**Executive Summary:**

### 4.1.1 Executive Summary

Research at the nanoscale has the potential to solve many fundamental scientific problems and lead to new developments in different disciplines and application areas, such as medicine and healthcare, sustainable and renewable energy, water, and the environment. Successful outcomes to such research will have a measurable impact on the future well-being of our global society; however, this can only be achieved through improving access to information and opportunities for international collaboration. The International Cooperation Partnership Countries Nano Network project (ICPC-Nanonet) has been one such initiative in this framework. The FP7 ICPC Nanonet project was funded from June 2008 until May 2012 and aimed to address these access issues through the following objectives:

- to provide an electronic archive of nanoscience and nanotechnology research publications and support the networking of researchers in the EU and ICPC.
- to establish a database of researchers and organisations in the EU and ICPC.
- to identify research strategies and organisation activities within the eight ICPC regions:
- to actively network EU and ICPC researchers through annual workshops to be held in the EU, China, India and Russia.

To achieve this, the project partners created, implemented and populated an online archive of N&N research papers, many of which are open access, and encouraged scientists to self-archive their research to increase its impact within the community and raise awareness of the latest developments. The consortium also created two fully searchable databases, one for organisations and one for researchers, which were made accessible to all registered members. These tools were designed to assist in identifying complementary research activities across the globe. To profile the research strategies, organisation activities, funding streams and the nano-research landscape in each region, the partners compiled Annual Region Reports using contributions from the global community, which were published online.

Finally, the project brought together a consortium of partners from the EU, China, India, Russia and Africa with the aim of facilitating online and face-to-face networking between scientists and researchers across different world regions. It built upon and collaborated with existing and complementary projects, including Nanoforum (http://www.nanoforum.org), EuroIndiaNet (http://www.euroindianet.info), NanoforumEULA (http://www.nanoforumeula.eu), observatoryNANO (http://www.observatorynano.eu) and other appropriate organisations, networks and projects. In this way, the project fostered direct collaboration between ICPC organisations that network activities in ICPC. This was to allow new information to flow quickly between all the organisations, enhancing the profile of the website and its facilities in the regions and among the scientists and researchers themselves. To cement these interactions, the project organised four annual workshops in each of the regions, which were also webcast live and recorded, and implemented online webinars so that networking opportunities would not be cost prohibitive.

The long-term goal of this project was to facilitate networking and increase the number of collaborations between ICPCs and the European Community. To this end, an advisory board of

international experts was established to assist in the identification of individuals and organisations, provide expert input, and support dissemination activities throughout.

All project output is available through the websites:

(http://www.icpc-nanonet.org) (http://www.nanoarchive.org).

**Project Context and Objectives:**

**Context**

As society increasingly considers knowledge a commodity and facilitates the transformation of nanoscience and nanotechnology (N&N) from a resource-intensive to a knowledge-intensive industry across the globe, it is recognised that this can affect the existing research and development divides between developed and developing countries and emerging economies. Unless barriers to knowledge access are lifted or overcome, global differences and inequalities in N&N could indeed increase and perpetuate.

In tandem with, and succeeding from the IT and micro revolutions, progress in current emerging technologies could widen the gulf between the developed and developing world, thereby creating what has commonly been termed the nano divide. We have seen such divides manifest themselves in a number of forms, most of which are fundamentally underpinned by disparities in national and regional capabilities and capacities to develop and utilise novel, emerging and advanced technologies. Sparrow (2007) identifies not one, but many different divides that nanotechnologies might open up or exacerbate between the wealthy and the impoverished and between the powerful and powerless both within and between nations.

We are aware of the causes: the dearth of facilities resulting from the high costs of equipment, the lack of funding and government backing; the concomitant deficiency of human resources due to ubiquitous brain-drain experienced by so many developing countries; the increasing number of patents being filed by more developed countries thereby precluding developing ones; intellectual property rights; an inability to access research because journal charges and the expenditures incurred in skilling up are often cost prohibitive; and then there are the development and scaling-up costs. Paradoxically, one of the symptoms of the technological divide  the lack of a stable IT and broadband infrastructure in a vast number of regions - is also a cause of the problem and a key to the solution.

A point in case is highlighted in a recent article  entitled Kenya: Why academics do not publish. The low rate of academic output is attributed to the fact that low salaries prevent academics from accessing current relevant research in the first place. Researchers cannot afford journal access fees: They accused some journals of charging such exorbitant publishing fees - including for online access - that they could not keep up-to-date with current literature and research findings." However, when there are apparently more pressing needs and demands on government budgets, such as potable water supplies, sanitation and basic education, investment in N&N research and development is a luxury to which many state budgets simply cannot be stretched, regardless of the benefits that advanced and enabling technologies could offer.

Moreover, if the scale of implementation of N&N is not carefully monitored, nano research and development itself can amplify the divide, as Sparrow  points out, 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 will have a negative impact on the economy and development of these countries. Invernizzi and Foldari (2005) suggest that Despite the optimistic assessments recently offered, experience suggests that nanotechnology could follow the mainstream economic trends that increase inequality. First, the development of nanotechnology faces many of the same problems faced by prior technological developments because large multinational corporations are patenting the majority of the

nanotechnology products. Patents are monopolistic guarantees of earnings for twenty years something that certainly works against the rapid diffusion of the beneficial potentials of this technology for the poor.

In agreement, Donald Maclurcan, a researcher at the Institute for Nanoscale Technology in Sydney, Australia, states: Overall, there are some encouraging signs that certain developing countries could play a significant role in the global development of nanotechnology. Yet, in light of increasing, market-based barriers and limited country participation on a number of levels, early signs are that nanotechnology will promote a greater global technological divide.

In analysing the correlation between nanotechnology and development, Invernizzi et al. (2008:125) identify two schools of thought. On the one hand there is the instrumental position, which emphasises the technical capacity (and even technical superiority) of nanotechnology to solve poverty problems and spur development  Technologies, in these views, may solve social problems, and social problems are often described as lack of technical capacities.

Conversely, the second school of thought espouses a contextual position, defined by Invernizzi et al. (2008:125) as those emphasising the social context wherein technology is produced, used and adapted In this view, factors such as profit-driven innovation, intellectual property rights, concentration of innovation in developed countries and social inequality are seen as key factors in the context of development of the nanotechnology trajectory that influence, and eventually hinder, their use for development and poverty alleviation. Debates between these two groupings were described as considerably polarised (Invernizzi et al. 2008:134).

Following this second line of reasoning, the typical scenario would be that a developing nation implementing nano solutions in order to bolster up a specific aspect of its infrastructure will draw less on its own commodities. As other societies follow suit and proceed to systematically replace more traditional solutions with nano ones, the corollary is a significant reduction in labour, commodities and exports and a depletion in economic resources in the original developing country. How, then, does that nation's government secure a budget to support future N&N developments And why would it want to if it has become apparent that N&N is essentially exacerbating the inequalities between rich and poor by making certain commodities less essential in the world market  Even if said nation were able to engage in N&N R&D at a minimal level, what degree of governance, regulation, risk assessment and management could it implement Inevitably, the final instalment in this narrative will describe the transfer of technology from developed to developing countries instead of focusing on capacity building.

In its Action Plan for Nanotechnologies,  the European Commission (EC) places great emphasis on global collaboration, stating 'International cooperation in N&N (nanoscience and nanotechnology) is needed both with countries that are economically and industrially advanced (to share knowledge and profit from critical mass) and with those less advanced (to secure their access to knowledge and avoid any "nano divide" or knowledge apartheid)'. Networks and collaborations between organisations, countries and regions, and between researchers and scientists within these are fundamental to the success of research and development across the globe. By networking these individual entities, it is possible to appeal to motivational interests that transcend notions such as competitiveness and discrimination. By creating melting pots of complementary expertise, common solutions can be shared and new solutions explored.

A number of such networks are currently making great strides in forming global collaborations to bridge North-South divides and leaping oceans to create cross-regional, South-South alliances. The India, Brazil, South Africa (IBSA) network connects these named countries. The ReLANs Network orchestrates discussion and cooperation throughout Latin America. Other alliances include the Arab Materials Science and Nanotechnology Network and the Nanosciences African Network (NanoAfNet). Each association facilitates a pooling of knowledge, as well as critical physical and human resources. While inter-regional activities can be of immeasurable significance, it is also vital that such networks retain their individuality so that they are not simply pursuing some well-trodden development route, but adhering to solutions and strategies pertinent to specifically identified needs that are unique to its member components.

The ICPC Nanonet project was thus designed to make tangible and pragmatic moves to provide access to knowledge and facilitate networking between scientists and researchers intra and inter-regionally by overcoming certain obstacles to knowledge acquisition through a number of objectives, as described in the next section.

In the first instance, there would be a consortium consisting of leading expert organisations for each of the ICPC Nanonet regions who would be able to carry out networking and engagement activities and research all the latest developments as well as find out about networks, funding, contacts and the general N&N landscape in each of their regions, specifically China, India and Russia as these countries have the highest investment of ICPC in N&N RTD, and are specifically recognised as emerging economies for S&T collaboration in NMP. Each of the partners has wide-ranging knowledge of nanotechnology developments within their own and surrounding countries, and has demonstrated ability to gather and disseminate information through networks and organizations with which the partners have existing collaborations. The project consortium would thus be in an excellent position to provide information to a wide audience in ICPC and the EU, and to gather information on N&N activities in ICPC to better network researchers within the EU and ICPC.

