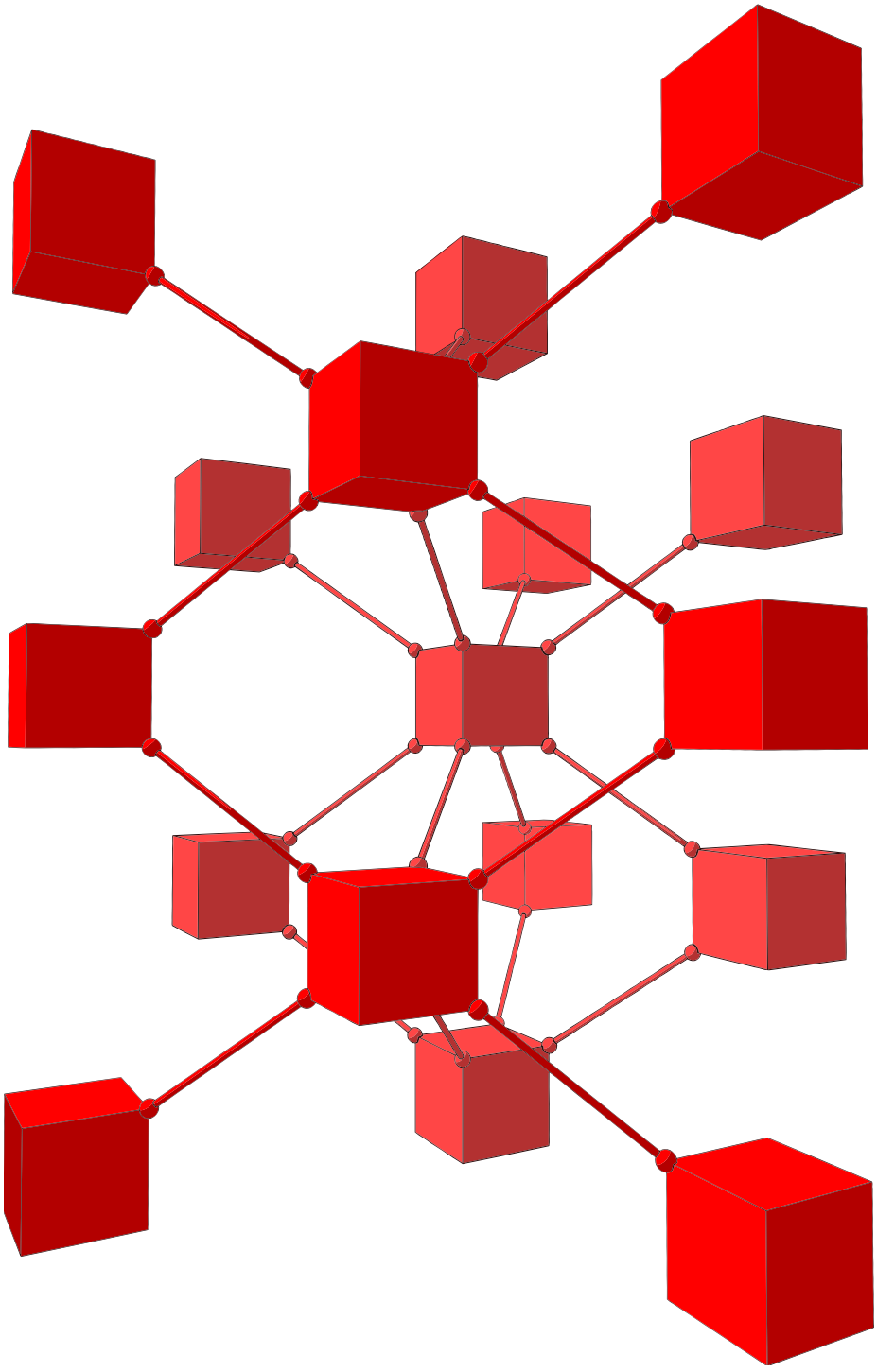
ESF Task Force on Systems Biology

Strategic Guidance and Recommendations



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Summary

The ESF Task Force on Systems Biology sets out below a road map and specific recommendations intended to establish a world leading Systems Biology research programme in Europe. The document is directed at public and private sector organisations with vested interests in Systems Biology. The recommendations are grounded in the ESF Forward Look on Systems Biology, and on a broad strategic overview provided by the Task Force. The specific recommendations are:

1. To establish a **task force** representing organisations that are already investing, or are willing to soon invest, in Systems Biology in Europe, that is supported by a European Systems Biology Office (ESBO).

