Park's Speakers Corner**', where each group will speak aloud in front of the other groups for 5-7 minutes and present a summary of their main ideas.

4.2.7.3.1.2.2 Virtual dialogue facility

The nanotechnology **virtual dialogue facility** is designed as a platform that enhances students' effectiveness in contributing to discussions about ethical dilemmas and policy issues. In this activity, 7 dilemmas will be presented using animation, flash or video techniques (like moving comic strips). The students will be asked to offer an opinion about each dilemma and to justify their opinion by using knowledge they have acquired. They will upload their arguments with the explanations and justifications to a forum on the project website where they can respond to each other. There are plans to open this forum to participants in various countries, in order to facilitate exchanges of ideas and opinions from different places and cultures, especially when it comes to original and intriguing opinions.

4.2.7.3.2 Activities in science centres

Outreach will promote dialogue with young adults from the 19-25 age segment, implementing **two participative workshops** in the Grenoble Science Centre and in the Cité des Sciences (Paris), on nanotechnology daily environment investigation and a real-sized nano experiment, which will be complemented by the nanotechnology users' conference. The implementation will enrol volunteers and nanotech and/or ICT scientists, one jurist, people from the science centre, and people in charge of evaluation. The 'do it yourself' activities outside these science centres will follow in each city, over one month, enabling participants to register their feelings and experiments day by day on a dedicated part of the project's website, such as the Blog platform and a photo-sharing system. This is expected to build a community-like feeling by enabling focus groups to debate on privacy, data security control and governance. It will also provide an opportunity to discuss everyone's experience and to assess what is at stake in the use of nanotechnology.

Schools and science centres work together to trigger communication and dialogue on nanotechnology (courtesy of NANOYOU project)

4.2.7.3.2.1 Workshops FUTU and SITU on nanotechnology daily environment

The **nanotechnology daily environment** begins with a 'kick-off' meeting that will take place in the science centre informing participants about nanotechnology in ICT applications that: (i) are already found in our daily environment (at school, in the hospital, in the supermarket, in cars); and (ii) are used without us knowing it (in our mobile phone, or through credit cards or smart cards). Numbering, mapping, classifying and finally clustering them will be done in a photo-based workshop, followed up with a discussion focus group based on the pictures taken of the chosen ICT devices. Comments and questions will be gathered on privacy, data security, control and governance issues.

4.2.7.3.2.2 Real-sized nanotechnology experiment

A **real-sized nanotechnology experiment** will make young people aware of ethical, legal and social aspects (ELSA) of nanotechnology and ICT convergence by letting them live a real experience.

4.2.7.3.2.3 Nanotechnology users' conference

The **nanotechnology users' conference** will focus on the experience, feelings, questions and views of non-experts who are using nanotech without knowing it. This will give way to an in-depth discussion with experts in science and technology and as well as ethics, law, regulation and economics, where the results of the previous workshops will also be discussed. Starting from the real experience of young people participating in investigation and experimentation, experts and other stakeholders can react in front of a wider

audience of 200-300 participants, setting up a list of recommendations to gain better information and governance of nanotechnology and ICT.

4.2.7.3.2.4 Teacher training material

Teacher training materials will be developed and tested to help them educate, motivate and inspire young people about nanotechnology and its applications, developing course formats containing both theoretical and experimental components that suit the various educational approaches, student levels and course cultures of the participating schools. European SchoolNet (EUN) will take part in outreach efforts in schools in 28 member countries of their network ([14]), reaching about 400 schools in 20 Member States and/or Associate States. The main tasks are: (i) engaging pilot schools to act as the core outreach group; (ii) launching a multilingual outreach campaign of press releases, news articles, Web reports to encourage participation; (iii) programming customised lesson modules; (iv) supporting teachers in pilot and newcomer schools via online and offline tools including nanotech user guides and teacher training kits.

The outreach campaign will be based on EUN network of partners and associated organisations (Ministries of education, schools, teacher associations, science associations, education/science bloggers, eTwinning network), using: (i) EUN portals and websites (etwinning: http://www.etwinning.net Xplora: http://www.xplora.org home page: http://www.eun.org, corporate site: http://www.europeanschoolnet.org; Insight for policymakers: http://insight.eun.org); (ii) newsletters (for educators, about 30 000 subscribers; EUN, about 25 000 subscribers; Xplora newsletter, about 3 000 subscribers; eTwinning about, 10 000 subscribers); and (iii) specific communication to Ministries of education via the European news list of editors working in Ministries.

4.2.7.3.2.5 One-day and modular training

Customised training in one-day programme or lesson modules will be made available online, including the teacher's guide to organising events and a tool for teachers to upload the results, including virtual and face-to-face tools and activities for reaching 11- to 18-year-olds. (Table 12).

[14] See http://www.europeanschoolnet.org/ww/en/pub/eun/committees/steercom.htm online.

Table 12. Overview of NANOYOU tools and activities

Activity name	Activity type	What does it teach?	Activity duration	Target age groups	Equipment + instructional kit
Nanotech time machine Virtual game	Virtual	Nanotech Knowledge	20-45 minutes	11-13; 14-18	Computers; e-portfolio and instructional kit
Virtual exhibition	Virtual	Nanotech Knowledge	15-45 minutes	11-13; 14-18	Computers + instructional kit
Role play workshop	Face-to-face	ELSA of nanotech	45 minutes	11-13; 14-18	Cards and teacher instructions
What is Nanotech? Workshop	Face-to-face	Nanotech Knowledge	45 minutes	11-13; 14-18	Teacher instructions
Video	To be followed by face-to-face	Nanotech Knowledge	15 minutes	11-13; 14-18	Video or computer with projector + instructional kit
Nanotech virtual dialogue	Virtual	ELSA of nanotech	20-40 minutes	11-13; 14-18	Computers; e-portfolio and instructional kit

4.2.7.3.2.6 Travelling nanotechnology ICT exhibition

A **travelling 'nanotech and ICT' exhibition** will be aimed at disseminating the results of all previous activities: it will be built as a final step coming from all public participatory events. This will allow for good exploitation of the achievements, as workshops and public debates can be set up at various times during the life of the travelling exhibition, which may continue for three to four years. It is structured on the basis of: (i) individual stories and testimonials of 'investigation' and 'real sized experiment' workshops; (ii) assessment of the focus groups and recommendations from the public debates; (iii) outcomes from 'the role play workshop' and the 'nanotechnology virtual dialogue'; and (iv) contributions from European experts in nanosciences, nanotechnology, information technology, law, ethics, economics, political studies and sociology.

This exhibition is inspired by the 'News exhibitions' model developed by Cité des Sciences, an 'easy-to-distribute' digital exhibition via DVD support, enabling science centres from about 20 EU countries to showcase the exhibition in panels and language, customising texts, videos and multimedia. The exhibitions will be shown first in Grenoble Science Centre for six months, which is expected to reach about 15 000 visitors, of which 4 000 are estimated to be 19 - to 25-year-olds. In 2011 the exhibition will be presented for three months in the Barcelona Science Park. At the Cité des Sciences, Paris, it will be set up close to its new 'Innovation Gallery' and will attract approximately 180 000 visitors, of which 36 000 are expected to be in the 19 to 25 age group.

4.2.7.3.2.7 Communication toolkit

A **communication toolkit**, i.e. a dedicated guide for school teachers and another for science centres will support the exhibition and the continuous dialogue between experts and non-experts. Dissemination will follow, including press-release and presentations of results and stands at relevant events and in journals, and exciting the interest of some national and European networks involved in nanotechnology communication, science and society activities, as well as in scientific culture. Exploitation will be carried through the EUN's extensive networks comprising school teachers, administrators and other involved parties focused on ICT and science education. The **NANOYOU Web Portal** will be developed using an open source platform integrating Web 2.0 tools. It will feature an external interface for public use with downloadable materials and an internal area for registered users.

4.2.7.4 TIMEFORNANO Project

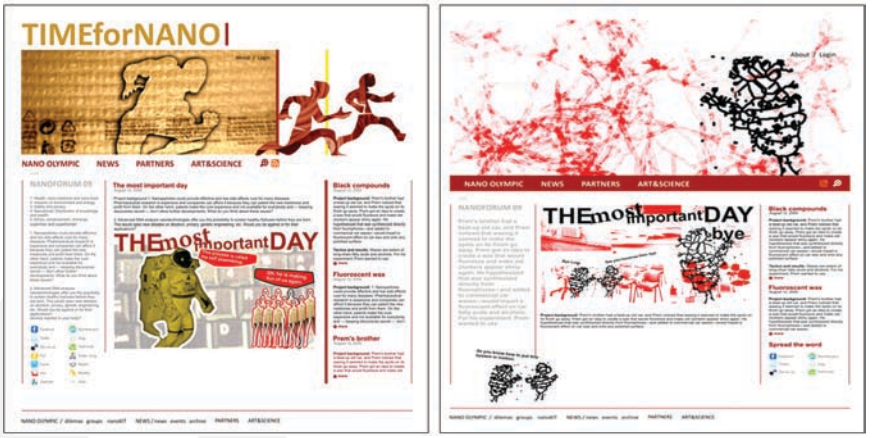
The **TIMEFORNANO** project (http://www.timefornano.eu/timefornanoeu/ and http://www.timefornano.org/) aims to present scientific phenomena that support the development of nanotechnologies and nanosciences, as well as show their potential applications, opportunities and risks to stimulate discussion among citizens, especially young people. Two specific informal education products will be developed, i.e. the **Nano-Kit** and the **NanOLympics** EU-wide contest ([15]) complemented by the organisation of **Nano-Days** in 20 EU Member and Associated States.

4.2.7.4.1 Physical and virtual educational supports

4.2.7.4.1.1 Nano-kit

This will be the basis for the realisation of events and debates aimed at society even outside the consortium countries and designed to collect opinions and feedback from the participants. The products will use an inquiry-based learning approach, specifically developed in science centres/ museums, where people understand by doing. The nano-kit will contain a whole array of small exhibits, nano-objects and materials, scripts for experiments, role/team game cards, and PC animations. It will also include tools for engaging scientists, stakeholders and the public in general within a lively debate. The Web platform will be a resource centre and an attraction for the whole community of science communicators, through its contents (such as a cookbook and activities description, complemented by the continuous addition of new information), its innovative tools (not only forum and newsletter, but online community tools such as blog, podcasts, videocasts, e-museum) and online feedback collection. A great added value of the project is that of 'raising' a growing community of people engaged in nanotechnology communication, through the realisation of training courses in each of the participating Science Centres (at national level) and at European level with the support of ECSITE. These activities are intended to reach at least 450 multipliers (experts working in outreach and education efforts), who will be carefully chosen among three main target groups: (i) explainers in science centres and PhD students in science communication; (ii) teachers from primary schools; and (iii) teachers from high schools.

[15] TIMEFORNANO *Annex I, Description of Work*, contract No, NMP-CSA-2-233481, EC.



A web page links the description and use of the Nano-kit to the other associated project activities, reaching a broad user community (courtesy of Brida and TIMEFOR-NANO project)

4.2.7.4.1.2 NanOlympics EU-wide Web contest

The NanOlympics contest will be to ask participating students to provide solutions to five 'nano dilemmas', and propose them via expressive languages (e.g. GSM video). Awards will be assigned at both national and EU level, thanks to the support of science centres and schools from at least 10 countries.

The **nano-dilemmas** are to be framed along the following lines.

1. ***Health**: nanomedicine and nano-food*

   Nanotechnology has a vital role to play in realising cost-effective diagnostic, therapeutic and prevention tools. Nanoparticles can be used in diagnosis, since their reduced dimension and high reactivity allow them to be used as miniaturised labs to detect biological parameters directly on the body surface (the so called lab-on-a-chip). Nanomedicine can develop novel diagnostics, theranostics and drug delivery systems, and neuroprosthetics. But the change in chemical and structural properties of engineered nanomaterials could lead also to toxicological effects and carcinogenicity, volatility, flammability, and persistence and accumulation in cells. At present, more toxicological research is needed.

2. ***Impacts on environment and energy***

   Nanotechnology offers new solutions through particles and filter systems that can detect, **bind and remove or inactivate pollutants** within land, sea and air. Moreover,

in the energy field, they aim to 'copy' biological processes (such as photosynthesis) to increase efficiency in the use of solar energy.

More **efficient use of resources,** renewable energy, and **environmental monitoring** could be expected. On the other hand, little knowledge is available on the environmental effects of nanomaterials, their life time and synergies with existing pollutants, which could affect their route into the food chain. Additionally the very same properties, effective for the degradation of organic pollutants, water decontamination and air purification may become hazardous if they are active in the wrong place.