The project activities would be supported by a panel of experts who would comprise the ICPC Nanonet steering committee and provide input to the research quests.

Through the consortium partners, the steering group members and ICPC Nanonet members, all project output would be widely disseminated. Additional channels of dissemination were to be identified so that the net could be cast more widely and the reach of the project extended to benefit more individuals and organisations across the globe.

Networking and dissemination events would be held in person and online based on relevant themes and in the target regions so that connections could be made and collaborations could be fostered. As far as possible, these would not be cost-prohibitive to attend.

**Objectives of the ICPC Nanonet Project**

The project essentially aimed to provide regularly updated information to N&N researchers within the EU and ICPC that would facilitate their research objectives and the establishment of collaborations. This divided into three main objectives: the development of an online archive or repository of N&N publications; updated information on research activities in different world regions; and the means to network N&N researchers in different global regions.

The core objective of the Nanosciences, Nanotechnologies, Materials and New Production Technologies (NMP) 4 theme is to improve the competitiveness of European industry and generate the knowledge needed to transform it from a resource-intensive to a knowledge-intensive industry. NMP research aims to strengthen the competitiveness of European industry by generating 'step changes' in a wide range of sectors and implementing decisive knowledge for new applications between different technologies and disciplines.

Essential to the realisation of this goal is to ensure that complementary knowledge and experience are shared not only between EU scientists but between the EU and third countries. This maximises the potential of EU research by establishing collaborations with scientists and groups which have complementary experience in other regions, and by developing and exploiting shared resources (such as major infrastructure).

In the first instance, therefore, the ICPC NanoNet project aimed to provide an electronic archive of nanoscience and nanotechnology research publications and support the networking of researchers in the EU and ICPC. The electronic archive was to be based on open-source software (EPrints) that is widely used by scientific institutions and libraries across the globe, and allows the incorporation of full-text open access publications (submitted by authors themselves) and the incorporation of entries from other publicly available sources (including other open access repositories, electronic tables of contents and abstracts). This facilitates researcher access to new data and the identification of groups that are performing complementary research for potential collaboration.

ICPC Nanonet aimed to establish databases of researchers and organisations in the EU and ICPC, which included contact details, research interests and expertise. These databases have been made available to all registered users of the website, allowing researchers to search for individuals that have specific expertise and organisations that have desired instrumentation and capacity. Researchers have been able to contact each other through an internal mail forwarding system and online discussion fora.

The project activities were to include the identification of research strategies and organisation activities within the eight ICPC regions: Africa; Caribbean; Pacific; Asia; Eastern Europe and Central Asia; Latin America; Mediterranean Partner Countries; and Western Balkan Countries. These were reported on an annual basis and the reports were made available to download from the website.

Project activities were designed to actively network EU and ICPC researchers through annual workshops held in the EU, China, Russia and India. The workshops were webcast live to facilitate wider participation. Moreover, a number of separate online workshops allowed further networking and exchange of information and research output to be achieved.

The success of the project would be contingent on interaction with researchers throughout the EU and ICPC and required partners who have an existing relationship with key organizations in different regions and who can engage with individuals within these organizations to learn of their activities and encourage researchers to register on the website and contribute to the archive and networking activities.

**Project Results:**

### 4.1.3 Description of the Main S&T Results

The ICPC Nanonet project is a very important experience because it is the first step to promote the dialogue in different countries and region around the world. The possibility of networking less developed regions with industrialized countries will impact positively in avoiding nano divide. In my opinion, this kind of project should be maintained and reinforced by including grants to promote international cooperation among the different networks.

Prof. Anwar Hasmy, Universidad Simón Bolívar, Director General at Red Venezolana de Nanotecnología

This section describes the main activities individually and demonstrates how the project activities and output were inextricably intertwined in an iterative process, whereby the networking activities facilitated the information gathering processes, and vice-versa, as shown in the figure below. In addition, further networking connections were created by researching information and organisations to be documented in the region reports, and through this process more experts were identified and invited to register on the database. This again led to an iterative process through which, following registration and a presence in the public domain, researchers could be added to the region reports. On achieving this, a sufficient number of researchers were directly contactable for the purpose of developing online workshops and networking vehicles. Simultaneously, wider dissemination and promotional activities continued to attract newcomers and foster networking. Throughout the project, researchers were invited to utilise the archive to their best advantage, and the archive was used to host their own output.

Figure 1. Overview of iterative approach adopted by ICPC Nanonet.

i) The electronic archive (publishers, authors and open access repositories)

An electronic archive was set up based on Eprints software, developed by Southampton University and used by over 256 institutional and subject-based repositories. This was branded in keeping with the project website and customised to accommodate a nanoscience and nanotechnology-based taxonomy to replace the standard Library of Congress classification system. A large number of highly-cited N&N articles published since 2005 were sourced using Web of Science and their metadata exported as BibTex files. Partners were then instructed in the uploading procedure for these. Regular XML data deliveries for a number of journals published by Springer Link were secured, to be converted into BibTex data for uploading. Following this, RSC Publications granted permission to upload metadata from the journal Nanoscale articles and from N&N books. Partners have also uploaded papers from their own institutions. For purposes of quality control, the focus was on the inclusion of peer-reviewed material, with any other material being clearly labelled as to its status. All material was reviewed by partners before being moved to the repository. Users had and still have the facility to search all fields in standard metadata records from journal tables of content and abstract, such as: title, abstract, author, organisation, publication date, and DOI. The Nano Archive has been registered on OpenDOAR (Directory of Open Access Repositories) and ROAR (Registry of Open

Access Repositories). Archive usage and visitor trends continue to be monitored by Google Analytics and the website's own webaliser analytics.

In its second phase, the Archive was further developed and widely publicised in regular newsletters, webinars and dissemination activities. Meanwhile, the project partners worked to achieve a level of sustainability through the promotion of the self-archiving facilities available to researchers. In addition, when researchers provide articles on request, they were invited to request an editor's account so that they could then self-archive.

The Nanoarchive currently has:

- 356 registrants, including 91 editors who self-archive their research
- 8826 items uploaded
- 1954 full texts
- 145,833 visits recorded from 179 countries/territories 10th July 2009 16th July 2012 (Google Analytics)

It was anticipated that there would be an inevitable decline in the number of visits logged by Google Analytics, since during the earlier stage of the project the partners were uploading a vast number of articles in order to populate the archive. Partner input has now decreased while self-archiving by researchers has increased, but clearly not to the same degree.

The archive currently allows researchers to quickly identify previous work that has an impact on their own research, and to identify groups that could be potential collaborators through complementary expertise or facilities. This represents a new facility, as other existing archives are either restricted to output from a particular institution or are focussed on one particular area of research, for example arXiv is maintained by Cornell University and focuses mainly on physics and mathematics.

In creating the archive, it was assumed that that bibliometric tools could be created to allow cross-referencing and citation analysis to be performed. It was envisaged that the database would log all the references of each publication, and provide the capability to track citations of individual papers. Aggregation of the citation and publication results over time combined with other categories such as author or organization would be implemented. Then, by harvesting information from the address fields and or author ID fields, and combining these with the publication or citation search results, an author network and/or organizational network will be plotted. However, it transpired that the software would require considerable expert programming in Perl in order to implement these complex modifications. Moreover, Web of Science could provide considerably more data with which to perform bibliometric analysis and since this was already being carried out for the EC funded observatoryNano project, it seemed prudent to avoid duplication of effort.

Thus, for each year of the project, MERIT provided the partners with the data through the MERIT Database of Nanotechnology Scientific Publications (Web of Science publications), from which they could create sub-data sets by selecting the countries from each region. The partners then analysed the publication data of each region and created lists of the number of Web of Science nanotechnology publications of the ICPC countries and the most prolific organisations and institutions in each region. In addition, for the second annual reports, published in June 2010, MERIT provided the sectoral analyses of the scientific publications of the EU-27 countries (Web of Science publications) in line with the ten industrial sectors, namely, aerospace, automotive & transport; agrifood; chemistry &

materials; construction; energy; environment; health, medicine & nanobio; ICT; security; and textiles, for the period of 1998-2007. However, because the institutions in the list are not exclusively from the regions due to international collaboration (e.g. the American, Chinese and Indian institutions appear in the list for Eastern Europe and Central Asia), the partners were also required to identify the institutions located in the regions based on their expertise and further organise/clean the list as required.

Ultimately, two sets of data were utilised. The first comprised the benchmark data for each region and the different countries within it as well as comparative data for the individual institutions. The second set consisted of sectoral bibliometrics. The two types served different purposes and were therefore not interpreted jointly as there was overlap within the sectoral analysis dataset, whereby one paper could feasibly cover one or more sectors. The benchmark analysis represented the total publications in the MERIT database. Each data set of the ten sectors, however, represented only a part of the total database. Moreover, the sum of these data sets may or may not have covered the total database as some papers may have been classified within the sectoral analysis, but others may not. The essential purpose of the sectoral analysis was to illustrate the dynamics of nanotechnology/science research in different fields and the concomitant implications for industrial application worldwide. The datasets could then be used to benchmark the major countries which have a sound scientific base, as well as an established history of production, research and development in the field and industry. They were not designed for benchmarking the much smaller countries, such as those that produce only 3-5 publications per year, since this level of contribution to a field where major countries produce thousands of publications makes zero impact and is therefore almost negligible.

