

Draft Paper

Enabling Europe. Nanotechnology and the Shaping of the Union

In view of the recent expansion of the European Union and of the acceptance of accession negotiations with Turkey, the strengthening of Europe's unity is becoming decisive for the success of the European project. Only if this unity is well-anchored and culturally felt in both the infrastructure and in institutions will the citizens and the nations of Europe be ready and willing to face the impositions and risks of physical and ideological border openings. The strategic challenge derived from these circumstances is not only to shape this unity politically and juristically, but also to put unity in the center of all commission actions. This challenge is evident in the cultural field, whereas it seems to be a mere technical task in the infrastructural sphere. In the future-determining sphere of research and development, the challenge is at the same time overtly important and complex. But what should "shaping the union" mean for this sphere of well-founded diversity and necessarily open discussions? Is that not contradictory?

Nanotechnology and the alternatives of its financing by programs offers itself as a starting point to answer these questions and to find a solution to the problems mentioned above. It is a key technology because it enables the development of new product-lines, it directs research in different directions, and it will have a large role in determining future options for societal development, as is now the case for information technology in the framework of a knowledge society. Even if no decisions have been reached as yet, it appears that nanotechnology will play a role in the 7th EU-Framework Programme for Research (FP 7) and for the time period following similar to the role information technology played in and before the 6th program. This creates a difficult similarity, however. Did we not invest into a bubble – and at the same time fix the European knowledge society to be the framework even of the research programs yet to come? Can we focus on something like "nanotechnology" or should we go further and immediately focus on the "converging technologies"? And how can one go about something like this "Europeanly"?

I am perfectly aware, that nanotechnology is a phenomenon that offers opportunities and poses risks, that awakens hopes and triggers apprehensions throughout the world. But I am certain, that the focused basis of nanotechnology itself offers solutions that are interesting not only for Europe. European models could help "shape unions" world-wide or at least help avoid the emergence of a nano divide that separates members of humanity from each other as the digital divide did. This should not be misunderstood: I am not talking about establishing rules for others. But one can learn something from the way that nanotechnology is pursued in Europe - with consideration for what is most reasonable both for the science itself and for the needs of people - when one wants to do something "African", "Asian", "Latin American", or "North American". And that is certainly a good

way to imbed the world-wide research cooperation of nanotechnology in world-wide humane goal-setting.

In the following I have summarized weak and strong definitions of nanotechnology and nanotechnological convergence (1). I then contrast such extreme positions with “medial” ones. If one observes this in a context of innovation theory, then they also prove themselves to be interesting for practical purposes. In conjunction with conceptions of “convergence” and “enabling” that were discussed in the context of the EU’s Nano-action plan (2), I derive suggestions, the context of which is the elaboration of FP 7. From my point of view, these suggestions indicate how nanotechnology could gain a strategic meaning for the further development and shaping of European unity - and more (3).

1. The War of the Definitions

There are weak and strong definitions of nanotechnology; however, when closely examined, these definitions above all indicate a different understanding of the essence of nanotechnology. “Nanoscience and nanotechnologies”, the Royal Academy and British Society of Engineering Report, does not hesitate to provide definitions: “Nanoscience is the study of phenomena and manipulation of materials at atomic, molecular and macromolecular scales, where properties differ significantly from those at a larger scale.” “Nanotechnologies are the design, characterisation, production and application of structures, devices and systems by controlling shape and size at nanometre scale.”¹ The report holds that nanotechnologies are “genuinely interdisciplinary”, and collaboration certainly includes collective “knowledge, tools and techniques”. But the bottom line is sobering: “Apart from a characteristic size scale, it is difficult to find commonalities between them.”²

A semi-historical approach seems to offer a basic perspective of convergence: “‘Top-down’ techniques involve starting with a block of material and etching or milling it down to the desired shape, whereas ‘bottom-up’ involves the assembly of smaller sub-units (atoms or molecules) to make a larger structure ... These two methods have evolved separately and have now reached the point where the best achievable feature size for each technique is approximately the same, leading to novel hybrid ways of manufacture.”³ But the only result of this definition is the mere designation of a name: “(E)volutionary developments in each of these fields towards investigating matter at increasingly small size scales has now come to be known as ‘nanotechnology’.” The report portrays “convergence” as something that concerns only certain groups. The term is the backdrop for horror scenarios,

¹ Nanoscience and nanotechnologies: opportunities and uncertainties, Report of Royal Society and Royal Academy of Engineering, London 2004 (<http://www.nanotec.org.uk/finalReport.htm>), 5.