3. ***Safety and privacy***

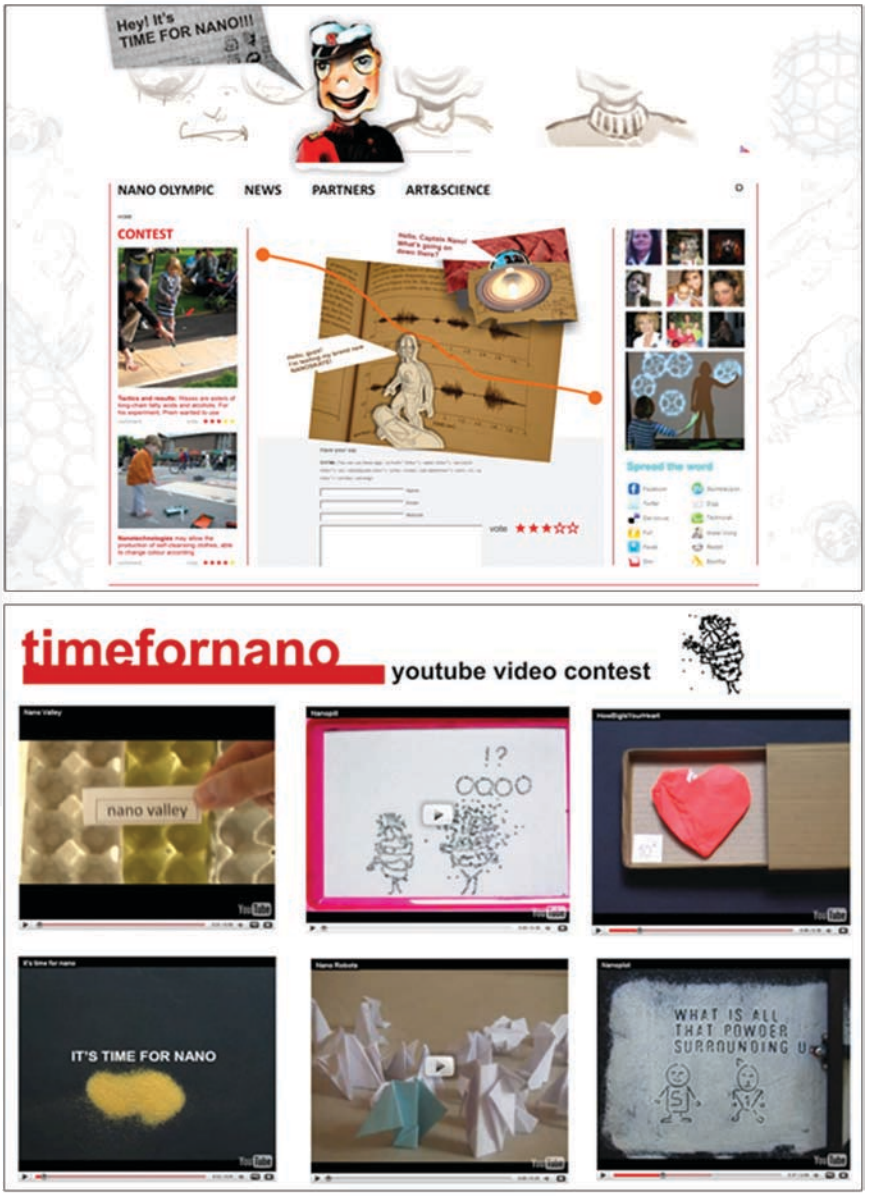
   Ambient sensor systems can provide useful information such as pollution levels and traffic conditions, transmitting it rapidly to portable devices. However, they can also transmit information about individuals' activities. As such the potential for abuse is there and the limits on the type of information that can be gathered need to be clearly defined by society through the legislative system. Privacy issues may also arise through advances in medical diagnostics allowing doctors to screen people routinely for the presence of genetic disease. Such technology could become crucial for early treatment, but the patient's right to choose should be discussed. Additionally, health insurance companies could demand it as a prerequisite for issuing policies, raising the question on whether and how to disclose this information.

4. ***Nanodivide: distribution of knowledge and wealth***

   As ICT, nanotechnology could have the effect of widening the divide between the rich and the poor, or more specifically the developed and developing world. Primarily this can be achieved through advances in healthcare, transport or energy supplies, which may be more available to the wealthy. However, paradoxically it may also come about through a decreased use of natural resources, because many of the precious metals and minerals that new nanomaterials are expected to replace are mined in the developing world. The loss of this revenue without a strategy for its replacement could have a negative impact on the economy and development of these countries.

5. ***Ethics and human enhancement: chimeras, superman and superhuman***

   In the long-term nanotechnology will be able to manipulate molecular and atomic structures fully, with the ability to change human tissues and cells at the molecular level. This will allow for new medical treatments that were previously thought impossible, and will also open the door to 'enhancing' human body and skills. The more controversial enhancements would probably be 'unnatural' enhancements of human talent: extreme intelligence and memory capacity, significantly heightened sense of awareness, astonishing athletic capability and strength and beauty are just a few examples: they will bring up important moral, ethical, and legal questions that human society has not had to face yet.



The NanOlympic contest challenges the participants to find out science-grounded and creative solutions to socioeconomic, legal, moral and ethical nano-dilemmas (courtesy of Brida and TIMEFORNANO project)

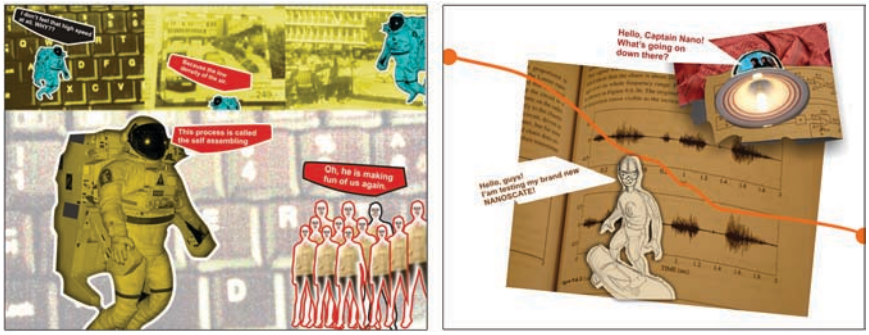
4.2.7.4.2 Events

4.2.7.4.2.1 Nano-Days

The project will culminate with the organisation of some specific events in 20 EU countries, among which the NanoDays are featured, which are meant to be occasions for: (i) informing/educating and engaging citizens; (ii) collecting perceptions and opinions; and (iii) stimulating debate and dialogue.

4.2.7.4.2.2 European NanOlympics Awards

A virtual final conference in the occasion of the European NanOlympics Awards could be organised in 2011.



Stimulating scientific curiosity and inspiring imaginative solutions is the challenge of the light-hearted character 'Super-Nano', featuring the stories presenting the various nano-dilemmas (courtesy of Brida and TIMEFORNANO project)

4.2.7.5 Additional projects from social sciences

Five projects launched by DG Science in Society will support the setup of a science-based societal dialogue on nanotechnology, enabling more permanent public and policy deliberation in a broad societal context. As a result, a European-wide platform could be created in upcoming years through FP7 activities allowing for the monitoring of public and policy debate at international, European and national levels. The major outcomes of these projects from 2006 to 2010 will include **deliberative processes**, workshops, processes and citizens' *forums* for boosting ELSA in nanotechnology and multi-stakeholder platforms for dialogue (projects DEEPEN and NANOPLAT respectively), **conferences** for designing ELSA recommendations for NGOs, industry and policymakers (project NANOCAP), workshops and conferences to present a **Governance Plan** for stakeholders on responsible nanotechnology (project FRAMING NANO).

The project **DEEPEN** ([16]) is a leading research partnership for the integrated understanding of the ethical challenges posed by emerging nanotechnologies in real world circumstances, and their implications on civil society, governance and scientific practice. The project is coordinated by the Institute for Hazard and Risk Research (IHRR) at Durham University. The project team includes researchers based at Darmstadt University of Technology (Germany), the Centre for Social Studies at the University of Coimbra (Portugal), and the University of Twente (Netherlands). This project will focus specifically on two areas of nanotechnology development: the development of nano-sensors, and their potential to become integrated within electronic consumer goods, cars, medical devices, security and surveillance systems, pollution monitoring devices and so on; and the field of nanobiotechnology, and its promise of investigating the machinery of life. Both chosen domains are representative of two distinct approaches to nanotechnology, and as areas of intense innovation activity they are seen as being most likely to engender ethical concern. Deepening ethical understanding of nanotechnologies, mapping the relationships between ethical and normative commitments and increasing ethical reflection will lead to organising relevant **deliberative *forums*** for citizens,

[16] See http://www.geography.dur.ac.uk/Projects/Default.aspx?alias=www.geography.dur.ac.uk/projects/deepen online.

experts and decision-makers to identify recommendations for boosting ethical reflection on nanoscience and associated governance processes. Deliberative workshops (UK, Portugal, May 2009), Festival of Social Science (Durham, UK, November 2008), conferences and operational meetings (UK, Portugal, Netherlands, Germany, Belgium 2006-2008) have been the main outcomes from 2006 to 2009.

The project **NANOCAP** ([17]), Nanotechnology Capacity Building NGOs, is a three-year project spanning between 2006 and 2009 to deepen the understanding of environmental, occupational health and safety risks and ethical aspects of nanotechnology. It is a consortium of five environmental NGOs, five trade unions and five universities that held a series of focused working **conferences** in which a structured enhancement of stakeholder capacities was planned. The universities took care of the scientific input for the conferences. NGOs and trade unions developed their positions after discussions with their members. A portfolio on ethical issues and a position concerning 'responsible nanotechnology' was prepared and actively disseminated. This enabled a structured discussion between environmental NGOs, trade unions, academic researchers and other stakeholders at European level. This process improved the understanding of nanotechnologies by participants, formulating positions within their actual policy context supported by scientific inputs. As a result, five European NGOs adopted a position on the responsible development of nanotechnology and the European Trade Union Confederation adopted a resolution representing 60 million workers in Europe. This lead to **recommendations** on how to stimulate industrial and academic RTD performers to focus on source reduction of manufactured nano-particles and to make risk assessment an important dimension in their work. The project is also developing recommendations to enable public authorities to address the health, safety and environmental risk issues related to the rapid introduction of nanotechnology into society.

The FP7 project **NANOPLAT** ([18]) aims at creating a deliberative forum for nanotechnologies-based consumer products and evaluates various instruments which have been used for assessing the societal dimension of nanotechnologies across Europe. As of August 2008, the nanotechnology product inventory had grown by nearly 279% (from 212 to 803 products) since it was released in March 2006. Personal care, clothing and cosmetics products top the inventory at 153, 126 and 115 products respectively.

The positive visions for nano-sciences and nano-technology are apparently without limits. This is especially the case within medicine and bio-nanotechnology, but similar visions are also found for energy, ICT and materials for the consumer industry. According to these visions nanotechnology will have a qualitative innovative influence on the production processes, energy and material use, information and communication systems and – after a while – a substantial influence on the everyday life of individual consumers and households. Cheaper, stronger and lighter products could be obtained: in contrast to the previous history of technology, nanotechnology might combine economic growth with a reduced consumption of materials.

At the same time, scepticism grows along two lines, associated with (i) the lack of knowledge regarding both environmental and health risks of the new nanotechnology materials, (ii) fun-

[17] See http://www.nanocap.eu/Flex/Site/Page.aspx?PageID=&Lang online.

[18] See http://www.nanoplat.org/ online.

damental questions about the relationship between man and nature, raising ethical, political and even religious dilemmas.

So **deliberative processes** will be set up on human and environmental safety, ethical and moral dilemmas, and perceptions of risks and responsibilities as revealed through focus on the market interfaces across the value chain of goods and services. This will be important for the development of deliberative democracy in Europe, to stimulate the deliberative dialogue and give scientific support to the stakeholders who are responsible for this dialogue. Evaluating selected deliberative processes in Europe and identifying the needs of stakeholders (focusing on producers, consumers, NGOs and society) will make sure that a deliberative and science-based **platform for the dialogue on nanotechnology between stakeholders** in Europe and beyond is developed.

From 2008 until 2010 the FP7 project **FRAMING NANO** ([19]) will be aiming to develop a multi-stakeholder platform for dialogue on regulation promoting responsible nanotechnology. National **workshops** organised in the Czech Republic, Germany, the Netherlands, Switzerland and the UK allowed presenting a Governance Plan covering the requirements for a safe development of nanotechnology, so an international multi-stakeholder dialogue is already at work. Additionally, best practices and cross-links and contacts between national activities are being developed. Then, an international workshop (Brussels, February 2009) presented the supporting Delphi studies, debates on critical issues and facilitate cross-contacts, while a final **conference** (Italy, 2010) will be the meeting ground to discuss stakeholders' respective positions and expectations on the development of responsible nanotechnology. This will be the time to aim for consensus before presenting the final proposal for a **Governance Plan** on responsible nanotechnology.

Finally, from 2009 until 2011 the FP7 project **MACOSPOL** ([20]) will be aiming to experiment and develop new tools for exploring and representing public debates on scientific and technological issues. This project is a joint research enterprise that gathers science, technology and society experts across Europe. Its goal is to devise a collaborative platform to help students, professionals and citizens to map out scientific and technical controversies. Technical democracy requires spaces and instruments to facilitate public involvement in technological and scientific issues. Such democratic equipment is yet to be assembled, even though much research has been done to give it a theoretical shape. At the same time, digital innovations are providing an increasing number of new instruments and forums that can be used to promote public participation. Therefore, the project has been set up to facilitate the alliance between these two developments, by making sure that the best research on science, technology and society is twinned with the best research on Web-based tools. The goal of the Macospol project is to assemble a Web-based platform to aid the exploration and mapping of scientific controversies. This will be reached through the involvement of 8 partner teams and different lines of research represented by 8 Work Packages. First, the project aims to collect tools, survey, test and evaluate the massive amount of techniques, procedures, software and sites available on the Web. The second step focuses on delivering two Internet-based mappings of controversies about potential risks involving the use of food supplements and nanoscale materials. Then interactive tutorials will be rolled out to help users to get familiar

[19] See http://www.framingnano.eu/ online.

[20] See http://www.macospol.eu/ online.

with the tools for analysing controversies and subsequently overcome the compatibility issues. This will lead to **designing the space of controversies** through different kinds of work (such as case studies and comparisons between the collected tools, for instance) which will open the way to test the political relevance of the platform as a 'quasi parliament' capable of hosting and shaping the most topical debates about science and technology.

4.2.8 Workshop on collaborations between EC projects communicating nanotechnology

A dedicated workshop was set up during EuronanoForum2009 to identify synergies, cross-fertilisation and collaboration between the most relevant projects on communicating nanotechnology (Table 13).

