

9. IMPLICATIONS OF GENNESYS FOR EDUCATION

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The structure of our universities has changed little in the past fifty years, they are still organised in the traditional fields with little or no horizontal structures. In materials science – as in many other fields – much of the most exciting discovery potential is located at the boundaries between traditional disciplines: Already today, many new materials and devices are designed and developed by materials scientists working with chemists, physicists and engineers. It is thus apparent that we need to create new types of universities and colleges which have “departments without walls”.

To face up to the massively sectorial investments of major or emerging countries targeting world leadership in some economic areas, Europe and partner institutions must overcome the fragmentation of the human and materials resources of European Research by gathering the best teams to share these resources through integrating them into new European organisations (GENNESYS European College of Excellence). The GENNESYS initiative represents a unique and attractive opportunity to gather and integrate geographically-dispersed human resources and effectively scientific facilities for training and promoting activities.

In order to compete with USA and Japan as well as China and India, Europe has to mobilise resources and establish Centres of Excellence in biology and nanomaterials research and education, as pioneered by our nuclear physicists and astronomers (CERN is a heroic example).

In nanotechnology, breakthroughs happen closer and closer to discoveries in basic research. In turn, the concept of “pre-competitive research” has little relevance for this field. Furthermore, progress in materials science and nanotechnology is to a large extent related to development of new characterisation methods.

Education challenge in nanomaterials science and technology

Many companies throughout Europe and the world report problems in recruiting the types of graduates they need, as many graduates lack the skills to work in a modern economy. For Europe to continue to compete alongside prestigious international institutions and programmes on nanomaterials, it is important to create a “European Elite College” which provides a top-level education and the relevant skills mix. This should be a new institution, involving new “satellites” of leading universities and other institutions throughout Europe. Such a college should cover education, training, sciences and technologies for research, and have strong involvement by European industry.

The elements for such a high level education are

- Multi-disciplinary skills;
- Top expertise in nanomaterials science & engineering;
- Literacy in complementary fields;
- Exposure to advanced research projects;
- Literacy in key technological aspects: exposure to real technological problems;

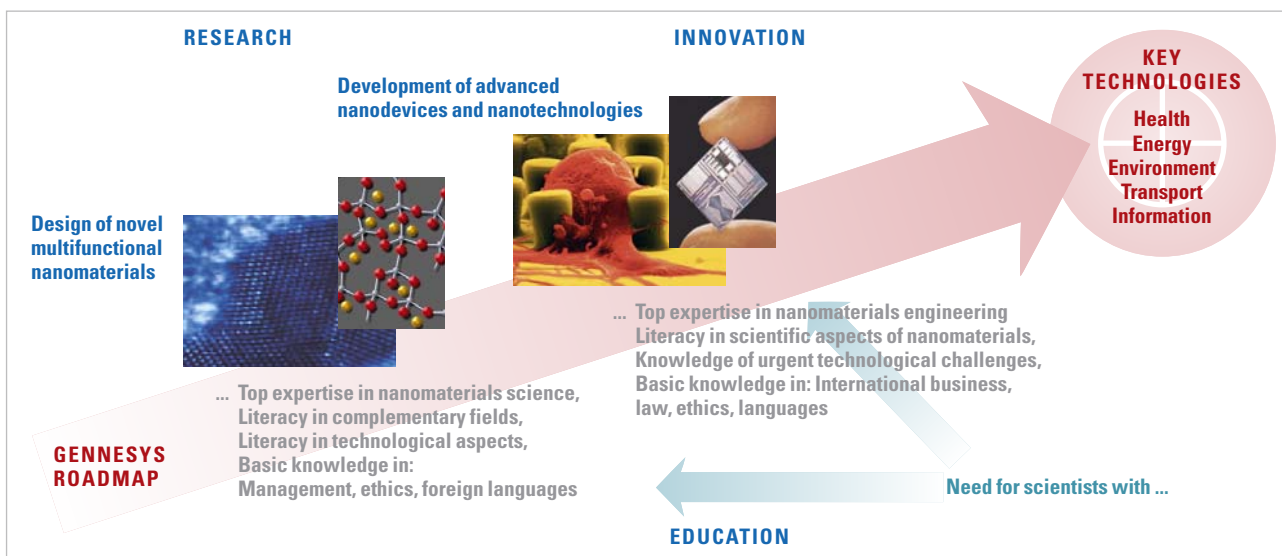


Fig. 9.1: The education challenge in nanomaterials science and technology.