2. To assign the following tasks to this task force:

a. initiate, coordinate and fund, a single Grand Action on Systems Biology (GRASB). This programme should consist of a **portfolio of coordinated activities aimed at an integral activity entitled 'Networks for Life'**. The portfolio of activities should build on the major Systems Biology activities that the task force members have put in place already, and constitute the world's largest and most effective single Systems Biology programme.

b. to put in place early in 2008 the following calls for applications and expressions of interest in grant support of six major actions, on research, standards, technology, thinking and training:
   - a network of activities that together constitute a **Massive Technology Development Initiative for Systems Biology,** integrated with:
   - **a network of research on Systems-Biotechnology**
   - **a network of research on Multi-Factorial Disease**
   - a European **network of Training Activities** for Systems Biology
   - a network of **European Reference Laboratories** for Systems Biology
   - one or two **Centres for Advanced Studies** in Systems Biology

c. to organise a set of focused strategy development workshops for defining further aspects of the programme in the required detail and for keeping the activities up to date. The actions should not wait for the results of these workshops but rather proceed, calling for such workshops and fine-tuning the action whenever new insights arise

d. to develop by summer of 2008 a blueprint for a single Grand Action Programme for trans-national Systems Biology in Europe, including mechanisms for funding by current and future task-force members. The blueprint will be based on the grant proposals, strategy workshops, and extensive consultations with international advisers and European stakeholders

e. produce a publication with the calls for proposals that together aim at putting in place the Grand Action Programme before 2010 (calls end of 2008, evaluation 2009, funding beginning January 2010)

f. define general data and technology dissemination strategies for all GRASB activities.

Introduction

In Molecular Biology the object of investigation is the molecule, Physiology describes the entire organism, while in Systems Biology the principal object is the network. The question addressed is how 'networking' (collective arrangement, connection and interaction) of components (such as those molecules) leads to properties that are functional for Life.

While the biological sciences have contributed much to society, it is fair to say that in many areas expectations have not yet been met, and major societal challenges remain unsolved. Most of the diseases that plague us today are multifactorial, complex diseases that require a systems level approach for their diagnosis, stratification and therapy. Most of the limitations to biotechnology derive from our limited understanding of the biological networks in the living cell and the consequential inability to optimise or redirect their function in a rationale manner. Physiology and Molecular Biology have contributed to the understanding of both issues, but Systems Biology provides the critical 'glue' required to achieve a deep systems level understanding.

Systems Biology is a new approach in the life sciences. In terms of the effort put into it, the scientific results that come out of it, as well as expectations, funding, ideas and industrial interest, Systems Biology is growing very rapidly. This was documented in the Forward Look report on Systems Biology, which concluded that Systems Biology is a Grand Challenge for European science.

This paper constitutes a general road map and specific recommendations of the ESF Task Force on Systems Biology on actions required over the next few months to establish in Europe a world leading Systems Biology programme. It is based on the Forward Look report on *Systems Biology: A Grand Challenge for Europe* that is simultaneously being published and on the views of the Task Force. The document addresses the question of how the European 'science community' should try to develop the European Systems Biology arena and on the roles that the various organisations, including ESF, should play.

Observations

Technology development

The sophisticated methods developed over the last five decades for molecular biology are useful and necessary, but not sufficient, for Systems Biology. The technologies (both experimental and computational) for the identification of the diverse types of networks, for the analyses of their properties and dynamic behaviour, for the measurements of the diverse types of networking in living cells in real time, for data management, and ultimately for the understanding of emergence of function are, for the most part in an embryonic state. In many cases, existing technologies need to become much more specific, broader in scope, faster, or more quantitative. For example is essential that systems components such as metabolite or proteins be identified and accurately quantified, globally and at high throughput. In addition,

entirely new technologies are needed to identify, and measure, compute, visualise and simulate the dynamic behaviour of networks in single cells, cell clusters, organs and organisms. Therefore, in addition to the requirements noted in the Forward Look report, the Systems Biology Grand Challenge needs to be primed with a **massive technology development initiative** aimed at providing broadly enabling technologies essential for Systems Biology research.