Table 13. Collaboration between EC projects on communicating nanotechnology

From/ to	NANOTV	NANOYOU	TIME4NANO	NANOTOTOUCH
NANOTV	-	Videos in science centres TIME4NANO: • in video presentations • in virtual games & virtual dialogue tools • in travelling exhibition • in teachers' training	Videos in sciences centers TIME4NANO: • in nanokit • in NanOlympics • As part of NanoDays materials	Videos in sciences centers NANOTOTOUCH
NANOYOU	• 1st set three Videos received in July 09, for feedback September 09 • 2nd Set Videos in December 09, for feedback March 2010 • Filming 4 Videos nano-learning in January 2010		• synchronise dilemmas • NANOYOU schools in NanOlympics • NANOYOU teachers participate in NanoDays & training TIME4NANO	• NANOYOU schools attend Open-Labs @ Live-Areas • NANOYOU portal provides their Live Coverage and discussion platform between scientist and students
TIME4NANO	• 1st set three Videos received in July 09, for feedback September 09 • 2nd Set Videos in December 09, for feedback March 2010 • Filming Videos nano-learning January 2010	Nanokits offered as tool NANOYOU • Synchronise dilemmas • TIME4NANO network distributes NANOYOU's workshop/exhibition (CCSTI Grenoble)	-	• TIME4NANO sciences centers attend Open-Labs & Live-Areas • Scientist NANOTOUCH access NanOlympics results • TIME4NANO portal & NANOYOU+NANOTV

From/ to	NANOTV	NANOYOU	TIME4NANO	NANOTOTOUCH
NANOTOTOUCH	• 1st set three Videos received in July 09, for feedback September 09 • 2nd Set Videos in DE-cember 09, for feedback March 2010 • Filming 4 Videos nano-learning in January 2010	• scientist NANOTOT-OUCH visit NANOYOU schools • NANOTOTOUCH provides Open-Labs & Live-Areas for their Live Coverage and scientist for discussion with students	• NANOTOTOUCH provides Open-Labs & Live-Areas for their Live Coverage	-

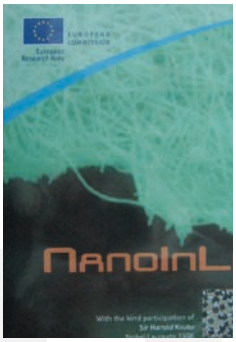
4.2.9 NanoIn Life DVD movie

This video is delivering a set of 'Supporting Stories' ready for media use, featuring some of the very best nanotechnology research and development results. It was officially presented at the EuroNanoForum2009 conference in Prague, 2-5 June 2009 (see Section 5.1.1). These supporting stories are the DVD's backbone, as told by Nobel Prize Professor Harry Kroto, who features here both as an excellent scientist and an enthusiastic communicator. The stories are spaced throughout the audiovisual production in a sequence resembling a travel of a young girl, Alice, through the real world of nanotechnology, and offering exciting snapshots of the future. A complex story is woven around the main present and future headlines of nanotechnology research and development; indeed, each chapter contains interviews with nanotechnology scientists and researchers explaining these findings.

Alice is meant to represent the future of EU citizens here. There is plenty of compelling story angles to portray the main possible applications of nanotechnology. The actors of these stories are both the creators of nanotechnology research and development and the people who could benefit from it: they are represented together as contributing to build a more desirable European society.

NanoInLife is the EC's third video addressing the general public, so it can be regarded as the latest chapter of a trilogy built on two previous DVDs produced over the past four years. The first was called: **Nano: The Next Dimension** and was addressing young audiences while the second, called **Nanotechnology**, targeted broader audiences with a general interest in science and technology. But a different editorial vision is proposed this time. NanoInLife's approach is based on telling **stories on research results through scientists' life and experience:** indeed, it's about **scientific facts through stories, and stories through real people,** which should ultimately be the answer to a basic, very simple question: *what should be filmed and communicated about nanotechnology?*

This is why this DVD is also an example of the appropriate communication criteria that should lead to the identification of projects, facts and people with potential audiovisual media appeal.



Nobel Prize Harry Kroto and little Alice in the nano-world feature this last chapter of the EC video trilogy on nanotechnology

4.2.10 EuroNanoMedicine

This conference was jointly organised by the three NMP FP6 Integrated Projects 'Nano-BioPharmaceutics', 'NanoEar' and 'MediTrans', as part of their dissemination activities. It was held at the end of September 2009 in Bled, Slovenia. It was also supported by the ETP Nanomedicine and Dechema, which took care of the logistics aspects. Improving the synergy between the three Integrated Projects and other EC-funded projects in the field of Nanomedicine was of the essence here. The conference, opened by Commissioner Potocnik, covered the hottest range of nanomedicine and therapeutic issues such as overcoming biological barriers, medical diagnostics and sensor devices, regenerative medicine, nanopharmaceuticals for gene delivery, and safety aspects of nanomaterials contained in medical applications. The audience attracted about 250 participants ([21]).

4.2.11 Annual Meeting of the Controlled Release Society

This was an important international event ([22]) for the pharmaceutical sector with an expected attendance of about 1800 participants, and took place between 18 and 22 July 2009 in Copenhagen. During the conference the EC gave a plenary presentation about Nanomedicine research in the Seventh Framework Programme. This conference gave full visibility to the EC's full commitment to nanotechnology and nanomedicine in FP7, the ETP Nanomedicine, calls for proposals and other ongoing activities.

4.2.12 Workshop on converging technologies and impacts on society

This forthcoming, dedicated workshop on public engagement on nanotechnology, which is expected to be held from April 2010 onwards, has already sparked a flurry of discussion around the key issues of converging technologies and their impacts on the whole of society. This is particularly important as converging technologies are the cutting edge of nanotechnologies, combining nano-bio-info-cognitive approaches, leading to a brand new neuroprosthetics industry. Some of the top experts in the field of industry, media, NGOs and investors will share success, best practices and challenging stories, with a view to taking part in consensus-making to foster sustainable design and use of converging technologies.

The leading theme of the converging technologies workshop will focus on 'converging humanities, education, science & technology' to establish an innovative, open, borderless

[21] See associated web pages online (http://events.dechema.de/euronanomedicine2009.html; http://www.nanobiopharmaceutics.org/; http://www.nanoear.org/; http://www.meditrans-ip.net/).

[22] See http://www.controlledrelease.org/meeting/ online.

think-tank among the best scientists and scholars, joining all available professional forces while inspiring and educating the young scientists as the future science leaders.

This vision wants to be a meeting place for outstanding professionals active in all fields of science, such as exact science, humanities, medical and life sciences, engineering. In the forum they will try to bridge the gap between their respective disciplines and bring together their know-how, thoughts, interests, research tools, barriers and dreams.

The workshop will create the setting for fruitful exchanges among some of the world's best scientists and leaders from both government and private industry. It aims to bringing about a creative and open-minded approach to science and give a big boost collaborative research. Last but not least, it will provide a forum for young scientists, too. Art-oriented people will also be encouraged to take up a leading role in science, which is a very novel approach for both artists and scientists. The workshop will be (i) s**urveying** stakeholders' position, values, concerns and expectations, communication models, cultural specificities, (ii) developing **new models and tools** for communicating, dialogue and engagement, (iii) ensuring **access and engagement** on ethical, social and legal dimensions of converging technologies and (iv) shaping a new **choice-making process** with stakeholders, by exchanging scientific cultures and precious foresight.

4.2.13 Second Implementation Report on Nanotechnology

The Commission expects to publish the second and last report on the implementation of its Nanotechnology Action Plan 2005-2009 by September 2009 (the first report was published in September 2007). The report will cover progress in all areas of the Action Plan, namely research, infrastructures, training, industrial innovation, societal issues, safety and regulation, international cooperation, and coordination of activities. Investment considerations in nanotechnology research will feature among the highlights of the report, with stronger focus on applications, industrial innovation and regulatory appropriateness. This ensures good progress in understanding potential risks and reviewing applicable legislation within a more engaging societal and international framework. At the same time, the report will identify areas where further work is needed to promote faster commercialisation of research output safely.

4.2.14 Second EC Action Plan on Nanotechnology (2010-2014)

Towards the end of the period covered by the present Nanotechnology Action Plan, a new Action Plan, covering the time span 2010-2014, is expected to be considered by the Commission. This new, very important document will build upon the progress made in the EU so far and will propose new actions. It is expected to be published after February 2010.

4.2.15 EC Communication Roadmap on Nanotechnology (2009-2011)

This document will cover the final period of the present Nanotechnology Action Plan and the beginning of the new Action Plan for 2010-2014. It will bridge the two policy documents on communication outreach and dialogue on nanotechnology, and is expected to be e-published via all relevant EC web pages and cross-links, National Contact Points and project networks.

4.2.16 Clustering and Mapping EC projects on Nanotechnology

This activity involves clustering and presenting in both publication and Web mapping formats most relevant nanotechnology research projects funded under FP6 and FP7. The resulting publication is expected by early 2010, while the associated mapping is likely to be published from mid 2010. About 150 projects will be presented in clusters, e.g. agrifood, electronics and Ict, industrial applications, nanomedicine (sub-divided in drug delivery, diagnostics and regenerative medicine), security, textiles, outreach, Ethical-Legal-Social Aspects (ELSA), Environmental and Human Safety (EHS), and Coordination and Support Actions (CSA). The project's performance will be assessed according to the following criteria: scientific challenge, technological achievements, achieved or expected prototypes, impacts on society, industrial relevance and impact, as well as impact on media. It will describe and represent in an eye-catching way the most relevant EC-funded nanotechnology projects according to their geographical, thematic and performance distribution.

4.2.17 European platform on Nano Outreach and DialoguE - NODE

EC research is investing yearly EUR 600 million on Nanotechnology, but in comparison very few reports are produced that bring these results to the attention of the public. Excellent results are there, but they have not been communicated yet. Objectivity, rather than subjectivity, is the issue in this project, aiming at developing an unambiguous Science-Technology-Social platform supporting a transparent and continuous dialogue exercise.

The outcome of all this communication work would feed back to researchers so as to increase their appreciation of what their work really means to the public.

A dedicated Internet platform for continuous dialogue with society will be put in place, possibly by 2011. The idea is to establish an Observatory for Nano-dialogue which

continuously monitors consumer opinion about nanotechnologies, as market surveys to understand trends in public opinion usually do.

This work will be supported by the socioeconomic research carried out by the projects mentioned in Section 4.2.7.5; these have been developing the tools to give the people the opportunity to get involved and express their opinion about a message or a product about nanotechnology. These tools range from systems mapping controversy to others for capturing and analysing random remarks. These tools will allow a technical democracy platform to be put in place: public opinion will be monitored on a continuous basis through Web-based measures that could be picked up by other media. In fact, communication activities previously developed (Sections 4.2.7.1 to 4.2.7.4, 4.2.8, 4.2.9) and development of adequate tools for dialogue (Sections 4.2.7.1 to 4.2.7.4, 4.2.3 and 4.2.7.5) will make the platform one of the most appropriate means to monitor what people really think about nanotechnologies and promote evidence-based dialogue.

Clearly, this is a media resource too. The idea is to shape the correct cognitive tools to monitor and capture public opinion, structure it, correlate it and transfer it into messages that policymakers would use for more effective policymaking. Regular conferences do not exhibit a trend, while on the Web it would be possible to monitor how opinions change, according to which socioeconomic group and geographic part of Europe. Results from honest, unbiased research will be made available not only to researchers or industries, but also to the whole of society (e.g. NGOs, media, consumers, citizens) in a way they can understand, to enable continuous monitoring of public opinion and feedback, to get the feel of what people really think. In this way, if something inappropriate is being done, prompt corrections are possible.

For instance, if people are clearly favourable to areas of nanotechnology other than in their food, research policy will have to take heed of such an opinion. In addition, if something very controversial comes up, a consultation from a formal point of view could be set up in this respect.

Public funded research requires the public to be always consulted, and the public would respond with informed feedback. In summary, initiating the dialogue and outreach and keeping them balanced, at the same level as the research, is the key issue.

This platform, whose target will be continuous dialogue with everybody, in 2011, would be based on already developed tools that monitor's public opinion, where Internet and online media will be mainstream. The European Commission will kick-start the platform, but then the Member States will have to be involved, to include associations in each Member State also as a part of the system.

Member States will have their own monitoring posts and conduct continuous surveys of public opinion. The questions may not be identical for everybody: local trend differences should be considered, though they will not change the initial architecture and aims. Clearly, the European Commission will initiate this technical-democracy based online dialogue but then it will belong to the public, hopefully supported by Member States.

FORUM OF EC COMMUNICATION PROJECT COODINATORS

INTERVIEW WITH MARIO MARTINOLI

Mario Martinoli,
Director of iCons Srl,
Coordinator of NANOTV project

'It's about a new multimedia model with wide coverage'

Q. What is the main novelty of NANOTV's communication model, also considering that you are a free content provider?

A. It's a multi-media model with uniquely wide coverage. We succeeded in placing ourselves among the mainstream broadcasting of European TV networks like an independent agency, reaching newsrooms and science programmes through Euronews, Eurovision and our own contacts. Providing free content Video News Releases is a rather uncommon feature in broadcasting, but this is tied to the very identity of our platform, http://www.youris.com, which represents the other half of our model and which we recently turned into an online science magazine with our own original, in-depth feature articles and interviews. As high quality content providers, we take the initiative to reach broadcasters with our VNRs and we have found this model works particularly well in increasing our outreach to new Member States, for instance. Our initial approach had been born out of the ambition to bring EC-funded European science research achievements into visual media, which we did for almost 10 years in many other research domains. But with NANOTV we are taking a step forward, because we want to focus on nanotechnology's major issues and on their ethical, legal and social implications in a balanced way.

Q. So the rather rare feature of your model is that you can reach a wider audience by fitting your free videos into news programmes.