Figure 2: Example of bibliometric data analysis - Comparison of total number of publications for each ICPC region 2010

In sum, the development of the archive since inception has resulted in a user-friendly, fully searchable comprehensive online repository of an ever-increasing number of N&N papers. A questionnaire regarding the various project tools, their usefulness and suggestions for further development elicited a number of constructive suggestions and positive responses, including the following:

- -A possible link or integration with other dedicated databases, like that at the URL: http://webnet.oecd.org/NanoMaterials/Pagelet/Front/Default.aspx maintained and published by the OECD and others, such as the Nano-EHS Database Analysis Tool, http://icon.rice.edu/research.cfm; or the NHECD, http://nhecd.jrc.ec.europa.eu/ ) could be useful for complete bibliographic researches. The OECD, as an example, provides a link to other databases, enabling the user to get different output with the same Boolean string. The databases reported here are dedicated to the toxicity of nanomaterials; similar strategies could be put into action with other fields, chemical and physical descriptors, or standard procedures, as an example.

- -As a network and in view of the difficulty to access the scientific literature in several regions in Africa, this cloud electronic high quality scientific database was and is of an uppermost importance. For the sake of sustainability, this archive should and must continue. Either it should emigrate to an other programme but should be still under the leadership of those who were the main architects

Finally, the partners were highly appreciative of the recognition given to the Nano Archive by CORDIS who highlighted ICPC Nanonet's achievements in establishing and developing the Nano

Archive (http://www.nanoarchive.org) for special promotion on the CORDIS Technology Marketplace (http://tinyurl.com/5t5jamq).

ii) The Researchers and Organisations Databases

It has allowed the members of our network to initiate partnership with established actors and organisations in the field of nano. It should be sustained as the case of the Nano Archive

A key aim of the project was to provide the means by which nano stakeholders and organisations involved in similar areas of research across the globe could be identified with a view to networking and collaborating. Two databases for organisations and researchers, respectively, were designed to facilitate this.

a) The Researchers Database : 1561 self-registered researchers from 109 countries

The database of researchers in the EU and ICPCs includes contact details, research interests and expertise. This database can be accessed by all registered users of the website, allowing researchers to search for individuals that have specific expertise. With full technical implementation in place, researchers are able to contact each other through an internal mail forwarding system via the online discussion forum. Data protection is rigidly observed, and researchers have the option to conceal or omit their contact details.

**Achievements:**

In order to acquire researcher information, a template for capturing researchers details was successfully developed in consultation with all the partners, and subsequently disseminated via email to key researchers, inviting them to self register. Registration was vetted by the project coordinator before login details were issued. At the same time, a database and secure search system were developed. By registering on the website, researchers details were entered into the database. Registered users can still search for other researchers by discipline, application area and / or country.

Figure 3: Find researcher facility on ICPC Nanonet website researchers database

The website interface for the databases was formally launched in January 2009. Since then the number of self registered researchers has steadily increased and particularly during the weeks surrounding workshops and webinars. The following charts and tables compiled at the end of May 2012 document a comparison of the statistical, geographical and research representations of the researchers database for the second and third reporting periods. Subsequent charts document previous and current statistics for the researchers and organizations databases, including geographical and research representation. Overall they demonstrate that the site continued to be utilized more and more throughout the project and vastly extended its global reach.

| Country | May 2011 | May 2012 | Country | May 2011 | May 2012 |
|---|---|---|---|---|---|
| Albania | 1 | 1 | Jordan | 14 | 17 |
| Algeria | 5 | 7 | Kenya | 1 | 1 |
| Argentina | 15 | 20 | Lesotho | 1 | 1 |

Bangladesh 1 1 Libya 1 1

Belarus 2 3 Malawi 0 1

Benin 2 2 Malaysia 11 11

Bolivia 2 2 Mexico 28 34

Botswana 1 1 Morocco 9 12

Brazil 23 24 Namibia 1 1

Burundi 0 1 Nepal 0 1

Cameroon 1 7 Nigeria 18 24

Chad 0 1 Oman 1 1

Chile 4 4 Pakistan 14 18

China 32 36 Peru 2 3

Colombia 15 27 Philippines 1 1

Costa Rica 1 1 Russia 30 35

Cote d'Ivoire 2 2 S Africa 42 53

Croatia 2 2 Senegal 3 3

Cuba 7 9 Serbia 6 6

Dom. Rep 3 3 Sri Lanka 4 10

Ecuador 3 3 Sudan 2 3

Egypt 37 47 Syria 2 2

Ethiopia 7 16 Tanzania 1 3

Fiji 1 1 Thailand 9 12

Georgia 2 3 Tunisia 2 2

Ghana 1 1 Turkey 14 16

Guatemala 1 1 Ukraine 5 7

India 334 455 Uruguay 4 5

Indonesia 1 1 Venezuela 22 33

Iran 45 56 Vietnam 3 3

Iraq 1 3 Zambia 1 2

Jamaica 2 2 Zimbabwe 1 2

Figure 4. Increase in numbers of self-registered researchers from ICPC countries: May 31st 2011 to May 31st 2012

In the table above, a selection of countries show a significant increase in the numbers of self-registered researchers, including Colombia, Egypt, India, Iran, South Africa and Venezuela. The substantial increase in the number of Indian researchers can be attributed to the publicity and profile-raising of the Fourth ICPC Nanonet Annual Workshop, which was held in Goa, India in April 2012. Many individuals registered on the website so that they could take part in the live webcast of the event or registered to receive the DVDs of all the proceedings.

Region

Africa

Asia

West Balkans

Caribbean

EECA

Latin America

Mediterranean

Pacific Dec 2009

26

60

5

4

25

51

18

0 May 2011

85

446

9

12

39

120

84

1 May 2012

125

609

9

14

48

157

104

1

Figure 5: Increase in number of self-registered researchers per region December 2009 to May 31st 2012

Region

Africa

Asia

West Balkans

Caribbean

EECA

Latin America

Mediterranean

Pacific Dec 2009.

8

9

2

3

4

8

5

0 May 2011

16

12

3

3

4

12

8

1 May 2012

19

14

3

3

4

12

8

1

Figure 6: Increase in number of self-registered researchers per region December 2009 to May 31st 2012

Figures 5 and 6 show the increase in the numbers of self registered researchers and organisations per region over the duration of the project. It should be noted that the upload of orgnaisation information was mostly carried out by the partners as a result of their research activities, whereas the numbers of self-registered researchers show an increase as a result of promotion and dissemination of the project and its output.

As stated, one of the key features of the databases are the features created for searching by application area and discipline as well as geographical region. This information was completed by the researchers themselves at the time of registration.

Figure 7. Increase in the numbers of self-registered researchers per discipline from December 2009 until May 2012:

The figures and diagrams show that there have been consistently large increases in representation from all of the main laboratory based research disciplines.

Discipline Dec-09 May-11 May-12

Biomedicine 117 516 679

Chemistry and material sciences 181 602 784

Engineering 126 457 602

Physical sciences 152 462 617

Social and political sciences 43 114 145

Economics 39 102 135

Figure 8: increase in the numbers of self-registered researchers per application area from December 2009 until May 2012

Application Dec-09 May-11 May-12  Application Dec-09 May-11 May-12

Aerospace 53 135 190  Health & Safety 98 337 436

Agrifood 54 201 260  Healthcare 64 234 306

Biotechnology 118 434 572  ICT 45 118 153

Construction 38 106 152  Materials 210 617 827

Economics 40 111 158  Policy 37 96 131

Electronics 87 306 400  Security 39 105 137

Energy 127 463 644  Textiles 47 130 169

Environment 123 375 490  Tools & Metrology 52 135 173

Ethics 42 119 148  Transport 27 78 105

The figures above show that there was a marked increase in registrations from certain application areas, the largest percentage of increase can be seen in representation from the Agrifood, Biotechnology, Energy and Environment and Materials applications.

Overall, Asia provided the largest number of registered researchers, showing a marked increase in the final year of the project. Latin America provided the second largest number of reserachers. The databases also attraced a significant number of registrations from non-ICPC countries, with USA with 85 and the UK with 84 providing 85 and 84 respectively. As regards discipline, Chemistry and Material science followed by Biomedicine (as opposed to the Physical sciences) were the disciplines involving the largest increases in numbers of researchers. All disciplines were reasonably well represented. There was also a good spread among the application areas, with Materials being the application area involving the largest number of researchers, followed by Energy.

The table below shows the number of self-registered  ICPC Nanonet researchers registered for each of the top 15 ICPC countries, while the chart next to it shows the top 20 countries. It is evident that the project has made more of an impact in a number of countries, including Ethiopia and Sri Lanka, while others such as Malaysia, have maintained a status quo.