² Ibid. 6.

³ Royal Academy 6.

in which nanotechnology becomes an independent, uncontrollable entity. – The underlying, careful, “weak” definitions seem to be preferred by many similar national papers, including the Nano-Report of the Bureau for Technology Assessment of the German Parliament.⁴

In “Converging Technologies for Improving Human Performance”, the US-American NBIC-Conference report from 2002 that became famous, one searches in vain for clear definitions of the principle terms “convergence” and “nanotechnology”. Instead of that, we are immediately confronted on the first page by the conference symbol, triangles coming together at the tips.⁵ A second graphic links a goal-oriented representation of the convergence of the core research fields to an explanation that seems to be meant to replace these missing definitions. “Changing the societal ‘fabric’ towards a new structure” accordingly means: “The integration and synergy of the four technologies (nano-bio-info-cogno) originate from the nanoscale, where the building blocks of matter are established.”⁶ “Developments in systems approaches, mathematics, and computation in conjunction with NBIC” enable us as a result of “big O’s” “for the first time to understand the natural world, human society, and scientific research as closely coupled complex, hierarchical systems”⁷. Finally, the perfect pyramid shape of the NBIC-tetrahedron should symbolize the specific “convergence”. “Each field is represented by a vertex, each pair of fields by a line, each set of three fields by a surface, and the entire union of all four fields by the volume of the tetrahedron.”⁸

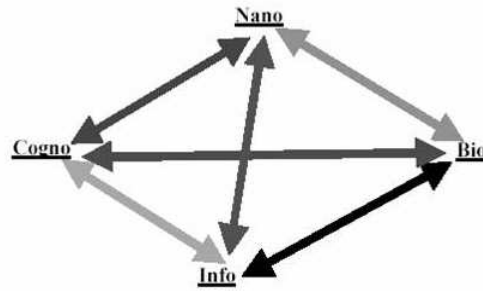
⁴ In the summary is it written as follows: “Nanotechnology is a collective term for a broad palette of technologies that concern structures and processes on the nanometer scale. A nanometer is a billionth of a meter (10^9 m) and indicates a boundary at which more quantum physic effects play an important role.” Further on it is made clear: “At this time there is still no generally accepted definition of nanotechnology.” Summary of the Nano-Report of the Bureau for Technology Assessment of the German Parliament (TAB-Arbeitsberichts) 92 (Nanotechnology), <http://www.tab.fzk.de/de/projekt/zusammenfassung/ab92.htm>.

⁵ Converging Technologies for Improving Human Performance - Nanotechnology, Biotechnology, Information Technology and Cognitive Science, ed. Mihail Roco/ William Bainbridge, Arlington 2002, (http://www.wtec.org/ConvergingTechnologies/Report/NBIC_report.pdf), VII (Executive Summary). For information regarding collective assessment, also in the collective context of the US-American Research program and regarding the European response, see Christopher Coenen/ Michael Rader/ Torsten Fleischer, Of Visions, Dreams and Nightmares: The Debate on Converging Technologies, Report on the Conference “Converging Technologies for a Diverse Europe”, in: Technikfolgenabschätzung / Technology Assessment. Theorie und Praxis / Theory and Practice 13/3, 2004, 118-125.

⁶ Ibid.

⁷ Ibid. IX.

⁸ Ibid. 2.