Unified approach

One of the fascinations of biology is the diversity of organisms and their responses to the stresses and stimuli they encounter. Their diversity notwithstanding, the molecular processes of life share general design and operational principles are, at present, poorly understood. During the development of molecular biology, biochemistry, cell biology and genomics, this unity of Biology has been a great help in spite of the apparent diversity of species. Similarly, Systems Biology will strive to discover the fundamental principles of the processes of life. This has practical consequences. For example, studies on diverse organisms, including micro-organisms, plants and animals, have already been, and will continue to be, essential to realise the potential of Systems Biology for human research. The molecular networks between organisms are thought to follow common design and operational principles, and the extents to which they are different are highly informative about the functioning of the networks that are compared. In addition, many of the new technologies that need to be developed will benefit during their development and testing from simpler systems such as those in microorganisms. This means that although a key long-term goal of Systems Biology is the understanding of highly complex systems such as human biology in health and disease, the relationship between single and multi-cellular organisms and their environment, and a knowledge based biotechnology, the Grand Action should extend Biology-wide. It will often be necessary to develop and test tools and concepts in model systems, in parallel with or before applying them in the ultimate, more complex, context of human health or biotechnology.

Linking up with much of science and engineering

Systems Biology will benefit greatly from input and engagement of, top notch engineering sciences. In living organisms, part of the detail matters and the specific complexities of living organisms will require new types of engineering approaches. Some of these may have to be pre-developed out of the immediate context of the living organisms, but could still be part of the Grand Action programme. Ecology is another biological science where nonlinear interactions play major roles. Also here avenues for cross fertilisation with the Grand Challenge Systems Biology should be opened.

The Systems Biology Grand Action should serve as a strong '**attractor and integrator**' **for much of science and engineering** as its ambition and scope will require the best of the many disciplines that are related.

Knowledge Organisation

With its emphasis on emergence of function and the corresponding nonlinear and multi-factorial nature of the entities its studies, Systems Biology is inherently and deeply dependent on the integration of large amounts and many different types of data describing the diverse types of networks and their dynamic behaviour. Data will be

required that describes the variation of multiple substances and their interactions with time. Meta-data will be required that precisely specifies the organism used including the genotype and pre-history, the experimental conditions, and the experimental perturbations, which may again be dynamic and multi-component. All these data need to be generated and eventually integrated for each experiment, even though they may also be individually relevant for more dedicated transcriptomic, proteomic and metabolomic databases. The mathematical model driving the experiment is an integral component of the data set, and may indeed serve as the focal point for storing, accessing and understanding the information. Further knowledge to be connected includes that from text mining of the literature, from corresponding experiments performed by other members of a consortium of laboratories and complex images and visualisations. This relates to multi-site distributed data storage and data storage through induction into models: new data handling and storage methodologies will need to be developed for Systems Biology. Also the data handling at the 'end' of successful projects requires new approaches.

Demand pull

The Forward Look report calls for a focused Systems Biology programme. The observations set out above for a parallel investment in massive technology development and new ways of data management. This might lead to a lack of focus and coordination, if each of the programme elements were taken as an independent focal point. The Task Force therefore recommends that a central comprehensive research programme addressing important biological and societal problems be defined that consists of biological and technological components. Within that programme technology development, data management, training, standardisation and all other essential aspects of new Systems Biology will be advanced in the context of the biological theme.

Crucially, most of the new technology that needs to be developed is generic and will benefit Systems Biology research in many specific biological topics. In order for the technologies to become most effective, it is better to develop the new technologies to full depth for a relatively small number of topics that all relate to a common theme or vision, thereby also integrating the new technologies with each other.

The Committee recommends thus a technology-push, which is prioritised by way of a demand-pull approach, with continual assessment of where technology may be advanced in order to allow the biological topic under investigation to be addressed most effectively.

The advice of the ESF Task Force on Systems Biology

A single central vision 'Networks for Life'

Systems Biology requires a clear, intriguing and concrete goal that is understood by, and serves society. Such a goal can act as a driver for scientific, technological and economic innovation. It also needs a set of coherent actions that together should make it possible to achieve that goal. Goal and actions can here be summarised under the banner 'Networks for Life'.