Figure 9: Numbers of self-registered researchers per ICPC country (top 15) comparison 2011 and 2012

Analyses of the statistics and timing of increases revealed that when there was an event and it was widely publicized throughout the ICPC Nanonet mailing list and through the dissemination channels, for example a webinar or an annual workshop, there was a corresponding increase in the number of registrations and in particular from stakeholder in the geographical or thematic area(s) concerned in the event. So for example, in the run-up to the India workshop that was a marked increase in the number of registrations received. Similarly, when theme-based webinars took place, there was a noticeable increase in the number of registrations from researchers involved in that particular discipline, eg nano-biomedicine.

b) The Organisations Database: 1223 organisations from 86 countries and regions

The organisations database was created with the aim of providing a means of identifying research strategies and organisation activities within the eight ICPC regions: Africa; Caribbean; Pacific; Asia; Eastern Europe and Central Asia; Latin America; Mediterranean partner countries; and Western Balkan countries. This database was made available to all registered users of the website, allowing researchers to search for organisations that have desired instrumentation and capacity or similar spheres of interest. Initially, to preserve data integrity, the partner responsible for the region of a relevant organisation was charged with submitting the details to the database. The data was drawn from a standard template that agreed on by the consortium).

Region Countries Organisations 2009 Organisations 2012

Africa 26 60 163

Asia 16 124 297

Caribbean 6 12 22

EECA 9 319 320

Latin America 14 151 161

MPC 12 64 136

Pacific 3 2 5

WBC 2 6 6

Figure 10: Number of Organisations per ICPC Region, December 2009 May 2012

An organisation template was also devised and sent to key identified organisations requesting them to submit further information for upload to the database. At first, partners uploaded information about organisations which continue to be searchable by name, discipline, type, application area or region. In addition, there is a free text search. Subsequently, organisations were given rights to upload their own information. The following charts and tables show the statistics for the organisations database illustrating its population over time:

The statistics showing the comparative increase in the population of the organizations database for the top countries are not represented here. Overall, Russia has shown little increase but a number of the countries in Latin America, Asia and Africa increased in their representation. Much of this is due to the research activities of the partners through the course of the project in finding out about the various institutions and populating the database accordingly.

Figure 11. Number of Organisations per Discipline, December 2009, May 2011, May 2012

The statistics for the number of organizations registered per discipline depict an increase in all fields over the three reporting periods. However, there are marked increases in chemistry and material sciences, and physical sciences. Chemistry and material sciences continued to lead.

Figure 12: Number of Organisations per Application Area, December 2009, May 2011, May 2012

Application area Dec 2009 May 2011 May 2012 The final year of the project saw a steady increase in the number of organisations registered within the various application areas. Organisations involved in materials remained tge most highly represented, again followed by electronics. Biotechnology overtook energy to take third place. Energy and environment maintained a strong presence, while economics, ethics and policy organisations still had the lowest representation within the organisations database.

Agrifood 40 60 68

Aerospace 37 44 49

Biotechnology 96 154 177

Construction 46 61 68

Economics 33 38 47

Electronics 175 218 229

Energy 103 134 156

Environment 79 120 136

Ethics 27 32 36

Health and Safety 41 64 72

Healthcare 79 123 137

ICT 70 85 93

Materials 263 413 431

Policy 29 38 43

Security 32 35 39

Textiles 29 38 46

Tools & Metrology 52 63 73

Transport 35 38 43

Type of Organisation Dec 2009 May 2011 May 2012

University/higher education 368 571 601

Research centre/institute 155 233 254

Governmental body 23 46 47

Commercial org > 250 employees 8 12 13

Commercial org < 250 employees 27 30 35

Network 56 72 79

Not-for-profit org 9 12 12

Figure 13: Number of Organisations per Type: Dec 09, May 2011, May 2012

The statistics show that there was an increase in all types of organisations in the database, with universities and higher education institutes continuing to lead. The lowest representation continued to be from not for profit and larger commercial organisations.

Year Researchers Organizations

2009 71 413

2010 572 1004

2011 1199 1122

2012 1561 1223

Figure 14: Four year summary of the incremental population of the researchers and organisations databases

The figures show that the number of self-registered researchers increased to a much higher degree than the number of organizations. This may be a strong indicator that the project had more appeal to the individual than to institutions and organizations, perhaps due to the fact that individuals may move from one organization to another as careers progress or as circumstances dictate, and therefore registering as an individual allows researchers and scientists to accommodate changes in their careers.

The next set of figures have been included to demonstrate site usage not only by researchers and scientists but by the global nano community and related stakeholders. The figures show visits, hits, and page requests over the duration of the project.

Figure 15: Website Usage Summary December 2009  May 2012

The table below shows the overall website statistics for the project duration from when records began:

Month Unique visitors/sites Visits Pages Hits

May-12 5360 10987 68211 107833

Apr-12 5401 9001 50494 79474

Mar-12 6631 11375 58597 124914

Feb-12 5470 8232 43208 67394

Jan-12 5165 8775 39240 67766

Dec-11 5297 10030 37454 57205

Nov-11 4477 9461 35608 62395

Oct-11 5217 8304 43027 73506

Sep-11 5154 9768 53831 122609

Aug-11 4350 13142 64067 93544

Jul-11 5466 12112 53660 83707

Jun-11 5524 8032 60856 94860

May-11 5958 8084 54020 115683

Apr-11 5582 7598 36636 79462

Mar-11 5250 8032 43214 91655

Feb-11 4143 6705 37560 64978

Jan-11 8857 7150 43392 91839

Dec-10 9076 7858 48549 103453

Nov-10 11164 8311 38395 86861

Oct-10 11160 8509 41131 82795

Sep-10 9064 8856 41983 89293

Aug-10 8014 9408 41214 80188

Jul-10 5096 8337 39211 70847

Jun-10 4466 7206 33529 68164

May-10 5992 8993 42431 86882

Apr-10 6626 8403 33526 74799

Mar-10 7314 9333 28771 58111

Feb-10 5605 7560 22993 41190

Jan-10 6360 8140 29131 55457

Dec-09 6458 6274 33354 69104

Nov-09 7875 7007 34141 83357

Oct-09 7449 7728 25836 58459

Sep-09 6784 6162 24834 61928

Aug-09 5525 6969 26305 48744

Jul-09 4137 3701 20300 44119

Jun-09 2756 3145 16007 38783

May-09 3467 2853 12690 29886

Apr-09 5240 2733 13805 53551

Mar-09 3279 1794 15814 34891

Feb-09 2245 1607 16624 41526

Jan-09 1396 359 11808 26175

The table shows that visitor numbers, page impressions, unique IP addresses and hits to the website increased at a healthy rate from the start of the webaliser records. The months when the website received the most hits and highest number of unique visitors were the ones when major project events were held, such as the Annual Workshop or high profile webinars. This can be partly attributed to the publicity drive for the events themselves but also the efforts of those involved to include their networks, students and department members.

Some modifications to the website took place in the second reporting period, which are largely encompassed by a new section designed to provide information about FP7 / COST and collaboration. New features included:

- A comprehensive guide to preparing an FP7 proposal: http://www.st-gaterus.eu/en/493.php
- Nanotechnology Strategy and the 2011 Work Packages: http://www.icpc-nanonet.org/images/stories/Presentations_Wshop2/Day1/1%20Hossain.pdf
- Opportunities for ICPC institutions in the FP7 theme NMP: http://www.icpc-nanonet.org/images/stories/Presentations_Wshop1/jyrkisuominen.pdf
- EC Nanotechnologies Information: http://cordis.europa.eu/fp7/home_en.html, http://ec.europa.eu/nanotechnology/index_en.html, http://nanofutures.eu/
- NMP official work programme and topic list for 2011: http://www.nmpteam.com/library/
- European Cooperation in Science and Technology: http://www.cost.esf.org/

In addition, all presentations for each online workshop and webinar were available, as were the proceedings from the Annual Workshops and the Annual Region Reports.

iii) The Research Activities

It is important that ongoing research activities in ICPC are identified and the information made widely accessible to EU researchers. This will help facilitate collaborations between research groups and build consortia for new projects (such as the Framework Programmes).

The project brought together key players who have an insight into research activities within three countries with which the EU has established S&T agreements. These countries are the largest funders of N&N in ICPC and also rate significantly on the global stage in terms of publications and patents. In addition, the project built on collaborative agreements already established between Nanoforum and networks and organizations around the world; so the consortium had either direct knowledge or access to information necessary to compile detailed and authoritative reports on nanoscience research and strategies within the different global regions.

Links were also provided to other project websites reporting on EU activities. In particular, direct links were established to appropriate webpages and the database of the observatoryNANO project which provided analysis and forecasting of nanotechnologies in terms of socio-economic benefits, opportunities, barriers, and risks. As both projects were coordinated by the IoN, multiple links between the webpages and databases of each project could be facilitated, allowing users to access more information relevant to their needs, regardless of which project website was their entry point. At the same time the partners regularly uploaded news items, reports, and articles of relevance to the community (such as calls for proposals in FP7, new infrastructure, government strategies, and output from other relevant projects and organizations) to the Nanoforum website, which already contained a database of EU organizations

The main thrust of this work package, however, was the compilation and publication of the annual regional reports. It is important that ongoing research activities in ICPC were and are identified and the information made widely accessible to EU researchers as this will help facilitate collaborations between research groups and build consortia for new projects (such as the Framework Programmes). The reports were thus aimed at providing an overview of national and regional research priorities, major infrastructure, networks, key researchers and publications (high citation index). The aim was to keep EU researchers abreast of activities in ICPC to facilitate the formation of new collaborations, and to inform the EC and national governments of areas of synergy to be explored in joint funding initiatives, for example. Research activities in the EU were specifically not covered, as such information is readily available through other projects (such as the observatoryNANO).