Therefore, when the authors write: “The same principles will allow us to understand and, when desirable, to control the behavior both of complex microsystems, such as neurons and computer components, and macrosystems, such as human metabolism and transportation vehicles”⁹ – this can only be understood, from my point of view, when one presumes a “strong” definition of “converging technologies”. The technologies converge at this point, because they refer to a sphere of application that is essentially and unchangeably developed by nano-science. This establishes “atomtech” entirely in the sense of the critical “Big Down” report of the “etc-Group”.¹⁰ According to this theory, nanotechnology manipulatively accesses the basic elements of a complexly constructed object sphere that has many overlapping layers. Thus biotechnology, information technology, and cognitive science do not occur to an arbitrary extent or in an arbitrary fashion; as that strongly defined key technology, they must align themselves to a scale of complexity. A principle of technical “do-ability” results from this reconstructible core:

„If the *Cognitive Scientists* can think it
the *Nano* people can build it
the *Bio* people can implement it, and
the *IT* people can monitor and control it.“¹¹

- and the goal of the overall program is not coincidentally “enhancing human performance”.

“Converging Technologies”, the Brussels expert’s report, reacts seldom directly, but always openly to this NBIC-challenge. For one, the report strives to overcome by overbidding. Its first step is to expand the number of technologies that are capable of converging. It is not only those “big O’s” that are found in the US-American Program. Openly programmatic and inconspicuously polemical, the American shorthand forms (nano, bio, etc.) are intertwined in a wreath of alternatives already on the title page of the paper. “Nano-Bio-Info-Cogno-Socio-Anthro-Philo-Geo-Eco-Urbo-Orbo-Macro-Micro” technologies are all capable of converging. And they should converge. The Brussels paper raises questions concerning the American goal-setting of the NBIC technologies aligned to that “enhancement of human performance”

⁹ Ibid. 1.

¹⁰ From Genomes to Atoms. The Big Down. Technologies Converging at the Nano-Scale, Winnipeg 2003 (www.etc.group.org).

¹¹ Converging Technologies, cit. annotation. 5, 13 (according to a statement from W. A. Wallace at the conference).

and then furthers the perspective.¹². A completely different kind of convergence is used here. The course of this convergence can be indicated by three examples: First there is, in contrast to the NBIC-self-representation, a noticeably large amount of space in the Brussels report taken up by dialogue perspectives and the discussion of risks. Secondly, “divergence” becomes in the paper, as in the context of the resulting discussion, the key term of an especially European interaction with these new technologies. Thirdly, an “engineering *for* the mind” is sketched as a motto very different from the US-American “engineering *of* the mind”.¹³

The report also tries to overcome the US-American approach using a paradigmatic shift. Now nanotechnology is no longer the central aspect, but rather technologies that align themselves in any way to a defined goal are.¹⁴ “Converging technologies are enabling technologies and knowledge systems that enable each other in the pursuit of a common goal.”¹⁵ This definition goes beyond the NBIC-approach – more exactly, the older definitions of “converging” are converted to principles and shifted into a new context.¹⁶ “CT always involve an element of agenda setting.” Converging technologies are defined through the procedure of their goal-oriented application. This convergence, defined by goals, corresponds to the shaping of a procedure and to shaping by procedure. Thus it follows, that the expert group says: “By proposing ‘Converging technologies for the European Knowledge Society’ (CTEKS) it places the emphasis on the agenda-setting process itself.”¹⁷

The way is opened for “Widening the Cercles of Convergence” (WiCC), the EU-initiative proposed by the group. That itself should further develop into “European Design Specifications for Converging Technologies”: EuroSpecs.¹⁸ And it is here that the participating shaping elements have their systematic place: “Because of this, converging technologies are particularly open to the deliberate inclusion of public and policy concern.”¹⁹ All this taken together forms, if not an explicit opposing reaction, certainly a true, (old) European approach standing in contrast to the US-American approach.

In the USA, how NBIC products will be formed is apparently left to what the technique allows – and, over and above that, apparently left to the self-shaping powers of the market. But there can still be no talk of an actual shaping of the technology in the national European standard reports, of

¹² Alfred Nordmann (reporter), *Converging Technologies – Shaping the Future of European Societies* (High Level Expert Group “Foresighting the New Technology Wave”) Brussels 2004, 15-19 (Limits of Convergence) (http://europa.eu.int/comm/research/conferences/2004/ntw/pdf/final_report_en.pdf).

¹³ Ibid. 21.27.

¹⁴ Ibid. 14f. (The Definition of Converging Technologies).