- Basic knowledge in: social sciences, management, ethics, foreign languages;
- Literacy in neighbouring disciplines: international business, law, etc;
- Interlinkages between: education, research and industrial innovation: students will be ready for that research and development will provide;
- Sharing of post-docs, Masters and PhD students to foster the mobility of permanent researchers and professors between different institutions are needed to create "team spirit".

Companies, universities, governments, research organisations and technical societies must all strive to define their roles in this partnership.

The goal of the GENNESYS College is to develop a mechanism where education, research and industrial innovation merge. The GENNESYS vision is to create a place for training the most promising and highly motivated young scientists in Europe, where students will receive the highest standard of education and research management which will arm the graduates with the knowledge, methods and mechanisms to solve the future problems. The "output" will be graduate scientists and engineers excellently equipped for careers in top posi-

tions in the academic world, research management and industry to safeguard the future welfare of the society and meet industrial/economic challenges (see also Fig. 9.1).

The new educational syllabus will be multi-disciplinary with an early involvement of the students in current research projects. The curriculum will be developed and adjusted jointly with industry. The studies are to be complemented inter alia with language, culture and society knowledge.

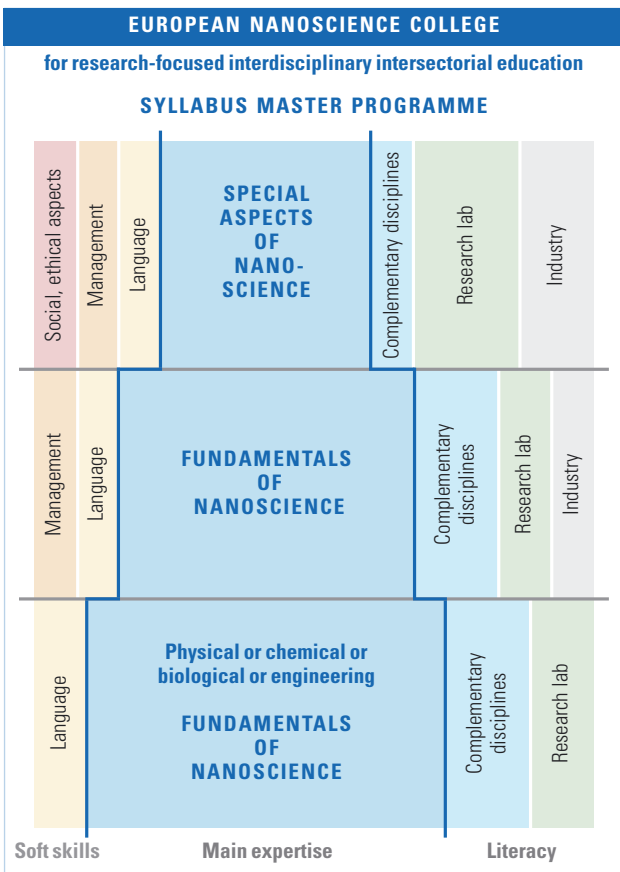


Fig. 9.2: New education syllabus for future materials scientists.

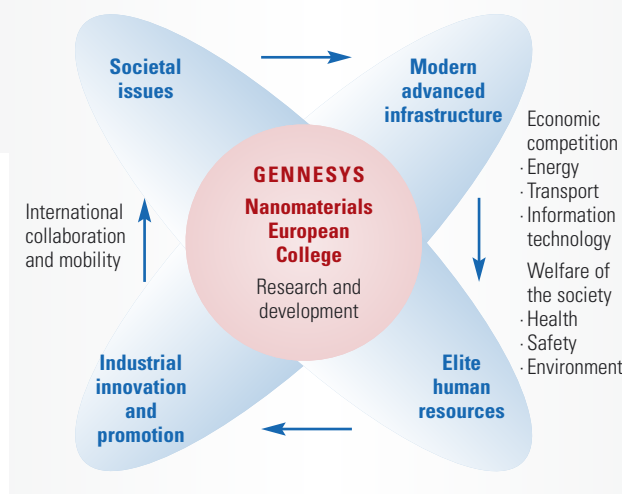


Fig. 9.3: GENNESYS COLLEGE: "Nanomaterials development scheme".

Partners of the European College

The international institute will offer both education and training. The training will cover master's degrees and professional doctorates, linking university researchers and training for industrialists with recognised qualifications.

The European College should have strong links with universities of excellence in Europe, nanomaterials research institutes, the research infrastructure and industry. The GENNESYS Centres of Excellence should play an important role.