Each partner in the project was given responsibility for one or two ICPC regions and was charged with carrying out research activities in order to produce an annual report for their respective region(s) of responsibility: Africa, Caribbean, Pacific, Asia, Eastern Europe and Central Asia (EECA), Latin America, Mediterranean Partner Countries (MPC), and Western Balkan Countries (WBC).

Through the course of gathering details of researchers, reviewing literature and contacting appropriate organizations and networks, the partners gathered the necessary information to compile these reports. Each one described areas of international excellence, main centres for nanoscience research (including details of facilities and support offered to external users), levels of government funding and support strategies for nanoscience research, networks supporting activities, and other relevant initiatives and organizations. By publishing annually, researchers could be kept up-to-date with the changes in facilities, capabilities, support, and strategies offered in different global regions.

So that the report structure could be consistent and information comparable, each year a common template was agreed on by the project partners. To compile the reports, the partners performed a substantial amount of desk analysis, reviewed literature and contacted appropriate individuals, organisations and networks.

It was also intended that further networking connections could be created by researching information and organisations to be documented in the region reports, whereby more experts will be identified and invited to register on the database. This lead to an iterative process through which, following registration and a presence in the public domain, researchers could be added to the region reports. On achieving this, a sufficient number of researchers became directly contactable for the purpose of developing online workshops and networking vehicles. Simultaneously, wider dissemination and promotional activities continued to attract newcomers and foster networking.

The reports were further enhanced by the inclusion of bibliometric data supplied by MERIT. Each year, MERIT created a sub-data set by selecting the countries from each region focusing on publications for different research and industrial sectors. The information supplied by MERIT was gleaned from the results of their work on the observatoryNano project to avoid duplication of labour. They then analysed the publication data of each region and presented the consortium with lists of the number of Web of Science nanotechnology publications of the ICPC countries and the most prolific organisations and institutions in each region through the MERIT Database of Nanotechnology Scientific Publications (Web of Science publications), for the relevant period from 1998.

In addition, for the second annual reports, published in June 2010, MERIT provided the sectoral analyses of the scientific publications of the EU-27 countries (Web of Science publications) in line with the ten industrial sectors, namely, aerospace, automotive & transport; agrifood; chemistry & materials; construction; energy; environment; health, medicine & nanobio; ICT; security; and textiles, for the period of 1998-2007. However, because the institutions in the list are not exclusively from the regions due to international collaboration (e.g. the American, Chinese and Indian institutions appear in the list for Eastern Europe and Central Asia), the partners were required to identify the institutions located in the regions based on their expertise and further organise/clean the list as required.

Four sets of Annual reports were compiled and made available free online to registered members. The second, third and fourth reports provided updated information as well as insight into regional and national themes for collaborations but only for those countries where there have been observable developments in N&N R&D. For this reason, following the first two reports describing the scientific landscape and potential for N&N R&D, there were no subsequent reports for the Pacific. The same could be said for the Western Balkans, whereby the region now consists of only Kosovo. Once the reports were compiled, each report was reviewed by at least two partners and two steering committee members. Individuals were invited to comment and provide input for future reports.

Subsequent to the publishing of the first and second sets of reports in July 2009 and June 2010, respectively, a new template and schedule for the production of the third annual report was developed. This incorporated comments and suggestions received from readers of the first sets of reports, who advocated greater and more in-depth analyses of possible synergies for collaboration between the regions and the EU. It was also decided that following the comprehensive overview provided in the first two reports, the third set would focus on the most active countries and their associated main organisations of interest for collaborative activities. In line with this, a review of the Pacific region revealed that there were no significant updates. A third report for this region was therefore not been compiled. In addition, the most recent European Commission list of International Cooperation

Partnership Countries has declared that what was formerly the West Balkan Countries region now comprises only one country: Kosovo. Since there was no significant N&N activity for the year 2010-2011 for Kosovo, a third report for the West Balkan Countries was not compiled. Conversely, the same list also declares that Turkey is no longer an ICPC. However, for the sake of continuity from the previous MPC reports and because of Turkey's importance within the region, it was decided to include an update in the third annual report.

Finally, for the third set of reports, the partners agreed to adopt a theme-based approach which was complemented by a similar approach for the Third Annual Workshop in 2011. The region reports thus not only provided an update to the information presented in the first two sets of reports but also, in line with the thematic approach, they described N&N R&D in the following areas where applicable for each country described:

1. Energy storage, production and conversion
2. Agricultural productivity enhancement
3. Water treatment and remediation
4. Nanomedicine and Nano Biotechnology
5. Food processing and storage
6. Air pollution control and remediation
7. Construction
8. Vector and pest detection and control
9. Communication technologies
10. Transport
11. Security
12. Fundamental Research

In addition, Dr Ali Soltani of the Iran Nano Initiative Council produced a Draft Proposal on the Measurement of Nanoscience and Technology Indicators to help inform the reports. The partners agreed that while implementing all the indicators is beyond the scope and time-frame of the project (questionnaire approach in particular), some could be usefully implemented in addition to the above theme structure. Useful feedback was provided by MERIT, MTV, SPI and JNCASR as well as IoN. Overall it was felt that for a number of regions there would be difficulties in obtaining the required information to fulfil all the criteria.

In the Consortium Meeting following the 3rd Annual Workshop, the partners agreed that for the final (fourth) set of reports, published online in April 2012, all countries - including the less predominant countries in each region would be explored for current activities and updated developments. Furthermore, there would be a sectoral analysis of nano research and development to mirror the bibliometric analysis of industrial sectors provided by MERIT for the reports. This final set of six reports was published in time for the Fourth Annual Workshop and poster presentations were given of each of the published reports.

The following feedback has been extracted from responses to an invitation issued to all ICPC Nanonet members to comment on on the region reports:

- -The information was needed to classify and compare the foreign activities with our national ones.
- -The document contains very interesting information that makes visible the nanotech activities in different countries
- -For the above reasons, it would be very interesting if the report continues to appear in the future
- -Is very important, it give some visibility to our network. But the annual region report must be done every year and the work doesn't finish yet.

iv) The Dissemination Activities, Webinars, Workshops and Networking Events

A key aim of the project was to engage in dissemination and networking activities in order to create as many opportunities as possible for researchers to be made aware of each other and to raise the profile of the project itself. Initially, this required the creation of an ICPCNanoNet project website as a repository for all information about the project. The partners also established a mailing list of dissemination channels, including news services and news aggregators, to provide information about the project through the form of regular press releases. Partners also used their own networks and activities to disseminate the project output.

These objectives for this workpackage were achieved in various ways, including:

a) Active dissemination:

- building upon the existing Nanoforum (http://www.nanoforum.org) website that attracts more than 80,000 visits each month; including some integration of EuroIndiaNet (http://www.euroindianet.info) and collaboration with NanoforumEULA (http://www.nanoforumeula.eu), as well as other appropriate organisations, networks and projects (such as the observatoryNANO which is also coordinated by IoN).
- identifying a number of dissemination channels, such as news sites, newsletters, through which information about the project and its activities can be published. In the latter half of the project this was extended to include social and professional networking sites.

a) Creation of networking platforms and facilitating opportunities:

- facilitating direct collaboration with organisations that network activities in ICPC e.g. those listed already on Nanoforum, EuroIndiaNet, and NanoforumEULA, as well as other contacts. This allows new information to flow quickly between all the organisations, enhancing the profile of the website and its facilities, in ICPC.

- hosting annual workshops in the EU, China, India and Russia, and through the webcasting of these workshops and separate online workshops wider participation could be achieved.

**Active dissemination**

As stated in the previous section, the NanoForum website was continually populated with news of the latest N&N developments, as well as information about research activities and collaborative agreements. Reports and articles of relevance to the community were also uploaded so that nano stakeholders could be made aware of calls for proposals in FP7, new infrastructure, government strategies and output from other relevant projects and organisations. One of the ICPC Nanonet project's achievements, therefore, was to keep the NanoForum website live and updated.

All Consortium members contributed to this deliverable and continued to disseminate project news and information through the channels that were identified at the outset of the project. These channels include conferences, exhibitions, invited talks, posters, presentations and other events as well as the following:

- Cordis
- Nanowerk
- The ICPC Nanonet quarterly Newsletter,
- NanoForum website
- Institute of Nanotechnology website and newsletter
- ICPC Nanonet mailing list
- ICPC Nanonet quarterly project newsletter
- Linked In
- NanoPaprika
- NanotechNow
- Nanotechwire
- SciDev
- Nanotechweb
- Nanovip
- observatoryNano project dissemination channels
- NanoPaprika
- NanoNews SANi / University of Witwatersrand

Figure 19. Quarterly project newsletter disseminated through all channels and aggregators

A key dissemination vehicle was the project newsletter, compiled and produced on a quarterly basis and then disseminated through all identified channels. The newsletter were also hosted on the website.