¹⁵ Ibid. 14.

¹⁶ Compare the list *ibid.* 12-14 (A Brief History of Converging Technologies).

¹⁷ Ibid. 4.

¹⁸ Alfred Nordmann (reporter), *EuroSpecs*, European Design Specifications for Converging Technologies, Brussels 2004.

¹⁹ Nordmann, *Converging Technologies*, *cit.* annotation. 12, 4.

which the British Report is only one example, either. We are looking for the societal and ethical integration of nanotechnology. And we see the establishment of limits and regulations and a still supplemental technology assessment following a containment policy and container philosophy.²⁰ Whereby it should be remembered, we are dealing with three different definitions of the objects: the American, stronger definition, and the British, weaker definition. The to-be-formed European definition (according to the paper cited above) proposes a strong definition of a procedure. Because here the suggested method appears to be identical with the intended goal.

And this way might be one of societal shaping. But the shaping of what exactly? “What about nano?”, asks Elie Faroult in the context of the suggested WiCC-initiative, and he answers this question as follows: “Nanotechnology is everywhere but nowhere in particular: In the short and medium-term, there may be CTEKS researches without an explicit ‘nano’ component. In the long term, all CTEKS may have a nano-dimension (if only in their material implementation). In the meantime, ‘nano’ is a visionary medium in which convergence takes place – it is the paradigm example of an enabling technology that is open to development in many directions and has no destination of its own.”²¹

There are good reasons why the implicitly weak definition of nanotechnology in this strong procedure context can make investors, that is, European citizens and politicians, nervous. One can suspect the US-American goals and doubt the strong nano (convergence) theory, but when one wants to ask for money in a program that follows NBIC-philosophy, then one has to suggest a cooperation of at least two core research fields, and one of the two will always be nanotechnology. One can accordingly prognosticate synergy effects that will strengthen themselves; the base of the NBIC pyramid will always become more solid. To a weaker extent, a long-term accumulating reinforcement of the identified core spheres is also expected for a nanotechnology that is societally-controlled according to the approaches followed by the British example.

The strong Brussels CT- and procedure definition however can completely free itself from the existing nano-science and nanotechnology and follow the ever-changing goals that are chosen by the current whim of the majority through a necessarily political process. The societal regulation of nanotechnology would then be its only stable line of “progress”. Should nanotechnology itself then, through spectacular success, become popular after all, the then created nanoconstructions might be expensive and short-lived like sculptures out of sand and snow particles. But there are

²⁰ Alfred Nordmann, Nanotechnology. Convergence and Integration (EuroNano Forum 2003), in: Darmstädter Beiträge zur Geschichte und Theorie der Nanoforschung/ Darmstadt Contributions to the History and Theory of Nanoscale Research, ed. same as above/ Gregor Kodbab, appendix D, 1-13.

²¹ Converging technologies: lessons from an Expert group, Converging Sciences, Trento 13./14. December 2004, Conference presentation (“Widening the Cercles of Convergence: Vision and Strategy for CTEKS“ (http://www.unitn.it/events/consci/download/presentation/Faroult_2.ppt).

possibilities to work against this danger. The possibilities focus on the “middle” solutions.

2. Between Top-Down and Bottom-Up: Searching for European Convergence

One may rely on the fact that proposals and applications based on that specific kind of convergence theory will be diluted through the formation of the program and compromised during the approval procedure because of other continuing programs and that nanotechnology itself does not really depend on that framework program sponsoring it. In order for this to function, one needs weak incentive theories, weak micropolitical theories, and strong assumptions in other areas. First of all, one does not have to perceive the hitherto practice of sponsorship and approval as essentially improvable. Secondly, one must ignore that information technology, which was at its beginning promoted as a peak technology, was finally sponsored within a program of the “European knowledge society”, a program which, up until the present time, continues to be effective strategically. Thirdly, one would have to consent at the present time that nanotechnology does not have the potential to replace information technology in its actual function for the sponsorship philosophy, sponsorship politics, and the approval procedures. And finally, if we want to promote nanotechnology the same way that information technology has been promoted in the former framework, programs, the nano-unspecific incentives, and approval practices may not disclose their own dynamics.