A. Exactly. It's about reaching out to the general public. Since we provide high added value broadcasts always for free, many public service national TV networks plus a few national pay-tv channels use them on their news programmes or science magazines. Our balanced approach to science issues has always made sure that we are given access to the main TV gateways, and the spread of our distribution gives us this wide coverage which is the most innovative aspect of our model. Any of our Youris VNRs generates 7 or 8 million viewers on Euronews only, but thanks to our distribution we get to dozens of millions of viewers for each VNR altogether. We have good contacts even outside Europe. There are a couple of US satellite networks which request our VNRs regularly, and I know our videos have been downloaded by TV channels as far as Venezuela and Vietnam. All in all, we reach out to over 40 countries.

Q. How is your video material and voiceover used by TV networks?

A. We send them a 3-4 minute 'teaser' with a voiceover in English, which is our own finished short narrative, plus the so-called B-rolls, meaning 12-minute long selected footage without any voiceover. It's then up to the TV networks to decide how to edit the footage, but it has to be said that our messages are always clear in either our teasers or B-rolls. In the case of NANOTV, we will also go beyond the research projects with our original features and articles about the bigger nano debate out there. Obviously the TVs will also be able to make use of this written material at the same time as our VNRs.

Q. Is your approach to nanotechnology communication aiming to inform the public at the same time as the research and developments come along?

A. This is our ambition. Nanotechnology is evolving very rapidly and cannot be compared to other, more stable and slow-developing technologies. It is among us already in some cosmetics, water filtration systems and biomedical sensors, but most of us are not aware of this yet. We want to keep the pace with nano discoveries just as they happen. I also feel that nanotechnology is innovative to such an extent, that it is likely to produce many spin-offs rapidly. We have also found out that, although we think globally, we often resonate with networks on a local level as well. In the past, for instance, our videos about water filtration were also downloaded by some TV channels in North Africa.

Q. European research success stories about nanotechnology will also become the 'pegs' on to which to attach a wider debate about nano applications and implications.

A. We can already say that one of the strong clusters of our editorial plan will be about nanomedicine, but we have also identified several cross-over topics such as nanoparticles and bio-mimicry. We are sure we are going to identify a series of very interesting nano stories, covering different points of view about S&T and the societal, ethical and legal aspects of nano in a balanced way. These stories also confront us with the fact that some of these developments are already causing so many hopes and expectations. The dialogue is going to start from our VNRs and written articles, which will be distributed to the TVs and the European printed and online press. It is going to take its initial shape on http://www.youris.com in the form of an exchange of opinions between a nano-scientist who will be chosen every month to answer selected questions by our audience on each video-related issue.

Q. Which direction would you like your communication model to take after 2011?

A. We have been in science communication since 1998 and our capacity for success has always depended on us having a dynamic model. So, from the end of 2009 we are also going to integrate Web 2.0 into our distribution model in order to widen our outreach beyond TV. So far it was generally assumed that people would watch a programme on TV first and go back to the Web to learn more later. We want to try and reverse this model now, by using Twitter and Facebook to inform people that on a certain date and time they can turn on their TV to watch one of our VNRs. Turning the interaction between Web and

TV around does look like a highly innovative communication model to me now. This way, the Web audience would migrate towards TV and back to the Web, of course, to debate the issues and go deeper. We would really like to try and do this through http://www.youris.com, perhaps by setting up cooperation with other European online newspapers as well, which would establish a new interactive model.

INTERVIEW WITH ULRICH KERNBACH

Ulrich Kernbach,
Director of International Cooperation at the Deutsches Museum in Munich, Coordinator of NANOTOTOUCH project

'Merging communication and research is the formula for Open Nano Labs'

Q. What were the main reasons behind your choice of setting up permanent Open Nano Labs and Nano Researcher Live Areas?

A. The European Science museums are a huge community under the roof of Ecsite, together with smaller institutions such as Science Centres. Museums normally have a collection, whereas science centres tend to deal more with the interactive part and hands-on exhibits. In order to introduce a new form of nano-communication, we aimed to gather as many partners as we could. So we brought together institutions such as the Deutsches Museum in Munich, the Museo Nationale della Scienza e della Tecnologia Leonardo da Vinci in Milan and the Universeum in Gothenburg, where we can have fully equipped and working Nano Labs because the settings allow for that, with institutions such as the AHHAA Science Centre in Tartu, the Città della Scienza in Naples and Technopolis in Mechelen, whose Nano Researcher Live areas will engage University researchers into public nano-debates and present their work or part of their equipment to the visitors.

As far as the Nano-Labs go, they are provided by the local Universities, and indeed one of the strong points of the project is this quite unique and close collaboration with the academic world. We have learnt from experience we need to have between one and three researchers permanently on site carrying out their work but also communicating with the visitors about what they are doing. The researchers may be local PhD students and they usually rotate every three months or so. We are convinced this will have an effect on further collaboration with Universities and could open up a new educational approach to develop together in the future. We will surely learn from each other.

Q. Could you name an experiment that can be carried out in the Open Nano Lab, which does not have to be under controlled conditions?

A. For public safety reasons, you could not have, for instance, a fully working, open chemistry lab inside a museum. But with nanotechnology, you can certainly have, for example, a scanning tunnelling microscope, which is a wonderful tool posing no safety problems whatsoever in such a setting.

Q. How did you set out to merge communication and research?

A. In Munich we have just a low glass pane separating the research area from the public. The principle is that people can really be in touch with the researchers. In the same environment we will have a small exhibition of nano products, some basic information about nanotechnology, films on the screen by NANOTV and other projects, and demonstrations on a regular basis such as experiments with ferromagnetic pigments, nanoparticles and nanodust. Of course the real face-to-face dialogue can start there, which is the most important part of the whole project. The questions can range from 'How did you choose a career in nano-science?' to 'What are the ethical and societal implications of your work?', to health and safety aspects. You can imagine a young scientist at the end of his studies talking to visitors under 25 years of age, which represent the bulk of our science museum public. A huge amount of young visitors will embrace this very powerful peer-to-peer communication tool, as they will be talking to people who are almost their age. Of course these young researchers, who have been trained in communication through our workshops, can act as role models for youngsters who are deciding which career to choose. Among the outcomes of the project there will be a handbook for researchers containing recommendations on how to develop a nano lab, which will be based on such workshops. Our researchers need to be able to answer all questions, and be open about them. Our researcher Paul Hix met one couple who questioned him for a whole afternoon and came back the next morning with some more queries.

Q. What impact do you expect your project will have on EU society and communication?

A. First, we expect a change inside the research community, as it will find out that communication is part of its research identity. The research community should be able to make society aware of what it is accomplishing, in order to inform people about the way it is using taxpayers' money. Not every researcher has to be a perfect communicator, but it's absolutely necessary to find people that are willing to do it, as it's very important to overcome the gap between the academic world and society. The other effect, as I said, is that this new model can have a strong effect on young people's career choices: it could give them an idea of what is possible and introduce researchers as role models. We know Europe does not have enough young scientists and researchers, and nano will be one of the key technologies to come, so this is about the future. I hope this very helpful approach by the EC's Nano and Converging Technologies Unit, which listened to players in the field before structuring calls on nanotechnology communication, will go on, as it maintains a direct link between research and communication.

Q. How do you see the future of your nano communication activities after 2011?

A. Here at the Deutsches Museum we will open a huge exhibition of more than 2,500 square meters for new technologies. We will move the NanoLab, which we have had over the last 3 years, to the museum and we will have a huge exhibition about nanotechnology, which will be the most important part of this initiative. We are currently involved in other projects co-funded by the EC, the NanoMedRoundTable whose outcome will be a set of recommendations to support decision making regarding nanomedical innovations. We will use the discussion coming out of this in one way or the other for our exhibition. And we are, of course, part of the TimeForNano project. Finally, here at the Deutsches Museum we have a huge research programme in the field of communicating nanotechnology. Due to our many initiatives in this respect, after 2011 we hope we will also become the platform for communication outreach of nanotechnology at a national level.

INTERVIEW WITH YOEL ROTHSCHILD

Yoel Rothschild,
Director of Moshinsky R&D Center, ORT Israel,
Coordinator of NANOYOU project

'Involving students from at least 20 countries is going to have a ripple effect'

Q. You have over 400 European schools on board of your educational project, which is a very broad target. Which characteristic of NanoYou do you regard as the most important?

A. The aspect that makes us unique is that we are targeting school students and interacting with them directly. We are doing this, of course, through an excellent partner, the European Schoolnet or EUN, which is going to appoint the coordinators in our pilot schools. The 11-18 age group will be addressed through involvement in middle and high schools and the 18-25 age group through science centres throughout Europe. We aim to train science teachers in at least 15-20 EU countries. Our educational package will be transferred to the students via a short school programme or a one-day festival on nanotechnology. The issues will include not just the technological developments but also an assessment of the benefits and potential risks and ELSA issues. The whole exercise will involve more than 25,000 students. One of our aims is to encourage the next generation of nanotechnology scientists and engineers.

Q. This will allow you to spread your network by branching out considerably. How are the teachers going to report back to you?

A. The challenge of NanoYou is that no teachers are specially trained to teach nano. So we are involving experienced science teachers, well versed in classical sciences and modern areas like biotechnology and so on, who are able understand the language of nanoscience and nanotechnology. Since nanotechnology is so complicated, we are collecting good stories and scientific case studies about nano innovation, such as energy, medicine and so on, and we are including them in a kit of basic knowledge about nano that has been put together for us by two of our partners, the Nanoscience Centre of the University of Cambridge and the Interdisciplinary Nanoscience Center at the University of Aarhus in Denmark. In our package there are plenty of dialogue instruments the students can use, from the NanoTimeMachine to other virtual games, such as role play and card games. Our aim is to inform and engage the students. We should get the report from the teachers through the pilot school coordinator and through student work which will be placed on the project's Web portal.

Q. What is your own approach to nanotechnology communication?

A. Very few young people know what nanotechnology really means. We want them to be prepared to make their own decision about the benefits and risks of tnano innovations to come, and understand that nanotechnology is one of the real future challenges for the whole of society and a huge area for science and technology innovation. Interest and knowledge are likely to snowball as a group of interested schoolchildren gradually builds up. We want to contribute and build the next generation of nanotechnology scientists.

Q. Could you tell me more about your virtual activities, such as the Nano Time Machine game?

A. Nanotechnology is a very young area of science, and we want to highlight its progress and its place as a station on an ideal route along the history of science. The Nano Time Machine is a route with a lot of stops along it. This, along with our other activities such as the virtual exhibition, will be available on Internet, in science centres and in the schools. We are lucky there are three parallel projects with a lot of cross-fertilisation opportunities, such as NanoTV, TimeForNano and NanoToTouch, so we can use a lot of their materials too. We also hope to produce a virtual simulation of a nano laboratory, which is quite sophisticated, and all the more necessary since in schools you cannot have real ones because of the high cost, and also for health and safety reasons.

Q. Your Nano Speakers' Corner, with 10 different chosen nano-dilemmas, almost resembles theatre role play.

A. We want all our dialogue to be based on real scientific, sound knowledge. This is the way we would like to discuss the benefits and risks of nano innovations. Take the example of nano-socks for sportswear: by introducing nanoparticles into the fabric they would not

smell anymore. But nobody understands at the moment if there could be some potential risks of nanoparticles going through the skin slowly, or if the risk can be dealt with. We would like students to take up such an issue and have a real debate about it, together with scientists, people from the industry, the health and safety sector, consumers' organisations, or the academic world. It would be a proper panel with real people. We are giving the schools quite flexible guidelines, with teachers having the opportunity of taking up a role, like actors. You can certainly call it nano-theatre. It will take place in classes, where it will be more organised. It is really an introductory project to get young people involved in nano and initiate the first stage of dialogue and discussion about it. It doesn't really matter what comes first, whether the dilemmas or the basic knowledge, because a good story will provide good discussion and good learning anyway. We need to be clever in finding a way to create a good attitude to talk about nano.

Q. And you want to leave the debate quite open, and take care of all the viewpoints.

A. Absolutely. We are now being given the opportunity to be linked to many other European organisations and projects. For instance, there is an excellent group in Cork, Ireland, working on neuronano. We could give them access to our schools and have that aspect debated by the NanoYou students. On the Internet, as well, we are being accessed by lots of science centres and organisations around Europe that would like to support our activities.

Q. So your NanoSpeakersCorner is the right place to do it.

A. That's right. It is just the perfect chance for all these people to come and introduce nano issues and challenges to the schools. We also want to get back to proper face-to-face interaction.

Q. What do you think your added value to European society and communication is going to be?

A. I think the most important thing is that we are going into schools to involve 25,000 students who are, in turn, going to talk to their parents and friends as well. Many young people will start thinking about developing a career in nanotechnology and many teachers are going to be exposed to nanotechnology. We are sure the impact across Europe will be tremendous. It's going to have a ripple effect.

Q. How do you see the future of your activities after 2011?

A. If there is a second stage, we would like to develop a full curriculum subject in nanotechnology: to design the textbooks and the experiments. I envisage we could involve the students from Grade 8 onwards, teenagers around 13-14 years of age. In this case the link to universities and the industry should be very strong. Also, there should be a pan-European schoolteacher training college for nanotechnology education.

INTERVIEW WITH LUIGI AMODIO

Luigi Amodio,
Director General of Idis-Città della Scienza Foundation in Naples,
Coordinator of TIMEFORNANO and NANODIALOGUE projects

'Visual NanOlympics are a creative way to tackle nano-dilemmas'

Q. You have devised the NanOlympics, nano-kit and nano-days to show the potential applications of nanotechnology. Which educational needs do these activities respond to?

A. Against the background of what is being done in Europe and abroad in communication technologies, there are two problems to be solved: the first is about basic knowledge of nano; the second lies in popular imagination, where nanotechnologies have somehow become threatening even before reaching a widespread application level, as you will remember from Michael Crichton's novel *Prey* which configures a series of catastrophic scenarios.