The GENNESYS European College complements and supports the ideas of the European Institute of Technology. The GENNESYS European Nanomaterials College should become an influential body in Europe that stimulates, fosters and promotes education, research and innovation in nanomaterials, nanomaterials-related (life-sciences, physics, chemistry, engineering) science and technology in Europe. The college should become a platform which brings together different aspects of materials science in Europe and makes interfaces/synergetic interactions with all science-, science policy bodies and industry in Europe and worldwide. The structure could be envisaged as schematically represented by Fig. 9.5.

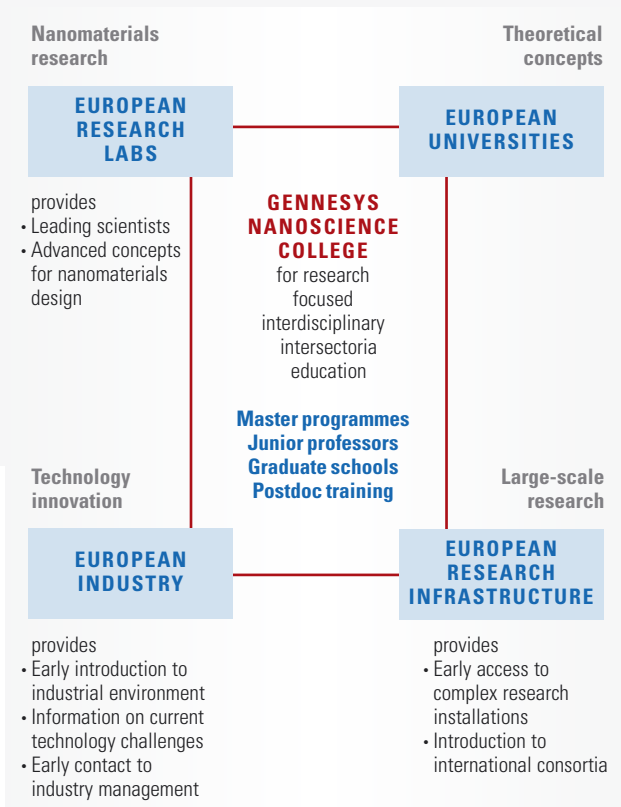


Fig. 9.4: Partners of the European Nanoscience College.

The benefits of a European Elite College in nanoscience are manifold: The students will:

- Receive an excellence degree recognised across Europe and appreciated worldwide;
- Become attractive top-experts with literacy and management skills;
- Get promotion to leading positions in universities, research institutes, industry and government in Europe;
- Get early contact with key industrial problems.

The universities in Europe will:

- Join for an advanced international nanomaterials education;
- Attract the best students;
- Be able to offer joint academic appointments across disciplines, between universities and industries;
- Be able to offer new professional degree programmes with research institutes, the European research infrastructure and industry;
- Be involved in knowledge integration and transfer.

The Research institutes will:

- Be directly involved in focussing the education to the current research fields;
- Be able to recruit the best suited students.

Industry will:

- Be able to directly influence the skills mix of the students;
- Get in touch with the best talents facilitating their recruitment processes;