To depend on all this is not without risk in the definition phase of FP 7. Because one can suppose with good reason that, during the execution of the FP 7 planning, nanotechnology will transform from the most demanded thematic field of sponsoring (more than even IT and biotechnology) into a paradigmatic field of strategic research promotion: precisely as IT did before it. If it does so being a “converging science” à la Européenne, than it factually enters into competition with the European knowledge society as the established sponsorship framework. From the beginning, strongly-defined nanotechnology would start handicapped then. And stuck between nanotechnology and IT, the “life sciences” may be crumbled as another Kondratieff-candidate. One does not know if a purely formal compromise or a compromise of content would be more harmful in front of this background of paradigm confusions in the arguments and the struggle of promotion strategies we can wait for.

It is precisely in the current situation that the danger of missing the important aspects with nanotechnology appears to me to be rather large, when one simply proceeds with a convergence phenomenon using a strong theory of procedure and then pursues a top-down strategy. On the other hand, in a European context a bottom-up strategy for the sponsorship of nanotechnology would rightly so fail in the search for consensus and political agreement if it simply proceeds inductively with functioning nanotechnology and tries to establish firmly the successful technical and economic practices in the sponsorship program. In this situation it would be worthwhile to start on the bottom from anew and to see what goes beyond

the weak nano theories – without releasing those strong convergence reactions right away. The German Parliament's restrained report goes beyond the assumption that the pure cooperation of the basically different technologies supposedly stands in the center, cooperation which – perhaps even just for a short time – only originates in the eye of the beholder. According to a description of the “converging” top-down and bottom-up approaches it continues: “When working at a nanometer scale, in addition to the increasing dominance of quantum physic effects, the surfaces and the edges play an increasingly important role compared to the volume properties of the material. Furthermore, multiple phenomena of self-organization occur.” A current “key technology” has resulted from these new effects, a technology which will change entire technology fields and have considerable “economic, ecological, and social implications”.²²

Into which theory framework could one appropriately categorize such specific manifestations of a cooperative nanotechnology? I would like to put forward and apply elements of a “strong theory” with “third terms” which can be further developed in the framework of an innovation theory. Those innovation theories best able to produce appear to me to be generally characterized by a singular start-constellation, a recursive formula, and an algorithmic solution. New forms constantly result from this schema, so that the correct perception of the result (and, by the way, also a consistent application of the respective theory) is not only the perception of a picture sequence order. It assumes the understanding of a unique story.

In addition to this necessity to tell a story of the emergence and manifestation of the new, handling with specific, generally-understood terms is the most important experience in the development and application of innovation theories. Innovation theories do not only at the beginning and at the end of an innovation process operate on singularities. In these places they normally are marketable products, which also are explainable through conventional theories. The characteristic building blocks of these theories are those modeling the in-between phases, and there they are most easily assessed negatively: When one tries to define them either as form or as content, either qualitative or quantitative, it leads to contradictions. They are “third terms”. Within the theory framework they cause digital decisions of form, but these reproduce themselves cascadingly in a branching system of decisions. Thus they become starting points of new decisions, building up graded backgrounds and becoming conception and perception principles of new forms; they “shape”. Typically those terms bridge over at least two systemic levels, that is, for example, the difference between “possible” and “necessary”, between pattern, example, model, and product. Depending on which interpretation or application of the innovation theory is used, third terms appear as complex signs, models, or institutions, which decide on development paths within specific processes. One recognizes an appropriate interpretation of those processes by the fact that it tries to conceive these terms as a constellation with a catalyzing function or as a complex condition

²² Summary of the Nano-Report of the Bureau for Technology Assessment of the German Parliament / TAB-Arbeitsbericht, cit. annotation. 4, 92.

of shaping through an arrangement of digital decisions according to a type of interface configuration.