The solution to the first problem is to inform people, the young generation in particular, by introducing them to non-banal concepts of quantum physics, chemistry and the study of matter. The other problem can be tackled by opening a mechanism of dialogue with people immediately, so they can understand how acceptable nanotechnologies may be to them.

The starting point for us, ever since the Nanodialogue project, is to elicit a reaction even before these technologies enter everyone's lives to such a degree that you won't be able to do anything else but accept them. It's surely fair that the discussion about publicly funded research is shared by as many people as possible. So we defined a formula to generate a discussion about possible scenarios, which was translated into an exhibition and related events that toured a number of museums taking part in that first project between 2005 and 2007.

Now with TimeForNano we have started looking at targeting young people mainly between the ages of 10 and 19, although everybody is welcome, in a more direct way on two fronts. We shall start from schools, to which we will deliver our nano-kit, containing an array of real and virtual activity tools; the other front is the Web, with the NanOlympics first of all, a European competition that will stimulate a creative debate about 5 nano-dilemmas. Not by chance we have Brida, a Slovenian society of artistic productions, as a partner for designing the interactive and Web part of the project. The results should be

really exciting. On nano-days, which will be like small science festivals, we would very much like to involve the media as well.

Q. How will the nano-scripts, the nano-exhibits and the card games in the kit keep youngsters' creativity flowing?

A. We will simulate some nanotubes or other nanostructure properties at a macro level. Most probably we will also include some real samples of nanotechnology-containing materials, such as water-repellent textiles, or anti-mist Plexiglas. For card games we have chosen a kind of well-tested role play that will allow youngsters to receive more structured information (for instance, about nano-investments across different countries and the different application areas of nano) and to take a stand about controversial matters. The idea is to provide schools with a series of materials and activities similar to those we use in museums. The nano-kit will be translated into the different languages of the nine European countries taking part in the project. But a further 100 copies in English will be made available to Ecsite, which will then send them on to whoever will request them, so hopefully these will also go out to other countries.

Q. How will young people be able to take part in the online activities?

A. There will be discussion forums and information materials in different languages, but above all the NanOlympics will require young people and classes to create the products by which they will play this game. Again, the participant countries will be able to enter this competition. With TimeForNano we want to go beyond the classic museum audience, and in cooperation with NanoTV, NanoToTouch and NanoYou we will expand our multiplier capacity even further. We find it really interesting that the European Commission has created this cluster of communication outreach projects, because we can see there will be a lot of mutual benefits to be drawn out of this collaboration network: this critical mass will strengthen all of us. I believe the visual languages of the Web, video clips and some TV can communicate and stimulate, say, a 17-year-old's creativity in a much more direct way. All activities will start at the beginning of the forthcoming school year in September. The NanOlympics final results should be available next May, but we will also work throughout the 2010-2011 school year.

Q. Talking about multipliers, your project will have over 450 of them, with teachers featuring prominently in this category.

A. Teachers are among the main users of science museums and we are very used to working with them. They are the ideal interface with youngsters. Public debate about nano is not as strong as that about biotechnology yet, but I do not doubt we will get a very good response from them. Teachers are also very interested in using new science teaching methods, as they realise the current ones leave a lot to be desired everywhere in the world. Among the multipliers, we are also talking about museums, of course, and their capacity to reach real and virtual visitors, too. Ecsite is obviously a very important subject in all this.

Q. How would you describe your public engagement approach to nanotechnology communication?

A. It is our very same approach to many other subjects: as science museums, we don't just want to be places of communication, but of engagement as well, at different levels of depth. We always aim to stimulate young people to ask questions to aid their development of the critical attitude which lies at the very foundation of the scientific method. With adults, of course we can discuss contents directly in an easier way. We also aim to involve public institutions and the world of research in dialogue.

Q. How do you see the future of your communication activities after 2011?

A. I believe we should aim for cross-Continental collaboration. We are in contact with the NISE network of US science museums working on nano. We should think about setting up nanotechnology communication projects bringing together European with American or Asian counterparts, e.g. with the US or Japan, for instance. I do feel very excited at the idea of building global projects.

PART V. WHERE AND WHEN IS IT HAPPENING?

A SOUND SCHEDULE FOR THE COMMUNICATION ROADMAP

Table 14. EC 'Communication and Dialogue Menu' on nanotechnology

CALL TO ACTION

TARGET MULTIPLIER- AUDIENCE

A. SCHOOLS	B. SCIENCE CENTRES	C. MEDIA	D. SCIENTISTS - INDUSTRY - BUSINESS	E. NGOs	F. POLICYMAKERS
1. **EDUCATIONAL: TV** audiovisuals on nanomedicine, nano-environment, nanoenergy, nano-learning: broadcast on **40 major EU/AS TV networks** and http://www.youris.com website (three video teasers on nanomedicine, nano-environment, nano-energy from July 2009, on nano-learning from July 2010)	1. **ECSITE Conference** (Milan, 2-6 June 2009) **Participative workshop** on EC policy and projects on communicating nanotechnology (6 June)	1. **ECSITE Conference** (Milan, 2-6 June 2009) **Participative workshop** on EC policy and projects on communicating nanotechnology (6 June)	1. **EuroNanoForum 2009** (Prague, 2-5 June 2009)	1. **EuroNanoForum 2009** (Prague, 2-5 June 2009)	1. **EuroNanoForum 2009** (Prague, 2-5 June 2009)
2. **EDUTAINMENT:** (400 schools of 27 EU/AS countries, from December 2009 (1st stage) and from June 2010 (2nd stage) until 2011 and beyond):	2. **Participative workshops in EU cities** (Grenoble, Paris, Barcelona from November 2009 to March 2011):	2. **EuroNanoForum 2009** (Prague, 2-5 June 2009)	1.1 – **Participative workshop** between EC projects on communicating nanotechnology (5 June)	1.1 – **Participative workshop** between EC projects on communicating nanotechnology (5 June)	1.1 – **Participative workshop** between EC projects on communicating nanotechnology (5 June)
2.1 – **Videos, posters, presentations** (nano-kits, travelling expo, lab-in-school) from 2010; prototypes monthly presented in Science Centres from December 2009 (1st stage) and June 2010 (2nd stage)	2.1 – FUTU: participative workshop producing **15 videos on nanotech scenarios** (Grenoble, Paris, Barcelona, from November 2009 to March 2011)	2.1 – **Participative workshop** between EC projects on communicating nanotechnology (5 June)	1.2 – **NanoInLife DVD** (2-5 June)	1.2 – **NanoInLife DVD** (2-5 June)	1.2 – **NanoInLife DVD** (2-5 June)
2.2 – **Workshop** 'WHAT IS NANO?' from December 2009 (1st stage) and June 2010 (2nd stage)	2.2 – SITU: **photo contest on ubiquitous nanotechs (**Grenoble, Paris, Barcelona, from February 2010)	2.2 – **NanoInLife DVD** (2-5 June)	1.3 – **three video teasers** on nanomedicine, nano-environment, nano-energy (2-5 June)	1.3 – **three video teasers** on nanomedicine, nano-environment, nano-energy (2-5 June)	1.3 – **three video teasers** on nanomedicine, nano-environment, nano-energy (2-5 June)
2.3 – **Virtual exhibitions** from December 2009 (1st stage) and June 2010 (2nd stage)	2.3 – **daily environment investigation** science centres in 12 EU/AS countries: from January 2010 (1st stage) and from August 2010 (2nd stage)	2.3 – **three video teasers** on nanomedicine, nano-environment, nano-energy (2-5 June)	1.4 – **Two articles and poster** presentations on EC communication projects	1.4 – **Two articles and poster** presentations on EC communication projects	1.4 – **Two articles and poster** presentations on EC communication projects
2.4 – NANO **Time-Machine video-game** from December 2009 (1st stage) and June 2010 (2nd stage)	2.4 – **real size experiments** science centres in 12 EU/AS countries: from January 2010 (1st stage) and from August 2010 (2nd stage)	2.4 – **Two articles and poster** presentations on EC communication projects	2. **ECSITE Conference** (Milan, 2-6 June 2009)	2. **ECSITE Conference** (Milan, 2-6 June 2009)	2. **High Level Expert Group** (Brussels, February and June 2009)
	2.5 - **nano-user conferen**ce science centres in 12 EU/AS countries: from January 2010 (1st stage) and from August 2010 (2nd stage)	3. **Second EC Implementation Plan on nanotechnology** (Brussels, from September 2009)	**Participative workshop** on EC policy and projects on communicating nanotechnology (6 June)	**Participative workshop** on EC policy and projects on communicating nanotechnology	3. **Five** ad hoc **Industrial Advisory Group** workshops (Brussels, July 2009)
		4. **EC Action Plan for nanotechnology** (Brussels, from December 2009)	3. **High Level Expert Group** (Brussels, February and June 2009)	3. **Second EC Implementation Plan on nanotechnology** (Brussels, from September 2009)	4. **Second EC Implementation Plan on nanotechnology** (Brussels, from September 2009)
		5. **NANO4YOU Workshop on public engagement** in nanotechnology (Brussels, from March 2010)	4. **Five** ad hoc **Industrial Advisory Group** workshops (Brussels, July 2009)	4. **EC Action Plan 2010-2014 for nanotechnology** (Brussels, from December 2009)	5. **EC Action Plan 2010-2014 for nanotechnology** (Brussels, from December 2009)
		6. **CORDIS web page** and leaflet (Brussels, from March 2010)	5. **36th Annual Meeting and Exposition of the Controlled Release Society** (Bella Center, Copenhagen, 18-22 July 2009)	5. **Future FP7 Calls for proposals and related actions** on communication and engagement (Brussels, from February 2010)	6. **Future FP7 Calls for proposals and related actions** on communication and engagement (Brussels, from February 2010)
			6. **EuroNanoMedicine** (Bled, Slovenia, 26-28 September 2009)	6. **CORDIS web page** and leaflet (Brussels, from March 2010)	7. **CORDIS web page** and leaflet (Brussels, from March 2010)

TARGET MULTIPLIER- AUDIENCE

A. SCHOOLS	B. SCIENCE CENTRES	C. MEDIA	D. SCIENTISTS - INDUSTRY - BUSINESS	E. NGOs	F. POLICYMAKERS
2.5 - Workshop **'Role Play'** from December 2009 (1st stage) and June 2010 (2nd stage) 2.6 – **Virtual Dialogue Toolbox** on Nano from December 2009 (1st stage) and June 2010 (2nd stage) 2.7 – **Training** via school-curricula through EU/AS SchoolNet from December 2009 (1st stage) and June 2010 (2nd stage) 2.8 – **Nano-kit** from December 2009 2.9 - Creativity-based EU/AS-wide contest **NanOlympics** (from January 2010) 2.10 – **educational training programmes** for students one-day or modular (from February 2010) 2.11 – **educational training books and programmes** for teachers (from February 2010) 2.12 – **Open-Nano-Lab to schools** (science centres in Milan (IT) and Gothemburg (SE) from March 2010, Munich (DE) from 2009), other EU locations from 2010)	2.6 - **travelling exhibition** from science centres in 12 EU/AS countries: from January 2010 (1st stage) and from August 2010 (2nd stage) 3. **Participative activities in EU/AS science centres** from December 2009, August 2010 to March 2011: 3.1 – **Nano-kit** (science centres in 12 EU/AS countries: from December 2009) 3.2 – Creativity-based EU/AS-wide contest **NanOlympics** (from January 2010) 3.3 – **educational training programmes** for students one-day or modular (400 schools from 27 EU/AS countries from February 2010) 3.4 – **educational training books and programmes** for teachers (schools from 12 EU/AS countries from February 2010) 4. **Open-Nano-Lab** (science centres in Milan (IT) and Gothenburg (SE) from March 2010, Munich (DE) from 2009), other EU locations from 2010) 5. **Nano Researcher Live-Area** (science centres in Mechelen (BE, Tartu (ET), Naples (IT) from October 2009)	7. **Workshop on converging technologies** (Brussels, from April 2010) 8. **Fourteen TV audiovisuals** on nanotechnology broadcast on **40 major EU/AS TV networks, Web platforms and newspapers (e.g. http://www.youris.com)** (from July 2010) 9. **DEEPEN, NANO-CAP NANOPLAT, FRAMING-NANO, MACOSPOL, NODE deliberative processes for stakeholders' dialogue** in nanotechnology (Belgium, Czech Republic, Germany, Italy, Netherlands, Portugal and UK, from 2009 to 2010; NODE in most Member States from 2011) 10. **EC Communication Roadmap on nanotechnology (2009-2011);** Brussels, from October 2009 11. **Clustering and Mapping EC projects on Nanotechnology**, Brussels, from April 2010	7. **Second EC Implementation Plan on nanotechnology** (Brussels, from September 2009) 8. **EC Action Plan 2010-2014 for nanotechnology** (Brussels, from December 2009) 9. **Future FP7 Calls for proposals and related actions** on communication and engagement (Brussels, from February 2010) 10. **CORDIS web page** and leaflet (Brussels, from March 2010) 11. **NANO4YOU Workshop on public engagement** in nanotechnology (Brussels, from March 2010) 12. **Workshop on converging technologies** (Brussels, from April 2010) 13. **Fourteen TV audiovisuals** on nanotechnology broadcast on **40 major EU/AS TV networks, Web platforms and newspapers** (e.g. youris.com (from July 2010) 14. **DEEPEN, NANO-CAP NANOPLAT, FRAMING-NANO, MACOSPOL, NODE deliberative processes for stakeholders' dialogue** in nanotechnology (Belgium, Czech Republic, Germany, Italy, Netherlands, Portugal and UK, from 2009 to 2010;	7. **NANO4YOU Workshop on public engagement** in nanotechnology (Brussels, from March 2010) 8. **Workshop on converging technologies** (Brussels, from April 2010) 9. **Fourteen TV audiovisuals** on nanotechnology broadcast on **40 major EU/AS TV networks, Web platforms and newspapers** (e.g. http://www.youris.com (from July) 10. **DEEPEN, NANO-CAP NANOPLAT, FRAMING-NANO, MACOSPOL, NODE deliberative processes for stakeholders' dialogue** in nanotechnology (Belgium, Czech Republic, Germany, Italy, Netherlands, Portugal and UK, from 2009 to 2010; NODE in most Member States from 2011) 11. **EC Communication Roadmap on nanotechnology (2009-2011)**; Brussels, from October 2009 12. **Clustering and Mapping EC projects on Nanotechnology,** Brussels, from April 2010	8. **NANO4YOU Workshop on public engagement** in nanotechnology (Brussels, from March 2010) 9. **Workshop on converging technologies** (Brussels, from April 2010) 10. **Fourteen TV audiovisuals** on nanotechnology broadcast on **40 major EU/AS TV networks, Web platforms and newspapers** (e.g. youris.com (from July) 11. **DEEPEN, NANO-CAP NANOPLAT, FRAMING-NANO, MACOSPOL, NODE deliberative processes for stakeholders' dialogue** in nanotechnology (Belgium, Czech Republic, Germany, Italy, Netherlands, Portugal and UK, from 2009 to 2010; NODE in most Member States from 2011) 12. **EC Communication Roadmap on nanotechnology (2009-2011)**; Brussels, from October 2009 13. **Clustering and Mapping EC projects on Nanotechnology,** Brussels, from April 2010