At the end of the project, the following feedback on the newsletter was received:

- -We found very interesting information about nanotechnology activities around the world, and this was a good way to share experiences.
- -More numbers of the newsletter.
- -It has allowed to have an overview of who is who and to learn from each other experiences.

News website, social media sites (including Linked in and NanoPaprika), news aggregators and other project website were all highly obliging and willing to host ICPC Nanonet news items, particularly if this led to mutual networking support. However, dissemination activities are best conducted multi-directionally rather than through push media channels alone. Networking platforms and pull media were required in order to allow for researchers and nano stakeholders to engage with each other

Creation of networking platforms and facilitating opportunities:

To facilitate one-to-one networking, a forum was constructed and hosted on the website allowing registered users to share information and discuss new initiatives as well as post information about events on the forum calendar. However, website forums do not allow for real-time discussion or in-depth showcasing of research and findings. For this reason, the project also held regular online seminars, or webinars.

**Webinars**

Conferencing software was effectively used as an online workshop and networking tool by the ICPC Nanonet members. After test-driving fourteen software solutions, initially Nefsis was selected for quality of audio, ease of use, cost effectiveness and support. Subsequently, Webex was chosen as it functions on Macs as well as Windows platforms, and has both phone-in and VOIP options. This meant sacrificing the excellent technical support and superior audio quality offered by Nefsis, but enabled more individuals to take part, particularly in broadband blackspots.

These systems allow registered hosts to create virtual conference for workshops. Users require a headset, microphone and broadband connection to access the online workshop or in the case of Webex they were able to phone in. There is a shared space where users can view powerpoint presentations, and upload files, and with some software users can make a number of visual signals online, e.g. to ask a question, to agree, etc. Each webinar was moderated and chaired to ensure that there was a smooth flow of discourse and interaction. Moreover, the workshops were limited to 25 participants to facilitate effective engagement. A number of webinars took place on topics relevant to ICPCs, often discussing local solutions to local problems. Other series focused on specific regions to showcase the latest R&D in N&N. For each webinar, the partner responsible and the coordinator invited a number of potential speakers with the aim of securing two or three for each session. Participants were also invited to submit one slide highlighting their research areas for networking

purposes. All materials and contact details of presenters and related researchers are still downloadable at http://www.icpc-nanonet.org.

Roughly one week prior to the event, the speakers carried out a test-run with IoN to ensure that their systems were optimized for the event. To generate interest and registrations, IoN then publicised the event through the ICPC Nanonet mailing list, NanoWerk, the Institute's own website, the project website, etc. MTV promoted them through NanoForum and SPI advertised it through all the other dissemination channels. Evaluation forms were sent out after the event, and correspondents were invited to comment on context, material, quality and so forth. They were also invited to propose topics of interest for future webinars. A few unavoidable issues were encountered including prospective speakers lack of confidence in delivering a webinar in English, no guarantee of a stable internet connection, and limited bandwidth in broadband blackspots. Nevertheless, each webinar attracted a considerable number of registrations - the common scenario was to have one third of those who had signed up appear on the day. All the webinars were well attended and received.

The webinars included the following sessions and series of sessions:

- Nano for Poverty-related Diseases and Cancer
- African Network for Solar Energy (ANSOLE)
- Nanomaterials for Biological Applications
- Nanoscience Research Highlights - Asia (East)
- Nanotechnology for Clean Water
- Nanotechnology for Solar Energy / Photovoltaics
- Bridging the Nano Divide - Networking and Collaboration
- Nanobiomaterials for drugs or medical applications
- Nanotechnology for a Knowledge Society
- Nanotechnology for Biomedical Applications (Latin America)

Among the general feedback on the project, the following comments were made about the webinars:

- -It would be very interesting to find a way to guarantee the webinar series promoted by ICPC-Nanonet. A regular programmation of these webinars is a challenge for the future in fields of common interest as has been done by ICPC-Nanonet.
- -We would like to host Webinar on Undergraduate Nanoeducation Degree Program and its Importance.
- -The web seminar you are inviting us are very interesting for us here in Havana. In fact, I would like to congratulate you for the achievements of the web seminars in topics of great significance and impact for our countries. Specifically, this last web seminar you are proposing is remarkably interesting for its topics that prestigious researchers will address. I am sure that actions as the ones performed by ICPC contribute in the introduction and spreading of cutting-edge topics with great impact in our countries.

- -This was the uppermost appreciated activity. I wish if we could continue to organize such webinars. Continuity and sustainability of such a webinar series in partnership with other ongoing EU FP programmes
- -It is a good opportunity for developing countries to attend these workshops and webinars.

Figure 20: Example of webinar interface and features (Nefsis software)

**Annual workshops**

The Annual Workshops were designed to attract researchers and representatives from the host region, to present the latest research developments and also to discuss ways of improving synergy and collaboration. They also aimed to include representations from appropriate government agencies and funding bodies in order to foreground national and regional strategies as well as financial opportunities for collaboration. The partners therefore planned for four annual workshops in four target areas: the EU, China, India, and Russia, to be themed around research areas of synergy between EU and ICPC researchers in that particular country and surrounding states (such as nanotechnologies for clean water, the environment, energy, and health). The themes were identified through the research performed for the annual reports and from members of the International Steering Committee. These individuals were selected for their internationally recognised expertise in N&N, and were invited to deliver talks and chair sessions at the workshops as well as contribute to the review of proceedings. Other speakers and panellist included leading researchers from the region and expert representatives from other regions. Up to 75 participants were invited to each workshop, including the invited experts and representatives from the partner organizations.

The first workshop took place in Prague, in conjunction with EuroNanoForum 2009. The Third and Fourth Annual Workshops were originally scheduled to take place in India and Russia, respectively. However, at the consortium meeting that took place following the Beijing workshop, St Petersburg Electrotechnical University proposed that since its 125th Jubilee Anniversary of the Institute would be taking place in 2011, it would be appropriate to host the ICPC Nanonet Workshop in conjunction with the anniversary celebrations. The consortium agreed and thus the Third Annual Workshop was held in St Petersburg on Tuesday 24th and Wednesday 25th May, 2011, while the Fourth was held on 2-4th April 2012.

Figure 21. The participants of the 2nd ICPC Nanonet Annual Workshop, Beijing 2010

Figure 22. Participants of the 3rd ICPC Nanonet Annual Workshop, St Petersburg, 2011

JNCASR organised the final workshop at the Zuri Hotel Resort, Goa, India from April 2nd 4th. The venue was selected for its excellent conferencing facilities. However, JNC also ensured that there were guides and accommodation available for those who wanted to visit the laboratories in Bangalore prior to attending the workshop. The theme of the workshop was Nano for Water, Energy and the Environment. As with previous workshops, the fourth ICPC NanoNet Workshop offered networking platforms and opportunities to

Figure 23 Participants at the 3rd ICPC Nanonet Annual Workshop, Goa, 2012

increase and intensify the number of collaborations between the EU and ICPC in the areas of Nanoscience and Nanotechnology. The event was held over two days and, in a departure from the

previous workshop structure, facilitated the required insight into Nanoscientific and Nanotechnological activity in International Cooperation Partner Countries (ICPC) through poster presentations rather than talks. Importantly, the workshop included a discussion group to examine the sustainability of the project output and generate ideas, as well as provide a platform for future collaborations and networking.

**Live Webcasting and DVDs**

As physical workshops can only ever reach a small percentage of appropriate, active researchers; the consortium developed a web-casting facility that would allow remote users to view presentations and engage in discussions in real-time. In addition to being able to view and hear the presentations, this facility afforded registered users the opportunity to pose their own questions, which were received by an anchorman from IoN at the workshop (one of the partners) and fielded to the relevant presenter. The webcasting facility for this widely promoted, however, despite widespread publicity and promotion there were fewer registrations than anticipated (19) and almost no participants. This was reviewed for the 2nd workshop 2010 and consequently there were 53 registrations. For the 2011 workshop, again there were even more registrations and participants, and more interaction in the form of questions being asked and fielded to the various speakers. The final webcast from India 2012 attracted nearly 100 registrations, but as expected not all attended. Nevertheless, the live webcast increased in popularity and effectiveness, especially as the ICPC members were becoming more and more familiar with the features and functionality of the system.

Since global time differences made participation difficult from a number of countries in different time zones, PDFs of presentations and all the proceedings were made available on the project website for registered users to download. In addition, a complete video of each workshop was created, edited and burned onto DVDs to be sent to ICPC researchers on request. It was originally decided that 100 DVDs would be pressed, but due to high demand, this was increased to 200 for the 2nd, 3rd and 4th Workshops.

Achievements:

After each workshop, feedback forms were distributed to the participants inviting them to submit their appraisals of the workshop using the following criteria:

- Structure of the workshop
- Information about the ICPCNanoNet project
- Presentations
- Information documents
- Organization
- Host city
- Venue
- Contact between participants

General remarks and suggestions made by participants and partners after each workshop were taken into consideration in the planning of the subsequent one. Significantly, after the fourth workshop, unsolicited feedback from participants was received via email, and included the following comments:

- -It has been useful to know the state of the art of specific fields and to networking researchers from different countries.
- -An international forum for nanotechnology networks around the world is very important to promote the dialogue, the international cooperation and the use of nanotechnology for a sustainable development. The ICPC-Nanonet project could be seminal in such propose.