In societal contexts, third terms intermediate between culture and market, when one understands both of these societal spheres of function in a wide, innovation-theory-plausible sense. In the beginning phases of an innovation process they are orienting patterns which disengage existing technical and market figures, they transpose these figures as starting material in the sphere of the culture which by this becomes a creative, large puzzle of possible formations, and they then build the figure-filtering and figure-building entrance gates back into the realm of technical and economic necessities in the final phases of the process. They first allow inventions and innovations to appear, and then they explain why they function as inventions and are successful as products – or why they do or are not. Because they themselves may have an institutional aspect they enable understanding of why procedures can also be inventions and that organizations may be transformed by innovation projects. As micropolitical arrangements they also show what the technological aspect of innovation hides: decisions continue to be effective in a cascading form through excluded possibilities. Developments disengage themselves from intentions. They generate unintended products, procedures, and institutions, for which it is difficult, however necessary, to ascribe and take on responsibilities.

Third terms also indicate the way to specific solutions. If the sharpened view for their manifestations goes along with the theory-directed methodical concentration on them as constellations, then possibilities for steering them arise, which could also be helpful to the present European endeavor regarding the appropriate pursuit of nanotechnology as a converging technology. If they were precisely identified with an appellation and established as constellations, then the innovation process would neither be blocked by qualitative designations nor could goal-setting and norms be dissolved through its dynamic in descriptions of function, which no longer apply to new products. Each of these constellations may be defined through a set of key data at the beginning, in continuation through a sequence of controlling-capable key data. The constellation range of these key data makes it very clear that the proper function of economic rational-choice, principle-agent, and property-rights theories, if there is one, is a heuristic one. We may therefore as a second concrete result, in addition to those critical key data, expect the more precise identification and the more exact naming of those third terms in specific applications. The instrument improves itself through appropriate use.

In spite of all this, I do not suggest a strong theory or even an innovation theory of middle or third terms (although I would like to), but rather once more “middle range theories”: “middle axioms”, which temporarily should apply to EU-support of nanotechnology. After all, Francis Bacon claimed that on such axioms “depend the affairs and fortunes of men”, and the Ecumenical Council of Churches developed its general concepts of a “responsible” or a “just, sustainable and participatory society” from a social

ethic oriented to those axioms²³. But this presumes proceeding patiently, pragmatically, and critically.

Axiom I: Converging Technologies may only be pursued in the context of an “enabling”-conception.

A technology should only be understood as “converging” and be promoted by the EU under this title, when it can be made plausible that it provides a context of necessity for the existence of another named technology (which will be promoted in the same project).

Axiom II: The support of “converging technologies” must connect to the previous development (and support) of nanotechnology.

A technology should only be understood as “converging” and be pursued by the EU under this title, when it can be shown that this support exists in a realistic connection to the previous development (and promotion) of nanotechnology.

These axioms complement one another. A consistent promotion would be strictly inductive. One cannot deny that the bottom-up principle thus predominates first. The promotion would almost necessarily start with harder nanotechnology and then work itself upwards along the NBIC-complexity scale. Social and human sciences would not occur somehow and possibly everywhere. Instead they would be inserted, or rather they would seemingly insert themselves, into new and revealing explanatory and evaluation correlations. This could result in a possible connection between the regulation necessities, the participation requirements, and the formation wishes of the European convergence conception with the synergy effects of the US-American NBIC-conception: a condition of survival in the global competition in which the EU finds itself.

3. European Solutions

I would like to clarify conclusively how these axioms work using several examples. To do this I pose possible consequences and stimulants for an EU-specific promotion of nanotechnology together with innovation theory arguments that can be legitimized here only by their heuristic function. “Third terms” have again a key function. They allow the bottom-up and the top-down perspective to converge better, the more vivid they become: as catalyzers of the specific endeavors of scientists and technicians, politicians and citizens towards a European identity.

²³ “(T)he middle are the true and solid and living axioms, on which depend the affairs and fortunes of men.” (Francis Bacon, First Book of Aphorisms, CIV); regarding The Ecumenical Council of Churches, see Ann Wansbrough’s overview, The Theological Foundations for an Ecumenical Methodology - what do the member churches say? (<http://unitingcarens.wact.org.au/library/thinking/foundations.pdf>).