CALL TO ACTION

TARGET MULTIPLIER- AUDIENCE

A. SCHOOLS	B. SCIENCE CENTRES	C. MEDIA	D. SCIENTISTS - INDUSTRY - BUSINESS	E. NGOs	F. POLICYMAKERS
2.13 – **Nano Researcher Live-Area open to schools** (science centres in Mechelen (BE, Tartu (ET), Naples (IT) from October 2009) 3. **CORDIS web page** and leaflet (from March 2010) 4. **EC Communication Roadmap on nanotechnology (2009-2011)**; Brussels, from October 2009	6. **Nano-Days, festivals, nano-cafés** (science centres of 20 EU/AS from November 2010) 7. **Future FP7 Calls for proposals and related actions** on communication and engagement (Brussels, from February 2010) 8. **CORDIS web page** and leaflet (Brussels, from March 2010) 9. **Fourteen TV audiovisuals** on nanotechnology displayed in 20 major EU/AS science centres (from July 2010) 10. **EC Communication Roadmap on nanotechnology (2009-2011)**; Brussels, from October 2009		NODE in most Member States from 2011) 15. **EC Communication Roadmap on nanotechnology (2009-2011)**; Brussels, from October 2009 16. **Clustering and Mapping EC projects on Nanotechnology,** Brussels, from April 2010		

WITH WHAT EFFECT

TARGET MULTIPLIER- AUDIENCE

A. SCHOOLS	B. SCIENCE CENTRES	C. MEDIA	D. SCIENTISTS - INDUSTRY - BUSINESS	E. NGOs	F. POLICYMAKERS
• **stimulate curiosity, interest, educate on nanotechnology** • **provide simple and realistic** information: what is nano? A science, not magic	1. provide attractive support to perform as active multipliers in cities and schools (via art festival, theatre, movies, games exhibitions and activities)	• set up a image and film database on nano • develop a neutral resource centre on nano • develop person-to-person relationship building initiatives between journalists of all specialties and nano scientists,	• provide viable and smart Internet resources • develop product labelling with a special logo indicating the presence of nanotechnology treated products • develop mouth-to-mouth marketing and	• promote the creation of platforms and forums linking scientists to NGOs • develop pairing scheme to provide permanent connections between groups	• create continuous channels of communication outside crisis • provide info on different levels for local, national or specialised decision makers

WITH WHAT EFFECT

TARGET MULTIPLIER- AUDIENCE

A. SCHOOLS	B. SCIENCE CENTRES	C. MEDIA	D. SCIENTISTS - INDUSTRY - BUSINESS	E. NGOs	F. POLICYMAKERS
• show how knowledge is growing and evolving, nothing is fixed • **stimulate** critical thought on societal and ethical implications of nanotechnology • stimulate interest in science careers and increase knowledge of opportunities in science • create responsible citizens • educate with fun • **stimulate curiosity** using perception, body language, dance and art • **foster user-oriented** approach answering the question: why is this interesting for me • exchange information on EC actions in nanotechnology and related web pages	• exhibitions in cultural centres, science centres, edutainment • events in schools • games, cartoons • nano fairs, theatre, festivals • the Internet, TV-radio-media • friendly guide, mascot or sympathy figure to show children the nano world • Internet platforms, podcasts/trendy media • organised debates • celebrity testimonials on science issues • bringing famous scientist to schools • festivals • contests for video and creative art productions • theatre productions • edutainment interactive applications – hands-on experiments • visit to labs/experimenting/stage experiments/ dialogue • open labs, out-campus events, real lab guided tours contact with scientists, internships, orientation fairs, EC stands • theatre, games, shows	ethicists, social scientists, NGOs, etc. • set up crossover shadowing /work placement opportunities • set up events/discussion events developed in partnership with media	product demonstration long term perspective • promote communication training for natural and social scientists trough seminars, courses, summer schools • promote meetings between natural, social scientists and communicators • prepare presentations for senior scientists – interview coaching • promote real hands-on experiences	• guarantee green quality markers for laboratories who reach pre-defined standards of safety in handling nano-products	

OUTREACH (E= end audience, i.e. citizens) - OUTPUT: coverage - OUTTAKE: Feedback - OUTCOME: dialogue

TARGET MULTIPLIER- AUDIENCE

A. SCHOOLS	B. SCIENCE CENTRES	C. MEDIA	D. SCIENTISTS - INDUSTRY - BUSINESS	E. NGOs	F. POLICYMAKERS
1. **EDUCATIONAL:** Coverage: 630 kE for 5 minutes Feedback: 422 kE Dialogue (web pages): 105 kE	1. **ECSITE Conference** (Milan, 2-6 June 2009)	1. **ECSITE Conference** (Milan, 2-6 June 2009)	1. **EuroNanoForum 2009** (Prague, 2-5 June 2009)	1. **EuroNanoForum 2009** (Prague, 2-5 June 2009)	1. **EuroNanoForum 2009** (Prague, 2-5 June 2009)
2. **EDUTAINMENT**	• Coverage: 15 kE	**Participative workshop** on EC policy and projects on communicating nanotechnology	• Coverage: 13.5 kE	• Coverage: 9 kE	• Coverage: 1.3 kE
• Coverage: 3925 kE (directly 400 schools, 200 indirectly, 650 students each)	• Feedback: 12 kE	• Coverage: 50 kE	• Feedback: 8 kE	• Feedback: 5 kE	• Feedback: 800 E
• Feedback: 2653 kE	• Dialogue: 6 kE	• Feedback: 12.5 kE	• Dialogue: 4 kE	• Dialogue: 2.7 kE	• Dialogue: 400 kE
• Dialogue: 560 kE	2. **Participative workshops in EU cities** (Grenoble, Paris, Barcelona)	• Dialogue: 2.5 kE	1.1 - **Participative workshop** between EC projects on communicating nanotechnology (5th June)	1.1 - **Participative workshop** between EC projects on communicating nanotechnology (5th June)	1.1 - **Participative workshop** between EC projects on communicating nanotechnology (5th June)
2.1 - **Videos, posters, presentations**	• Coverage: 856 kE	2. **EuroNanoForum 2009** (Prague, 2-5 June 2009)	1.2 - **NanoInLife DVD** (2-5 June)	1.2 - **NanoInLife DVD** (2-5 June)	1.2 – **NanoInLife DVD** (2-5 June)
• Coverage: 76 kE	• Feedback: 581 kE	• Coverage: 37.5 kE	1.3 - **Three video teasers** on nanomedicine, nano-environment, nano-energy (2-5 June)	1.3 – **Three video teasers** on nanomedicine, nano-environment, nano-energy (2-5 June)	1.3 – **Three video teasers** on nanomedicine, nano-environment, nano-energy (2-5 June)
• Feedback: 57 kE	• Dialogue: 132 kE	• Feedback: 9 kE	1.4 – **Two articles and poster** presentations on EC communication projects	1.4 – **Two articles and poster** presentations on EC communication projects	1.4 – **Two articles and poster** presentations on EC communication projects
• Dialogue: 51 kE	2.1 – FUTU: participative workshop producing **15 videos on nanotech scenarios** (Grenoble, Paris, Barcelona)	• Dialogue: 2 kE	2. **ECSITE Conference** (Milan, 2-6 June 2009)	2. **ECSITE Conference** (Milan, 2-6 June 2009)	2. **High Level Expert Group** (Brussels, February and June 2009)
2.2 - **Workshop**	• Coverage: 3 kE (30 people per session, 300 via Web per 3 locations for about two years)	2.1 – **Participative workshop** between EC projects on communicating nanotechnology	**Participative workshop** on EC policy and projects on communicating nanotechnology (6th June)	**Participative workshop** on EC policy and projectson communicating nanotechnology	• Coverage: 1.2 kE
• Coverage: 76 kE	• Feedback: 2 kE	2.2 – **NanoInLife DVD**	• Coverage: 7 kE	• Coverage: 7 kE	• Feedback: 600 E
• Feedback: 57 kE	• Dialogue: 500	2.3 – **Three video teasers** on nanomedicine, nano-environment, nano-energy	• Feedback: 4 kE	• Feedback: 4 kE	• Dialogue: 240 kE
• Dialogue: 23 kE	2.2 – SITU: **photo contest on ubiquitous nano-techs** (Grenoble, Paris, Barcelona, from February 2010)	2.4 – **Two articles and poster** presentations on EC communication projects	• Dialogue: 2 kE	• Dialogue: 2 kE	3. **Five** ad hoc **Industrial Advisory Group** workshops (Brussels,July 2009)
2.3 - **Virtual exhibitions**	• Coverage: 18 kE (5 000 E direct + 5 000 via Web, for about two years)	3. **Second EC Implementation Plan on nanotechnology**	3. **High Level Expert Group** (Brussels, February and June 2009)	3. **Second EC Implementation Plan on nanotechnology** (Brussels, from September 2009)	• Coverage: 3.7 kE
• Coverage: 65 kE	• Feedback: 12 kE	• Coverage: 2.7 kE	• Coverage: 1.5 kE	• Coverage: 23 kE	• Feedback: 1.8 E
• Feedback: 57 kE	• Dialogue: 3 kE	• Feedback: 800 E	• Feedback: 0.8 kE	• Feedback: 16 kE	• Dialogue: 750 E
• Dialogue: 51 kE	2.3 - **daily environment investigation** science centres in 12 EU/AS countries	• Dialogue: 80 E	• Dialogue: 300 E	• Dialogue: 4 kE	4. **Second EC Implementation Plan on nanotechnology** (Brussels, from September 2009)
2.4 - NANO **Time-Machine video-game**	• Coverage: 76 kE	4. **EC Action Plan for nanotechnology**	4. **Five** ad hoc **Industrial Advisory Group**		• Coverage: 2.5 kE
• Coverage: 57 kE		• Coverage: 8.2 kE			
• Feedback: 51 kE					
• Dialogue: 20 kE					
2.5 - Workshop **'Role Play'**					
• Coverage: 57 kE					

OUTREACH (E= end audience, i.e. citizens) - OUTPUT: coverage - OUTTAKE: Feedback - OUTCOME: dialogue