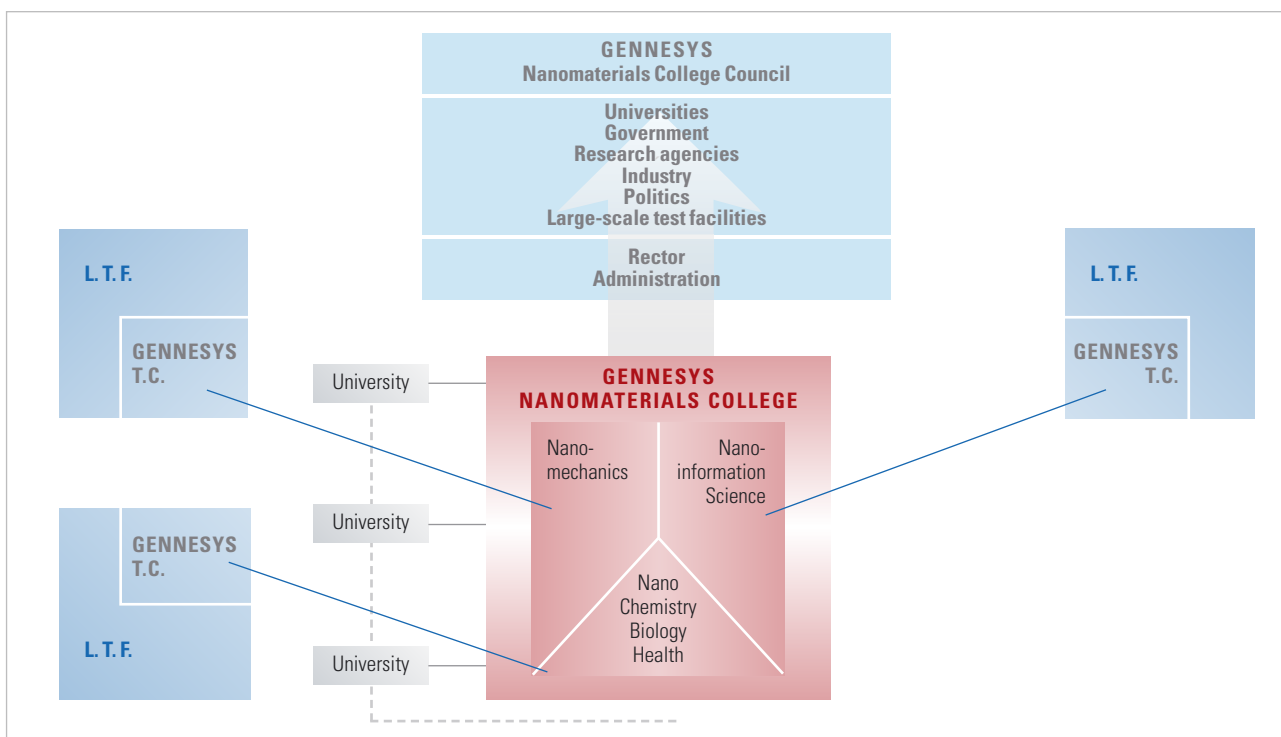


Fig. 9.5: GENNESYS College.

- Get in direct contact with scientific discoveries;
- Be able to help in the creation of spin-off companies.

The Society will:

- Benefit from a targeted education of young talented people;
- See more efficient scientists and engineers who tackle the urgent problems in energy, environment, health, and climate change.

Organisation and structure of the European College for Nanomaterials (see Chapter 11.12)

The education in nanomaterials science and technology demands excellent teaching staff and early access to the most advanced research laboratories and research infrastructures. The international institute for nanomaterials should operate under the sponsorship of the European Commission with the support from governments, European and national funding agencies and the research infrastructure. There should be a board of directors, an advisory board and the college rectorate. These boards should be represented by delegates from:

- Universities of excellence;
- Research institutions;
- Industrial research managers;
- Research infrastructure;
- Government bodies;
- Funding Agencies: national and European e.g. ESF;
- GENNESYS Centres of Excellence

Partnerships

Partnerships across disciplines and between universities, government laboratories and industry are crucial to leverage resources and strengthen interdisciplinary research, and to provide the awareness of technological drivers and potential applications.

The European Commission should provide incentives for the establishment of partnerships between universities, industrial labs and research centres and large-scale facilities that implement research in nanomaterials science.

These research and development partnerships should be encouraged in order to:

- Optimise the use of infrastructure and facilities;
- Enable cross-disciplinary research;
- Promote nanomaterials research in industry;
- Improve universities' and research labs' appreciation of industry priorities and needs;
- Develop integration mechanisms: to bridge the gaps between: education, research and industrial innovation; so that research discoveries spin-off into industrial applications;
- Share the risks and returns of long term research;
- Assemble teams that can recreate the fertile research environment of the former large industrial and governmental research labs;
- Develop the commercial exploitation and patenting of new technologies.

Conclusions

A European action plan in nanomaterials education has to be worked out urgently to underpin a sustainable nanomaterials research strategy. Strong efforts must be undertaken to improve integration of nanomaterials education and research, particularly at the boundaries of disciplines and to prepare flexible and adaptable nanomaterials scientists and engineers for the future.

A new framework of cooperation between universities, national research institutes and industry needs to be developed.

The proposed GENNESYS Nanomaterials European College" would ideally meet the requirements for the training of our future materials scientists and engineers. It would be a central institute with satellite schools at the GENNESYS "Centres of Excellence" – and with close associations to recognised research universities and corporate research in industry throughout Europe.

GENNESYS International Institute for Nanomaterials is ideally complementing the EIT (European Institute for Innovation and Technology). Joining both institutions would become the motor for "Innovative Europe" in nanomaterials science and technology.