- *Convergence as Nano-Ascendance*

The combination of this deliberate, bottom-up approach that has convergence perspectives with the pragmatically-sober, more convergence-skeptical British (and German) approach to the definition of nanotechnology will be of distinctive importance. Precisely when the mentioned axioms apply to the support of nanotechnology, it does not matter if a spectator gets the impression that successful tinkering in the nano sphere is going to be rewarded. Convergence begins as a successful nanotechnological cooperative effort and is staying in contact with it. The attention will concentrate on which materials, topics, and projects contribute to the success of this cooperation, where there are complementary units, which regional complementarity solutions stabilize themselves, which people and places stick out in these efforts, and, finally, which forms of networking - which cooperative procedures, models, and technology constellations - prove themselves as viable in these endeavors. Also interesting and helpful will be to see which concrete cooperative efforts prove themselves to be unviable, which procedures regularly fail, etc.

Medium-term we will probably be able to identify examples of successful cooperation between two, three, or more technologies and the particularly successful, institutional, and communicative integration of such cooperation. Experts are indicating that such example units, which can be observed as being particularly effective in this perspective, also have a particular middling term-size, which is to some degree already considered "typically European". It is also typical, too, that these units with world-wide recognized qualities and of international candor are at the same time more strongly involved in regional network cooperation than others. It is certain that oversized centers serve political prestige more often than effective research and easily become money-destroying machines. From this perspective the need for caution will be indicated if proposals focus on large projects. Perhaps a middle-sized ideal form emerges out of all this. In any case, an evaluation should be sensitive to that possibility of "shaping" a European research identity.

A thoroughly conservative proceeding could on the whole result in the emergence of a good cooperative form of nanotechnology marking the European dream path to converging technologies. On this path a philosophy of the granting of money that is downwards compatible but also consistent in its upward perspective is certainly to be recommended. Only *proven* cooperatives should be supported. Furthermore, during the course of the program, only *proven cooperatives* should be supported, according to a scale of increasing complexity in the object field. Regulation and evaluation criteria should mainly orient themselves away from products (that are regularly too slowly faced anyway) and focus on cooperative interfaces and the possibility to assign responsibility there. This allows and demands specific controlling and evaluation procedures.

And it is precisely here that one should assess the organization of cooperative nanotechnology. It is at the interfaces of succeeding cooperatives, where the first succeeding micropolitics and the institutional building blocks of good converging technology emerge. Under the emerging,

rather difficult, strategic framework conditions of research promotion and precisely when – as is to be expected - the developments in the promotion sphere accelerate, the developed approach proves itself to be prolific, in order to avoid the wrong decisions with far-reaching results.

- Top-Down Euro-Identification

The top-down approach supported by convergence theory should apply only to the routine linguistic procedure of the formulation of announcements and of the evaluation of applications and reports. This need not be grounded on an innovation theory basis; the following proposals can speak for themselves: they combine practical experiences or invite them to be tested. The demand that convergence sponsorship should connect to the previous sponsorship of nanotechnology is tested by the assumption that the later reports simply continue the former success story in a consistent way.

The bottom-up approach is the most easily retained and nevertheless also integrated in continuing convergence perspectives, if one presupposes this special use of language in all papers and positively discriminates certain text correlations

- in which singularities (people, places, times) are generally identified and named,
- certain (third term) classes of nouns and verbs like “cooperation”, “interface”, “define”, “identify”, “combine”, “copy”, or “reproduce” occur in sensitive contexts,
- where expressions like “define collaborative work”, “agree on collective standards”, “strengthen agreements”, “standardize identified cooperation models”, “proven model of interdisciplinary collaborative work”
- certain (third term) classes of nouns and verbs like “cooperation”,
- and eventually even specific expressions like “an enabling infrastructure”, “converging nano production lines”, etc. will appear.

Their context will be stories, in which one will be able to recognize and compare typical episodes, solution schemata, etc. In these contexts critical points may be defined in advance: which interface solutions the discourse should use, where controlling key data must be named, etc. - because the outline and the pattern of successful nano-convergence stories already emerges.