TARGET MULTIPLIER- AUDIENCE

A. SCHOOLS	B. SCIENCE CENTRES	C. MEDIA	D. SCIENTISTS - INDUSTRY - BUSINESS	E. NGOs	F. POLICYMAKERS
• Feedback: 51 kE • Dialogue: 20 kE 2.6 - **Virtual Dialogue Toolbox** • Coverage: 76 kE • Feedback: 57kE • Dialogue: 51 kE 2.7 – Curricula t**raining** • Coverage: 57 kE • Feedback: 51 kE • Dialogue: 20 kE 2.8 – **Nano-kit** • Coverage: 2010 kE • Feedback: 1347 kE • Dialogue: 337 kE 2.9 – EU/AS-wide contest **NanOlympics** • Coverage: 345 kE • Feedback: 231 kE • Dialogue: 116 kE 2.10 – **Educational training programmes** • Coverage: 57 kE • Feedback: 51 kE • Dialogue: 20 kE 2.11**Educational training books and programmes for teachers** • Coverage: 6 kE • Feedback: 5 kE • Dialogue: 2 kE 2.12 – **Open-Nano-Lab to schools**	• Feedback: 57 kE • Dialogue: 23 kE 2.4 - **real size experiments** science centres in 12 EU/AS countries: • Coverage: 76 kE • Feedback: 57 kE • Dialogue: 23 kE 2.5 - **nano-user conference** science centres in 12 EU/AS countries • Coverage: 20 kE (direct 150 E and 10 kE via Web, twice) • Feedback: 14 kE • Dialogue: 3.4 kE 2.6 - **travelling exhibition** from science centres in 12 EU/AS countries • Coverage: 720 kE (direct 300 000 E and indirectly 100 000 E, via Web, for about two years) • Feedback: 482 kE • Dialogue: 96 kE 3. **Participative activities in EU/AS science centres** • Coverage: 2,418 kE • Feedback: 1,620 kE • Dialogue: 467 kE 3.1 – **Nano-kit** (science centres in 12 EU/AS countries) • Coverage: 2,010 kE • Feedback: 1,347 kE	• Feedback: 2.5 kE • Dialogue: 250 E 5. **NANO4YOU Workshop on public engagement** in nanotechnology • Coverage: 5 kE • Feedback: 3.7 kE • Dialogue: 2.8 kE 6. **CORDIS web page** and leaflet • Coverage: 16.5 kE • Feedback: 5 kE • Dialogue: 500 E 7. **Workshop on converging technologies** • Coverage: 5 kE • Feedback: 3.7 kE • Dialogue: 2.8 kE 8. **Fourteen TV audiovisuals** on nanotechnology broadcast on **40 major EU/AS TV networks, Web platforms and newspapers** • Coverage: 82000 kE for 5 minutes • Feedback: 16000 kE • Dialogue: 300 kE 9. **DEEPEN, NANOCAP NANOPLAT, FRAMING-NANO, MACOSPOL,NODE** (UK, Portugal, Czech Republic, Netherlands, Belgium, Italy, Germany, from 2009 to 2010;	workshops (Brussels, July 2009) • Coverage: 7.5 kE • Feedback: 3.8 kE • Dialogue: 1.5 kE 5. **36th Annual Meeting and Exposition of the Controlled Release Society** (Bella Center, Copenhagen, 18-22 July 2009) • Coverage: 18 kE • Feedback: 11 kE • Dialogue: 8 kE 6. **EuroNanoMedicine** (Bled, Slovenia, 26-28 September 2009) • Coverage: 13.5 kE • Feedback: 8 kE • Dialogue: 6 kE 7. **Second EC Implementation Plan on nanotechnology** (Brussels, from September 2009) • Coverage: 31.5 kE • Feedback: 21 kE • Dialogue: 5 kE 8. **EC Action Plan 2010-2014 for nanotechnology** (Brussels, from December 2009) • Coverage: 125 kE • Feedback: 84 kE • Dialogue: 21 kE 9. **Future FP7 Calls for proposals and related**	4. **EC Action Plan 2010-2014 for nanotechnology** (Brussels, from December 2009) • Coverage: 25 kE • Feedback: 17 kE • Dialogue: 4 kE 5. **Future FP7 Calls for proposals and related actions** on communication and engagement (Brussels, from February 2010) • Coverage: 25 kE • Feedback: 17 kE • Dialogue: 4 kE 6. **CORDIS web page** and leaflet (Brussels, from March 2010) • Coverage: 50 kE • Feedback: 33 kE • Dialogue: 8 kE 7. **NANO4YOU: Workshop on public engagement** in nanotechnology (Brussels, from March 2010) • Coverage: 12 kE • Feedback: 6 kE • Dialogue: 2 kE 8. **Workshop on converging technologies** (Brussels, from April 2010) • Coverage: 12 kE • Feedback: 6 kE • Dialogue: 2 kE	• Feedback: 1.1 E • Dialogue: 450 E 5. **EC Action Plan 2010-2014 for nanotechnology** (Brussels, from December 2009) • Coverage: 11.2 kE • Feedback: 5.6 kE • Dialogue: 2.2 kE 6. **Future FP7 Calls for proposals and related actions** on communication and engagement (Brussels, from February 2010) • Coverage: 5.6 kE • Feedback: 2.8 kE • Dialogue: 1.1 kE 7. **CORDIS web page** and leaflet (Brussels, from March 2010) • Coverage: 8.4 kE • Feedback: 4.2 kE • Dialogue: 1.7 kE 8. **NANO4YOU: Workshop on public engagement** in nanotechnology (Brussels, from March 2010) • Coverage: 3.7 kE • Feedback: 1.8 kE • Dialogue: 750 E 9. **Workshop on converging technologies** (Brussels, from April 2010) • Coverage: 3.7 kE

OUTREACH (E= end audience, i.e. citizens) - OUTPUT: coverage - OUTTAKE: Feedback - OUTCOME: dialogue

TARGET MULTIPLIER- AUDIENCE

A. SCHOOLS	B. SCIENCE CENTRES	C. MEDIA	D. SCIENTISTS - INDUSTRY - BUSINESS	E. NGOs	F. POLICYMAKERS
• Coverage: 1,206 kE • Feedback: 844 kE • Dialogue: 42 kE 2.13 – **Nano Researcher Live-Area open to schools** • Coverage: 550 kE • Feedback: 368 kE • Dialogue: 20 kE 3. **CORDIS web page** and leaflet • Coverage: 3 kE • Feedback: 900 E • Dialogue: 90 E 4. **EC Communication Roadmap on nanotechnology (2009-2011)**; Brussels, from October 2009 • Coverage: 2.7 kE • Feedback: 0.8 kE • Dialogue: 81 E	• Dialogue: 337 kE 3.2 - Creativity-based EU/AS-wide contest **NanOlympics** • Coverage: 345 kE • Feedback: 231 kE • Dialogue: 116 kE 3.3 – **educational training programmes** for students one-day or modular (400 schools from 27 EU/AS countries) • Coverage: 57 kE • Feedback: 51 kE • Dialogue: 20 kE 3.4 – **educational training books and programmes** for teachers (schools from 12 EU/AS countries from February 2010) • Coverage: 6 kE • Feedback: 5 kE • Dialogue: 2 kE 4. **Open-Nano-Lab** (science centres in Munich (DE), Milan (IT), Gothemburg (SE) • Coverage: 1920 kE • Feedback: 1286 kE • Dialogue: 51 kE 5. **Nano Researcher Live-Area** (science centres in Mechelen (BE, Tartu (ET), Naples (IT) • Coverage: 820 kE	NODE in most Member States from 2011) Mainly via NODE: • Coverage: 9500 kE • Feedback: 3800 kE • Dialogue: 2850 kE 10. **EC Communication Roadmap on nanotechnology (2009-2011),** Brussels, from October 2009 • Coverage: 10 kE • Feedback: 3 kE • Dialogue: 300 E 11. **Clustering and Mapping EC projects on Nanotechnology,** Brussels, from April 2010 • Coverage: 10 kE • Feedback: 3 kE • Dialogue: 300 E	**actions** on communication and engagement (Brussels, from February 2010) • Coverage: 125 kE • Feedback: 84 kE • Dialogue: 21 kE 10. **CORDIS web page** and leaflet (Brussels, from March 2010) • Coverage: 250 kE • Feedback: 167 kE • Dialogue: 42 kE 11. **NANO4YOU Workshop on public engagement** in nanotechnology (Brussels, from March 2010) • Coverage: 7.5 kE • Feedback: 3.8 kE • Dialogue: 1.5 kE 12. **Workshop on converging technologies** (Brussels, from April 2010) • Coverage: 7.5 kE • Feedback: 3.8 kE • Dialogue: 1.5 kE 13. **Fourteen TV audiovisuals** on nanotechnology broadcast on **40 major EU/AS TV networks, Web platforms and newspapers,** e.g. youris.com (from July 2010) • Coverage: 250 kE • Feedback: 167 kE • Dialogue: 42 kE	9. **Fourteen TV audiovisuals** on nanotechnology broadcast on **40 major EU/AS TV networks, Web platforms and newspapers** (e.g. youris.com (from July 2010) • Coverage: 250 kE • Feedback: 167 kE • Dialogue: 42 kE 10. **DEEPEN, NANO-CAP NANOPLAT, FRAMING-NANO, MACOSPOL, NODE deliberative processes for stakeholders' dialogue** in nanotechnology (UK, Portugal, Czech Republic, Netherlands, Belgium, Italy, Germany, from 2009 to 2010; NODE in most Member States from 2011) Mainly via NODE: • Coverage: 170 kE • Feedback: 85 kE • Dialogue: 64 kE 11. **EC Communication Roadmap on nanotechnology (2009-2011);** Brussels, from October 2009 • Coverage: 25 kE • Feedback: 17 kE • Dialogue: 4 kE 12. **Clustering and Mapping EC projects on Nanotechnology,** Brussels, from April 2010	• Feedback: 1.8 kE • Dialogue: 750 E 10. **Fourteen TV audiovisuals** on nanotechnology broadcast on **40 major EU/AS TV networks, Web-platforms and newspapers** (e.g. youris.com (from July 2010) • Coverage: 62 kE • Feedback: 42 kE • Dialogue: 10 kE 11. 1**DEEPEN, NANO-CAP NANOPLAT, FRAMING-NANO, MACOSPOL, NODE deliberative processes for stakeholders' dialogue** in nanotechnology (Belgium, Czech Republic, Germany, Italy, Netherlands, Portugal and UK, from 2009 to 2010; NODE in most Member States from 2011) • Mainly via NODE: • Coverage: 127 kE • Feedback: 64 kE • Dialogue: 48 kE 12. **EC Communication Roadmap on nanotechnology (2009-2011);** Brussels, from October 2009 • Coverage: 10 kE • Feedback: 5 kE • Dialogue: 2 kE

OUTREACH (*E= end audience, i.e. citizens*) - OUTPUT: *coverage* - OUTTAKE: *Feedback* - OUTCOME: *dialogue* CALL TO ACTION

TARGET MULTIPLIER- AUDIENCE

A. SCHOOLS	B. SCIENCE CENTRES	C. MEDIA	D. SCIENTISTS - INDUSTRY - BUSINESS	E. NGOs	F. POLICYMAKERS
	• Feedback: 549 kE • Dialogue: 22 kE 6. **Nano-Days, festivals, open-campus** (science centres of 20 EU/AS • Coverage: 550 kE • Feedback: 385 kE • Dialogue: 20 kE 7. **Future FP7 Calls for proposals and related actions** on communication and engagement • Coverage: 15 kE • Feedback: 3 kE • Dialogue: 300 E 8. **CORDIS web page** and leaflet • Coverage: 15 kE • Feedback: 4.5 kE • Dialogue: 450 E 9. **Fourteen TV audiovisuals** on nanotechnology displayed in 20 major EU/AS science centres (from July 2010) • Coverage: 904 kE • Feedback: 606 kE • Dialogue: 12 kE 10. **EC Communication Roadmap on nanotechnology (2009-2011),** Brussels, from October 2009 • Coverage: 15 kE • Feedback: 4.5 kE • Dialogue: 450 E		14. **DEEPEN, NANOCAP NANOPLAT, FRAMING-NANO, MACOSPOL, NODE** (Belgium, Czech Republic, Germany, Italy, Netherlands, Portugal and UK, from 2009 to 2010; NODE in most Member States from 2011) • Mainly via NODE: • Coverage: 112 kE • Feedback: 56 kE • Dialogue: 42 kE 15. **EC Communication Roadmap on nanotechnology (2009-2011),** Brussels, from October 2009 • Coverage: 125 kE • Feedback: 84 kE • Dialogue: 21 kE 16. **Clustering and Mapping EC projects on Nanotechnology,** Brussels, from April 2010 • Coverage: 125 kE • Feedback: 84 kE • Dialogue: 21 kE	• Coverage: 25 kE • Feedback: 17 kE • Dialogue: 4 kE	13.1 **Clustering and Mapping EC projects on Nanotechnology,** Brussels, from April 2010 • Coverage: 10 kE • Feedback: 5 kE • Dialogue: 2 kE

OVERALL OUTREACH

TARGET MULTIPLIER- AUDIENCE

A. SCHOOLS	B. SCIENCE CENTRES	C. MEDIA	D. SCIENTISTS - INDUSTRY - BUSINESS	E. NGOs	F. POLICYMAKERS
OUTPUTS: 4,560 kE OUTTAKES: 3,077 kE OUTCOMES: 666 kE	OUTPUTS: 7,528 kE OUTTAKES: 5,049 kE OUTCOMES: 719 kE	OUTPUTS: 91,645 kE OUTTAKES: 19,844 kE OUTCOMES: 3,162 kE	OUTPUTS: 1,124 kE OUTTAKES: 725 kE OUTCOMES: 224 kE	OUTPUTS: 588 kE OUTTAKES: 359 kE OUTCOMES: 137 kE	OUTPUTS: 250 kE OUTTAKES: 136 kE OUTCOMES: 70 kE

Grand Total OUTREACH

TARGET MULTIPLIER- AUDIENCE

A. SCHOOLS	B. SCIENCE CENTRES	C. MEDIA	D. SCIENTISTS - INDUSTRY - BUSINESS	E. NGOs	F. POLICYMAKERS
OUTPUTS (Coverage): 105,694,640 kE OUTTAKES (Feedback): 29,191,977 E OUTCOMES (Dialogue): 4,978,769 E	Ratio Feedback/Coverage: 27.6% Ratio Dialogue/Coverage: 4.7%				

OUTPUT: how the product goes, i.e. direct and indirect COVERAGE; OUTTAKE: what audiences do with the product, i.e. FEEDBACK; OUTCOME: what audiences do with the message, DIALOGUE & ENGAGEMENT.

5.1 OUTREACH FIGURES: DISCUSSION

The concept of communication and dialogue outreach is not that simple to grasp. However, it can be evaluated with the help of various parameters (see also Section 3.3.8).

(i) OUTPUT: How far the communication product goes (The Coverage).

(ii) OUTTAKE: What audiences will do with the communication product (The Feedback), showing a certain **change of attitude** with respect to the EC's image, knowledge, awareness and trust in dialogue.

(iii) OUTCOME: What audiences will do with the message (The Dialogue and Engagement), showing a certain **change of behaviour** with respect to the EC. Also, it indicates the application of new knowledge to dialogue and engagement aimed at consensus-building.

Overall, projected estimates of the rough figures for outreach are considered: these are meant to measure how different the potential performance by various multiplier-audiences in reaching out to citizens-as-end-audience may be. So the outreach figures for the associated end-audiences are assessed according to the different multipliers capability to attain them. Clearly, the media are performing much better as multipliers than industry and policymakers, while NGOs show intermediate figures. This means the same communication product or activity behaves differently when handled by each multiplier, guaranteeing a different coverage for each end-audience.

Feedback measures the degree of reaction to the information that each audience shows, e.g. interest and quest for more in-depth information. As a safe estimate, between one third and two thirds of the audiences reached by information show a certain action or interest in knowing more. Dialogue is much a smaller figure so far, and represents a small fraction of feedback from one to twenty percentage points, depending on the activity, whether passive (e.g. video) or active (e.g. participative event, workshop, contest).