An update of the standard procedures to evaluate nanotoxicity should be welcome.

Very interesting for networking. We have developed very useful relationships that helped us to organise meetings and cooperation. New people and new contacts for information gathering.

Very important, it will more interesting to organise the annual workshop in developing countries.

- -Dvds El centro no tiene suficiente ancho de banda por lo que le pido a Lesley Tobin que me lo envie en DVD.
- -Other workshops on advances or recent nanotechnology fields

It was a wonderful workshop. I do hope this continues and the issue of sustainability is taken up seriously.

- -Thank you for your kind invitation, the workshop was interesting and meet our expectations. Looking forward to follow up the activities for future projects.

The net of nano has indeed become wider by this meeting. This widening is seen in terms of people, areas, implications, future and several others. I am glad that I was part of this. All the best.

- -Thank you once again for arranging such a nice workshop. I wish we will have further cooperation.
- -The meeting was excellent organized both from a technical and social viewpoint. It was also a pleasant location. Congratulation to the organizing team
- -Congratulations on a very successful event and thanks a lot for your huge efforts. It was my first participation in this forum and there was a lot to learn, it was very interactive and I am sure this network will continue and progress further.
- -Thanks you so much for the very able organization of a very successful conference. The hospitality and quality of presentations were great and are very much appreciated. I had a good time. and it was great to meet all those excellent Indian Scientists to come with Prof. Rao.
- -I'd like to send my appreciation and congratulation for every member of the organizing team.

It was a fantastic, memorable event, both the scientific and the social programs were great.

Thank you very much and congratulations,

- -I want to thank to the organizing committee for the excellent work carried out for the Fourth Annual ICPC Nanonet Workshop. It was a really wonderful conference with the possibilities to interact with all participant. I really hope that the activities of the network could be continued!

- -Work is progressing well thanks in large measure to my being able to attend the Goa conference I have now also included the nano-silver water filters as one of the case studies for my PhD. There are three of these nano-silver filters in the Indian market and two were represented at Goa. Following up from there, I have now had detailed interactions with both the groups of scientists- Dr TN Rao at ARCI, Hyderabad and Dr. Pradeep at IIT Madras. Much needs to be done but it promises to turn out well.

- -I think is an excellent effort. It will be very interesting if you will do a seminar in EUA, Canada, Mexico or in South America

**Conclusion**

In the European Commission Action Plan for Nanotechnologies it states that 'International cooperation in N&N (nanoscience and nanotechnology) is needed both with countries that are economically and industrially advanced (to share knowledge and profit from critical mass) and with those less advanced, to secure their access to knowledge and avoid any "nano divide" or knowledge apartheid. This knowledge divide can be attributed to the lack of facilities resulting from the high costs of equipment; the lack of funding and government backing; brain-drain; the increasing number of patents filed by more developed countries; intellectual property rights; journal charges; expenditure in skilling up; and development and scaling-up costs, among other causes.

The ICPC Nanonet project identified and developed tools to bridge the divide: tools that would not be cost prohibitive to researchers and scientists in developing countries and emerging economies. These tools include the web-based, open access repository of N&N publications: The Nano Archive; searchable databases of researchers and organisations for networking and forming collaborations; annual region reports to inform and facilitate networking between EU and International Cooperation Partnership Countries Research and Technical Development (ICPC RTD); online webinars, workshops and a forum; and annual workshops for dissemination and networking. It is evident that many of the networks and connections that have resulted from the project can be sustained by those engaged in ongoing activities and subsequent meetings and introductions. It has also been made clear that a number of organisations are now engaging in the development of their own tools and, for example, taking part and hosting their own webinars. However, it has been made clear from many of the participants that this has been an enormously successful initiative and momentum should be sustained through future complementary schemes that can draw on and develop the tools and ideas that have proven so popular within the global nano community, and this can only be achieved through continued interaction with researchers throughout the EU and ICPC. It requires actors who have existing relationships with key organizations in different regions and who can engage with individuals within these organizations to learn of their activities and encourage researchers to collaborate and participate in networking activities.

**Potential Impact:**

**4.1.4 Potential Impact and the Main Dissemination Activities and Exploitation of Results**

In the long-term the impact of the project could result in the establishment of networks of interaction and collaboration between and throughout the EU and ICPCs as demonstrated by the expansion and consolidation of the African Network for Solar Energy. These networks will have been built on the foundations of existing relationships between the consortium partners and key organisations in different regions, and new relationships forged during the course of the project. The goal has been to enable individuals within these organisations to engage with each other, learn about each others activities and encourage other researchers to join the network and contribute to its activities as well as to the archive.

As regards the online repository, it was envisaged that the number of articles would have reached an identified critical mass with the accumulated of deposited peer-reviewed publications from a number of sources including existing archives, publishers and journals, from the partners own research centres, and from other researchers across the EU and ICPCs. Moreover, there are a number of editors now who will continue to upload their own peer-reviewed research papers. This research is now available to and accessible by any interested party with an internet connection, having been promoted through partners existing and extending networks and contacts, via the project website, and through identified dissemination channels. Free online availability should substantially increase each paper's impact and help bridge the nano divide.

All researchers and organisations have been encouraged to register on the database, form networks, exchange information and engage in the various project activities, such as contributing to the annual reports and online workshops. In this way, they have discovered more about other researchers and their activities and inform these too. It is envisaged that the networking mechanisms will be in active and productive use on a regular basis. These tools are vital communication arteries that will sustain the flow of information throughout the various networks and their capillaries and thus support the active engagement of ICPC researchers who may not have the budget to travel to physical workshops, or for whom global time differences impede live communication to other areas. Using these tools has inspired a number of researchers to establish their own networking mechanisms using software packages, and to register for free webinars and online workshops. In this way, the project has helped to counterbalance the financial exclusion experienced by many scientists by making research, workshops and networking opportunities available online, thereby eliminating the travel expenditure that is frequently precluded to researchers.

Concerning the impact of ICPC Nanonet on sustainable development, it is outside the scope of this project to perform life-cycle analyses (LCAs) on new technologies. However, in the course of reporting on activities within ICPCs and disseminating information about the latest R&D in these areas, the project has identified those organisations that are undertaking such work, and through the webinars, reports and workshops it has showcased new technologies which can contribute to sustainable development in the EU and ICPC.

A key aspect of the project has been to inform researchers of opportunities to access FP7 funds. This was achieved through the publication of announcements from the EC, and through facilitated networking on the website to allow researchers who are geographically isolated but who have complementary skills, to collaborate on research proposals to the EC. A bespoke section on the

website was also created to provide guidance notes and links to FP7 calls and funding. In addition, information about FP7 funding and projects has also been delivered via the website, at the Annual Workshops, and during the online webinars.

Finally, the project output of ICPC Nanonet will directly contribute to an expanding body of knowledge within the EU through the active networking of researchers in ICPC who will continue to exchange and disseminate knowledge and expertise (both technical and educational) through their ongoing activities. It has also assisted in the mapping of an infrastructure outside the EU which could be of use to EU RTD through the annual reports on N&N research in ICPC. The project has included partners from countries which have an established S&T agreement with the EU and sought to build relationships with researchers in other ICPC through the broad range of activities it undertook.

**Potential Impact of the ICPC Nanonet Project**

Initiatives such as the ICPC Nanonet project require interaction with researchers throughout the EU and ICPC, and while critical mass is desirable and achievable, they still require input to sustain momentum and to be able to move with the times as well as with global shifts in research and market trends and influences. Nevertheless, the project ends at a point where the concerned researchers and scientists will continue to forge new relationships with key organizations in different regions and will engage with individuals within these organizations to learn of their activities and encourage researchers to liaise and collaborate through the tools that they have encountered through the project.

As regards the dissemination of selected high quality information in countries where nanotechnology is not yet developed, the ICPC Nanonet project has facilitated the aggregation of publications from a number of sources: existing databases, publishers and journals, and from researchers themselves. By making this information freely and easily available on a globally recognised website, it has ensured that it will be easily accessible from a very low-maintenance repository. Also by using this medium, the project has ensured that this information can be accessed by as wide a community as possible.

The project has created a number of mechanisms by which researchers can network: from email (through contact details in the electronic archive of publications or the database of researchers); and use of all the information hosted online, including the annual reports, workshop proceedings, webinar programmes and information and the databases. These routes to direct networking are crucial to the active engagement of researchers within ICPC who do not have the budget to travel to physical workshops and conferences. By providing freely available information on N&N research, and collating this material in one place, the project has helped to provide a level playing field with regards to access to scientific knowledge and it has promoted inclusivity in the research and development in nanotechnology. Importantly, by providing online networking, workshops and the opportunity to participate remotely in physical workshops, the project has demonstrated that those who want to participate and network, need not be excluded through lack of financial means. Evidence suggests that it is highly likely that many more events will be webcast, that scientists will be able to deliver talks and lectures virtually instead of allowing the lack of financial resources to prohibit them from engaging in forums, conferences and symposiums.