- European Convergence: The Script

One can propagate this because there is already a script of just such a European nano-convergence success story and because the semantics of this story are already worked out. Both the script and the semantics were laid out in the framework of the WiCC-Initiative. If the above mentioned axioms are valid, all that is left to do is to integrate them, so that the actors can play their roles. The material, with which this framework is filled, shows up seemingly from its own accord, as typically European and must then also appropriately be identified and named. This can be done without concern because this European identity by itself goes beyond cultural or regional narrowness.

In the national European nano reports as in the preparatory EU-papers, toxicity criteria and security, work place, environment, and user-protection regulations occupy a lot of space. The information requirements of those involved and the corresponding information and involvement rights of the population are broadly discussed. Specific educational and instructional measures precisely with this emphasis are suggested and made into conditions of sponsorship. This is throughout more the case as in the parallel converging papers in the USA. But the European papers differ from US-American papers most of all in the implicitness with which their authors advocate global standards and codes for distinguishing between civilian and military sponsorship, for cultural integration, and for the global spreading of key information in order to avoid a nano-divide. And those are not simply declarations of intent – the EU-administration is taking energetic steps to realize these aspects of converging nanotechnology in international conferences, commissions, etc.²⁴ It is necessary to understand and to name precisely this combination of syntax and semantics as European in order to mark a successful European way from nanotechnology to converging sciences. Without being aware of this vision of global integration of nanotechnology one overlooks how the EU really processes its own experience in dealing with variety and cultural diversity in the very definition of converging science. In the official papers at hand this explicit, European self-identification with propagated global standards is missing.

- European Nano-Vision

Alfred Nordmann explained the difference between American and European convergence visions through different underlying perceptions of nature. In one instance, nanotechnology converges with others on its own in order to improve “human performance”, in the other vision it is tied up in a complex societal web, in which the emerging convergence formations articulate hopes and fears and a variety of core-value-sets (“Leitbilder”) shaped historically by diverse cultural experiences. “One common denominator of the various NSF publications is that nature is nothing more nor less than a nanoengineer ... As nanotechnology shapes and reshapes the world atom by atom, it cannot violate nature even while surpassing, overhauling, and transforming it.” Nordmann calls this a “weak” (“thin”) conception of nature. A “thicker” conception of nature at least takes into consideration ecological stability requirements, as an evolution biologist would. In the USA “this thin conception is augmented by a generic appeal to the equilibrium of self-interests that can be achieved through market forces. Old Europe is less

24 “Common shared principles for R&D in nanotechnology could be embodied in a voluntary framework (e.g. a “code of good conduct”) to bring the EU together with countries who are active in nanotechnology research and share our commitment to its responsible development. Preliminary exchanges of views with representatives from e.g. USA, Japan, Switzerland and Russia are very encouraging in this respect and could pave the way for further initiatives.” The WTO is then named as a contact. Towards a European strategy for nanotechnology, Communication from the Commission, Brussels 2004, 20.

trusting and rightly requires that nanotechnological visions should be contained and integrated with the history of nature and culture.”²⁵

Nordmann himself is striving towards a symbolic containment of nanotechnology in the framework of a cooperatively directed development process of nano products.²⁶ Armin Grunwald also wants to reach a formation of converging technologies - through the shaping those visions.²⁷ Arie van Rip is working on a thorough conception of “constructive” technology assessment.²⁸ The rich and deep-reaching approaches to European TA conceptions encourage me to concentrate on the innovation process itself, to “disturb” the cooperating researchers with other points of view hoping that this “Integral Innovation” is even more successful in other perspectives. Because “deeper” than the NBIC-approach, which is related to the complex system structure of our reality, is only human creativity itself. It is the research process itself, from which integration prospects for higher levels of complexity are opened, including the self-steering of social and personal systems. These unite the European contributions beneath their varied regional approaches and at the same time open prospects to a global convergence of nanotechnology in the service of humanity.

²⁵ Nordmann, *Nanotechnology: Convergence and Integration*, cit. annotation. 20, 9f.

²⁶ EuroSpecs, cit. annotation. 18 , (Product Development on a European Scale; European Design Specifications for Converging Technologies); Ibid. 10ff (Conclusion: A Common Language for a Common Practice); see contribution at this conference...

²⁷ See contribution at this conference ...

²⁸ See contribution at this conference ...