The main outreach figures have been provided by project coordinators ([1]), and we have fine tuned them by adjustment formulas. For instance, activities targeting schools and science centres (A. 2.1-7, A.2.10-11, B.2.3-5, B.3.3-4) are addressing certain pools of students visiting science centres and attending schools taking part in the projects: though each activity takes place in a different moment of the school year, there are some overlapping pools of students benefiting from these activities, so it would not be correct to multiply the audience coverage by the number of activities, as most of the student pools are the same.

[1] Personal information from: Dr. Yoel Rothschild, coordinator NANOYOU; Dr. Ulrich Kernbach, coordinator NANOTOTOUCH; Dr. Laurent Chicoineau, partner NANOYOU and TIMEFORNANO; Dr. Anne-Marie Bruyas and Dr. Alessandra Zanazzi, coordinator TIMEFORNANO; Engineer Mario Martinoli, coordinator NANOTV.

Other activities show a different outreach behaviour, since different or partially overlapping audiences are reached once or repeatedly by way of dedicated events, actions in schools, science centres and city centres, project workshops and events, but also through both publications and the Web (A.2.8-9, A.2.12-13, A.3-4, B.2.1-2, B.2.6, B.3.1-2, B.4-6, B.8, B.10, C.1-7, C.9-10, D.1-12, D.14-15, E.1-8, E.10-11, F.1-9, F.11-12).

Some dedicated events (C-D-E-F.1, C-D-E.2) show different outreached audiences depending on their specific multiplying potential, such as media coverage, timing and Web. Additionally, other activities associated with events (B.2.1-2) are characterised by different outreach behaviours.

To illustrate, the participative workshop at point B.2.1 will feature various sessions for a limited audience, while the participative event under point B.2.2 is more like a contest than a conventional workshop, though integrated with one session in a lab or in a science centre for volunteers: therefore it can potentially reach more people.

Even if the participative event at point B.2.5 will not be addressing massive audiences, as it is a dedicated conference designed to reach a limited number of interested people directly, its significance on the Web could be stronger due to the importance and novelty of the approach. Finally, the exhibition at point B.2.6 will certainly attain high levels of direct outreach, because it is displayed in various towns for several months: as a consequence, its indirect outreach potential will not be negligible.

Other activities and events will address challenges of massive outreach (A.2.12-13 and B.4-5). When these activities address the general public (B.4-5), the outreach numbers directly attained (i.e. the visitors) and via the Web can be very high altogether, considering that these activities will take place in at least three European locations over two to three years' time, while additional locations are being considered. On the other hand, these activities do guarantee that a certain dialogue will take place, though the figures are not very high. The number of people they address are high so there is limited possibility to have a more in-depth discussion with visitors.

However, these activities (A.2.12-13) will be also presented to the schools, and will take place in at least three European locations over two to three years' time, while additional locations are being considered. In these cases the outreach figures for these young audiences will be slightly lower than those previously examined for the general public.

Clearly, reaching out to large audiences makes it difficult to develop an in-depth dialogue with all of them: the share of audience that is stimulated to develop a dialogue is therefore inversely proportional to the size of the audience reached by massive coverage.

Moreover, dialogue is favoured by a continuous communication activity targeted to a certain audience, which would guarantee better quality of both feedback and dialogue. In the case of several activities targeting school audiences (A.2.1 to 13), the communication

builds on a quite constant pool of target students who learn to participate in dialogue on various aspects of nanotechnology over the school years.

A similar situation is considered comparing **television news** lasting a few minutes and reaching large audience figures (teasers of C.8, D.13, E.9, F.10), with longer, edited documentaries (**features,** A.1, B.9, full edition of C.8, D.13, E.9, F.10) that are often topped by a 10-minute long talk show involving a non-expert audience, which should generate a certain dialogue among viewers.

However, communication activities via television media require specific attention. In fact, news can reach a larger audience on a bigger number of TV channels, targeting the news/information segment: they are short, they can be produced in great quantity and they address a very large number of topics and issues. News also has the added advantage of fitting into a variety of programming slots easily. They are very versatile when handled by multipliers and communication gateways, such as the Eurovision. On the other hand, reportages in form of 'teasers' with a typical duration of three minutes can just bring forward basic messages, and often do not have the strength to 'go inside' the message they refer to. So TV news occupies a kind of grey area between straight information and communication, depending on the way broadcasters use the footage.

In any case, there is a downside to longer, edited documentaries (features) packaged like full-edition video footage and materials: they have a more limited audience, as they are non-editable and they tend to impose a pre-defined editorial vision on broadcasters. From this point of view, they have a much smaller market than news. As a consequence, one should expect that the audience reached by fully edited documentaries will turn out to be much smaller than the audience reached by news. Costs (documentaries are more expensive to produce than straight news) and language (voiceovers need to be translated) are additional difficulties. On the other hand, a long documentary can put the message across much better, and explore many more angles of an issue with far greater accuracy.

According to these considerations, an adjustment formula has been applied to each of the ten Video News Releases (VNRs) of NANO TV (an additional four of them, which will target young people, are not taken into account here). This is meant to avoid an artificial inflation of the VNRs' audience. For instance, if we take Euronews as the leading gateway for NANO TV distribution, we can safely say each four-minute VNR broadcast in eight languages from a previous similar series reached an audience of 7 million people. Since, on a weekly average, Euronews broadcasts the same video between 10 and 20 times over, and since Euronews' audience is known to have a high turnover, audience data of any single VNR on a weekly basis dramatically increases up to an estimated 20-25 million people, a figure which takes the audience correction factor into account already.

However, a significant share of the same audience on such an international gateway (which is known to reach 244 million households) is overlapping and will be reached almost ten times. Assuming that more broadcasts do generate increasing feedback and dialogue within the same audience, this should guarantee an increased quality of the

expected feedback and dialogue. By applying the same adjustment formula to the whole set of 10 VNRs and by taking these overlaps into account, we can estimate a total outreach of around 35 to 40 million people on Euronews only.

The Eurovision/EBU gateway, which is another distribution pillar of NANO TV, can reach an average of eight national channels per VNR, accounting for an average audience of about 3 million people each. These broadcasts are generally longer and closer to a talk show approach. So the associated overall broadcasts of 14 VNRs can reach an estimated audience of about 21 million people, if an audience overlap, as mentioned above, is taken into account again.

Finally, the one-to-one distribution strategy (the third pillar of NANO TV media distribution) accounts for an average audience of about 3 million viewers per VNRs, bringing the total estimated audience for broadcasts generated by this distribution channel to another 21 million people, according to the same correction pattern adopted for broadcasts generated by the Eurovision/EBU distribution.

Considering that the production and distribution of NANO TV's videos will take place between 2009 and 2011, the total figures for television outreach over this whole period can be prudently estimated at around 82 million people, as summarised in the following table.

Table 15. NANO TV annual outreach via television channels and gateways (2009-2011) ([2])

Distribution channels/ gateways	Euronews	EBU/Eurovision Worldfeeds	One-to-One communication to TV networks
Estimated audience per item	20-25 million people	Approx. 3 million people	Approx. 3 million people
Estimated audience per item	35-40 million people (for approx. 60% of delivered VNRs)	Approx. 21 million people	Approx. 21 million people
TOTAL AUDIENCE (2009-2011)	**Approx. 82 million people**		
Number of TV stations actually broadcasting	1 (for approx. 60% of delivered VNRs)	From 5 to 10 (from youris.com historical series)	From 4 to 8 (from youris.com historical series)
Target	News/Features	Mostly News	Mostly Features
Languages	9 (English, French, German, Spanish, Italian, Portuguese, Russian, Arabic, Turkish)	All, but depending on downloads	All, but depending on contacts
Broadcasting time span from distribution	1 week	Several months	Several months
Tracking of broadcasting	Complete	Complete up to 6 weeks from satellite broadcasting	Complete for TV channels providing data

[2] Personal Communication from Ing. Mario Martinoli, coordinator NANOTV

5.2 CONCLUSIONS

This document presents the focus, objectives, methodology and actions to be developed in the near future for the purpose of communicating the nanotechnology promise to a public as wide as possible. This is just the beginning of a process with the final aim of establishing a permanent, open, deliberative and instantaneous European-wide platform on communication outreach and dialogue. And what a beginning it is. Apart from establishing a new model of communicating efficiently and effectively according to the real needs of the public, a robust methodology has been put in place that will make it possible to deliver messages to an estimated one hundred million EU citizens over three years between 2009 and 2011, and receive feedback consequently.

By building on knowledge and awareness of nanotechnology, this Communication Roadmap comes forward with a whole system of organised mechanisms designed to prepare the ground for very effective feedback and exchange with society. By placing European citizens at the centre of attention, it tries to design a feed-back-feed-forward mechanism to greatly enhance the EU's policymaking efforts in promoting and safeguarding the future of nanotechnology as a strategic tool for sustainable growth. It also aims to treat nanotechnology as a critical component that is bound to bring to the fore people's relationship with high technology developments, by advancing the concept of sciento-technological democracy.

Having shaped the message with an appropriate architecture and packaged it within a purposeful methodology, the task of delivering it has begun. From start-off experiences within FP6, this Roadmap has moved on to identify communication, outreach and societal dialogue initiatives within the current FP7, whose actions will last until 2013. Dedicated projects from 2009 to 2011 focus on strategic audiences and ways of attaining them.

First, they will be targeting the young, whose role in future developments is considered essential in building a sustainable economic model based on innovative nanotechnologies. This will happen via specific products (such as design-contests, live-lab experiences) through schools, science centres and media.

Next, they will target the general public, which will be targeted by means of audiovisual, press and Web media, i.e. movies, documentaries, teasers, clips, focus articles. The intervention of journalists and knowledge multipliers will make sure that the information about facts and evidence is comprehensible by an uninitiated audience, which also includes students and new entrants to the nanotechnology profession.

Finally, a group of projects will be addressing business, scientists, NGOs and policymakers through specific participatory events, workshops, videos and publications.

This way a complex subject can steadily be appreciated in its basic principles, where eventually everyone will be pitching in by relying on their sense of identity and standing in society. This will have the effect of creating trust and confidence, starting from the

young, who will engage in developing their own valid point of view based on scientific facts while tackling problems on the basis of a continuously updated knowledge.

Nanotechnology will affect us all, but beyond nanoparticles, critical length scales, and nanotools, European citizens will be able to see how all this science and technology will influence their lives ahead of the actual developments.

The investment devoted to this by the EC is remarkable when considering the combined budgets of all nano-related communication projects and their effective operational horizon.

As part of the 2005-2009 Nano Action Plan for integrated, safe and responsible nanotechnology, this investment fits well with the needs of other policy areas such as social and regulatory, environmental and educational.

The findings of this Communication Roadmap, based on validated strategies, methods and tools are to be used by all concerned, including Member States programmes. The challenge is to structure a unique communication outreach and a public dialogue platform covering the European Union and Associated States as well as international entities. Since such findings are going to be implemented over the years 2009-2011, they provide a seamless link to immediate and future plans for European advances in nanotechnology-based innovations, products and economic growth.

Beyond any spontaneous enthusiasm or mistrust any such highly innovative scientific development may bring, the fact that nanotechnology is becoming more and more deeply embedded in today's life should warrant a meaningful, conscientious communication based on continuous participation and exchange between EU institutions and citizens. The European Commission, as a major funding body, has recognised that taking the lead to develop such a dialogue is one of its own moral responsibilities.

Out of this dialogue, desirable patterns should emerge. If the associated opportunities, risks and uncertainties were properly addressed, all of us would surely be far closer to the mark of reaching consensus. Every audience, be it young people, teachers, business, organisations or, more broadly, the general public, will be increasingly called upon to get involved at European, national and local levels. As a result, good governance through inclusive policy debate will be promoted.

This consensus between stakeholders, society and policymakers on EC decision-making about nanotechnology should hopefully be the first big result of this Communication Roadmap. This will ultimately increase both confidence and trust in the EC, and will strengthen its image as an impartial, transparent and trustworthy communicator on nanotechnology.

ANNEX

Available free of charge from the Internet at
http://cordis.europa.eu/nanotechnology/src/publication_events.htm online.

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An appropriate social dialogue on nanotechnology needs open-minded, consistent and even audacious communication aiming to bring everyone in. Good governance depends on it, as the EC had already acknowledged robustly. The DG RTD, Directorate Industrial Technologies, is now firmly set to push this bold principle towards building a broad consensus to support the EC's policy on integrated, safe and responsible nanotechnology.

So appropriate communication comes first, which must outline whom to address, saying what and how, in order to make people feel personally involved and eager to know more. All these issues are analysed, structured and packaged in chapters one to three under a new communication model that relates to citizens' concerns and needs.

Dialogue and engagement are the next, crucial phase. By building on knowledge and awareness of nanotechnology, this Communication Roadmap comes forward with a whole system of organised mechanisms designed to prepare the ground for very effective feedback and exchange with society. This represents the contents of chapters four and five which set out an ambitious scheme of implementation measures that tests the communications model's efficacy to deliver its messages to millions of citizens.

This communication exercise is expected to have two major, desirable effects: increasing the consensus between stakeholders, society and policymakers on EC decisionmaking about nanotechnology; and strengthening the image of the EC as an impartial, transparent and trustworthy communicator on nanotechnology.

Innovation and creativity are of the essence here, and indeed the EC wants nanotechnology to speak, as a priority, the many expressive languages of web platforms, social networks, science centres, multi-platform media news or features and the open dialogue between scientists and citizens. On top of the conventional printed material, audiovisuals and event-related materials, the EC is now looking with special interest at the way art, design, music, theatre and films could enrich the communication of technology.

In this sense, this Communication Roadmap feeds into the philosophy and principles set out by the European Year of Creativity and Innovation which has been its inspiration.

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