The project itself has pointed towards a number of logical steps forward. These include the formation of education networks, both online and in the form of placements and exchanges for skilling up in practical terms; in other words, skilling up through human mobility programmes and research opportunities so that acquired skills and knowledge can be brought back home and cascaded through

the younger scientific communities. A second logical step would be to exploit the newly established connections and collaborations between ICPCs and the EU to bridge the valley of death between research and industry by investigating opportunities for investment and development in regional and global markets.

As regards sustainable development, ICPC Nanonet has revealed how in the quest to provide local solutions to local problems, nano has enormous potential for the millennium development goals, and in the course of reporting on activities within ICPC it has identified those organizations that are undertaking such work, as well as the new technologies which can contribute to sustainable development in the EU and ICPC.

A key aspect of the project has been to inform researchers of opportunities to access FP7 funds. This has been achieved through the publication of announcements from the EC on the website, during webinars, and at the start of the annual workshops. There are now ongoing plans among various organisations who have met and engaged through the ICPC Nanonet project to submit proposals for the 2013 FP7 calls for ICPCs. Through similar tools to those used during the project, parties who are geographically isolated but who have complementary skills can now collaborate on research proposals to the EC; meetings can be held on Skype and using web conferencing freeware. Guidance notes and links to CORDIS are still available on the project website.

Any perpetuation of the project tools will assist to reinforce the international dimension of European research within the 7th Framework programme. The project has brought together partners from key global regions, and its tendrils have reached a good many more through the engagement activities and dissemination channels. Introductions will foster further introductions and new relationships will be fostered five different states. The project aimed to inform and network researchers from the EU and ICPC, thus demonstrated its potential to be truly global in its outreach.

**B3.2 Spreading excellence, exploiting results, disseminating knowledge**

The ICPCNanoNet work programme was designed to maximise user feedback and input to the project deliverables. This was achieved through online networking spaces and physical workshops, input to the annual reports, and direct emailing of partners. By its nature this process will continue to help disseminate knowledge and spread excellence as introductions have been made, relationships have been forged and collaborations are in the making. The annual reports and proceedings from workshops have given clear indicators of infrastructure, research capacities and expertise within each region, as well as describing research programmes, and government strategies and policies. This will allow researchers to identify appropriate centres and support schemes for undertaking research activities.

The partners were already members of various networks each with different regional, international and disciplinary outreaches. The project undertook to establish and foster collaborations and information exchange with a wide variety of stakeholders, through the annual workshops where different experts and local researchers will be brought together, and dissemination activities including websites managed by the project partners, networks they participate in and existing information providers. This will continue as organisations and individuals have now been made more aware of each other and their respective capacities.

ICPC NanoNet made full use of dissemination routes established during the Nanoforum and EuroIndiaNet projects, including liaison with various international networks such as Asia Nano Forum (promotes excellence in research, development and the economic uptake of nanotechnology), NanoAfNet, ReLANS, IBSA, AMRS, Iran Nano Initiative Council, REGINA (a network of nanoscience and technology researchers in Mexico), and Nanotechnology News Network (a webportal and consultancy on nanotechnology and nanobusiness in Russia, the Commonwealth of Independent States and other countries). In addition, ICPC NanoNet will make disseminate information to the 13 000 (plus) existing registered users of Nanoforum, who are spread across the globe, the International Nano Community at NanoPaprika, which has over 5,000 members, and the IoN database of 67,000 nanostakeholders. In the course of the project, as more researchers registered online to make use of the project's facilities and as more publications were uploaded with author and editor contact details, this number was expected to increase year on year. The proactive uptake by news aggregators, and the willingness of numerous websites, such as NanoWerk, to assist in the promotion of the project has indeed helped to broaden the network.

**Overall**

The following general comments were received from various ICPC Nanonet members:

- A very important project to involve countries, which are not as developed like US, Japan or European countries; to give them a possibility to present their work and to offer chances for global networking.
- In my opinion the project is very practical and well organized.
- Integration with other similar projects could eventually improve the usefulness of the Archive, to provide an overview of research in the field more complete than what can be obtained on the only basis of voluntary download from the researcher. I do not know how many, interested in this field of research, are aware of this opportunity.
- The ICPC Nanonet project is a very important experience because it is the first step to promote the dialogue in different countries and region around the world. The possibility of networking less developed regions with industrialized countries will impact positively in avoiding nano divide. In my opinion, this kind of project should be maintained and reinforced by including grants to promote international cooperation among the different networks.
- Relevant and with strong impact
- The Nano Archive was and is an innovative cloud approach to access high level literature without infringing the copyrights.
- The webinars series has allowed our network to engage in new partnership especially within the south such as IBSA and BRICS platforms.
- The ICPC Nanonet should absolutely be sustained in a form or an other. It should either re-apply for a new FP7 or horizon 2020. In the meantime, it could also explore partnership with established organizations such as the UNESCO-TWAS http://www.twas.org

- I have been a late addition to the ICPC Nanonet project and attended only one meeting of this group. I however feel that this group is very interesting and can go a long way in fostering interdisciplinary research. My role in this group has been to talk about product sustainability. This is something of utmost importance in use of nano particles. In the nanonet project addressing of these issues have been done and I think that this is in the right direction.

- The ICPC-Nanonet is a great opportunity for me to have access on wide range of informations which are the most importants facts when it come to research and development and networking by knowing who is who and who is doing what.

- EXCELLENT AND OUTSTANDING ICPC NANONET AMONGST ALL NANONETS THE BEST - KEEP IT UP

- ICPC project was beneficial for us, our research group and our network. It was a good thing for our scientific activities in our country, it had push toward some developments and progress in the field of nanotechnology and Solar Energy.

- Thanking you for your interest in the support of scientists in developing countries.

- They are doing a great job in spearheading Nanotechnology and focusing on spreading information about new developments.

- Good ,very important

- I think it is very well presented, very well organized, and has a lot of support material.

- For us it is helpful. Thank You.

- It is very good project dealing with update in nanotechnology. It provides interesting information for researcher. However, it could be more advertised and seeks more for collaboration possibly in Asian or South East Asian countries, possibly by some workshop/conference/meeting events.

**How did the Project Engage with Policymakers and other Key Stakeholders**

Networking with the Networks

To facilitate direct collaboration with organisations that network activities in the relevant countries, the ICPC Nanonet project partners engaged in activities that would promote the project's networking tools and services among the global nano communities. Throughout the four-year duration of the project, partners attended events, conferences, seminars and workshops, delivered poster presentations, talks and lectures, and hosted exhibition stands. Connections were forged with NanoScience Africa Network, who became an Associate Partner of the Project; the Latin American Nano Network (ReLans), whose director joined the project steering committee; the Africa Materials Research Society; Asia Nano Forum, and the Africa Caribbean Pacific Ambassadors subcommittee for sustainable development in Brussels, among others. The project was also instrumental in assisting the start up of the African Network for Solar Energy (ANSOLE). The following selection of images depict some of the various networking activities that project partners took part in.

The African Network for Solar Energy  ICPC Partners assisted in its start up and networked the key African Researchers for the Linz Symposium at the Linz Institute for Organic Solar Cells, Johannes Kepler University

Asia Nano Forum, Iran 2011. ICPC Nanonet took part as observers to the proceedings and were able to promote the project. As a result the ANF representative from Sri Lanka was able to participate at the Annual Workshop in Goa and collaborate with regional counterparts.

In addition to an extensive fact-finding mission in the Latin America, ICPC partners hosted a webinar for Latin American researchers to liaise and network with each other, using the online webinar tool.

The project partners delivered talks online to a number of audiences across the globe, including the Instituto Tecnológico Metropolitano - Medellín  Colombia, and the Jordanian NCPs at an EU Policy Workshop in Brussels.

ICPC Nanonet took part in an inCREAST Project Meeting designed to intensify international cooperation in science and technology between the European Research Area and Eastern European/ Central Asian Countries and was showcased as Project of the Month:

http://www.increast.eu/en/1327.php

In return, ICPC Nanonet disseminated materials about the inCREAST Project at the St Petersburg Annual Workshop, 2011.

ICPC Nanonet hosted an exhibition stand at the Iran Nano Festival 2010 and again in 2012. Following this, there was a marked increased in the number of Iranian researchers registered on the project database. Two researchers delivered webinar presentations for the Nano for diseases series.

ICPC Partners took part in a number of global nano events, including Bangalore Nano, RusNano and EuroNanoForum 2011. Partners gave talks about the project and its networking tools and delivered poster presentations, as well as disseminating project literature.

Networking the networks: Morocco AMANET, African Network for Solar Energy, NanoScience Africa Network, African Materials Research Society, South African Research Chair initiative, and institutes in Tunisia among others were represented at the Linz Institute of Solar Energy Symposium for ANSOLE.

**List of Websites:**

4.1.5 Project Website and Contact Details

All information on the ICPC Nanonet Project can be accessed at http://www.icpc-nanonet.org (see below for a screenshot of the homepage).

Information is divided into details of the project, the organisations and researchers databases, a repository for the Annual Region reports, a news and events section, proceedings from all workshops and webinars, information and guidance for FP7 projects and other useful links. There is also a direct news feed from the NanoForum website.

**Partner Contacts**

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