The ESF Task Force on Systems Biology subscribes to the challenge noted in the Forward Look policy briefing, for Europe to (i) become a leader in the life sciences by creating **breakthroughs in health**. The Board also supports the ambition set out in the Forward Look report, for Europe to (ii) be at the forefront of **pinpointing the molecular and systemic limitation to biotechnology**, aiming at the rational design of new biotechnological networks and processes.

With the exception of some mono-factorial and infectious diseases and just a few microbial production processes, progress in biotechnology and health research in terms of delivering effective and robust processes, including therapies, has been slow. Indeed the progress has been slower than necessary to deal satisfactorily with most of the diseases that plague mankind today, or to substitute robust biotechnology for less sustainable production methodologies. The Task Force agrees that the crux of what has been limiting progress is the same for both biotechnology and human disease (and for other areas as well): it is the multifactorial nature of the processes that decide between function and dysfunction. There has been enormous scientific success when looking at individual macromolecules, and, more recently, when looking at large numbers of those molecules independently. The macromolecules have however not yet been studied in terms of their dynamic interactions, which lead to their functioning in and for the living system. This can now be put in place through Systems Biology. And, importantly it can be put in place simultaneously through a unitary coordinated activity, for both biotechnology and human disease.

The Board therefore proposes a paradigm shift. The response to the challenges of Systems Biology should *not* be to engage in studying the various diseases or aspects of biotechnology, as if they were unrelated topics. Nor should it do this with respect to the faltering that compromises living-cell biotechnologies. The problem is in the network: the new paradigm should be that when the behaviour of interest depends on the networks within and between living cells, one should study those networks in terms of the interactions of their molecules. This then should be the single focus of the Grand Action Systems Biology (GRASB).

As discussed in the Forward Look Report, and as also set out below, GRASB will be critical for the various Systems Biology activities in Europe by the development and the dissemination of enabling technologies and resources and by providing a framework within which scientists form different disciplines work together towards meeting the Grand Challenge. Various research, technology and training networks

need to be put together (see below), and this is the second meaning of the phrase '**Networks for Life'**.

Underpinning action TECHNOLOGY: A massive technology development initiative

The research programmes (action RESEARCH below) on 'Networks for Life; addressing the multifactorial basis of disease and biotechnology' critically depend on new technologies aimed at the comprehensive analysis of the networks of life and their dynamic behaviour. Similar to the genome project, Systems Biology **needs to be accompanied therefore by a massive technology development initiative**. The aims of such technology development should be driven by, and coordinated with, the requirements formulated out of the core research programme.

The relationship between the different types and levels of networks and technologies can be thought of in terms of a matrix. This matrix can be **expanded** over specific topics (for example specific types of networks such as protein interaction networks, transcriptional networks, metabolic networks, networks of enzymes and their substrates, networks of microRNA and their targets), and/or **split** into specific projects with milestones, deliverables etc. without losing the broad vision of developing technologies enabling the 'Networks for Life theme. The matrix below therefore represents a framework within which specific technological and biological projects will be conceptualised and developed.

	Identification and characterisation of network components	Quantitative and dynamic analysis of networks	Technologies for data integration, network modelling and simulation	Dissemination, outreach, training, education
Molecular cellular networks				
Cellular networks in organs				
Networks of organs in an organism				

The following are *examples* of new technology in need of development that are essential for Systems Biology. They are not elaborated in more detail in this document, because the Task Force feels the detailed formulation of goals and will be worked out by a broader cross-section of the community, in workshops (see below).

New information, data management and methodologies, pertaining to:

- computational infrastructure, like that needed to run models globally
- data storage, ownership and dissemination mechanisms
- methodologies to deliver the results of the programme to the outside world, data sharing
- new ways to represent and visualise:
    - the dynamic action of networks in models (as dynamic visualisations on computer screens or other devices)
    - data coming directly out of experiments
- simpler more usable modelling environments (user friendliness), e.g. such that statistics and models are used in the right way even by the novice user (e.g. through standard work flows and front ends)
- ontologies consonant with and linking different functional areas
- more efficient ways of transferring new data into annotation databases and ontologies
- efficient means of describing the organism, the experimental conditions and experimental design in a user-friendly but definite and standardised manner, which allows such meta-data to be readily stored, accessed and searched
- quality controlled text mining
- model-centred data handling

Advances in experimental design and documentation

- more standardised perturbations (tuneable, quicker and more stable and reproducible than RNA interference)
- technologies to discover, quantify and monitor novel regulatory mechanisms (e.g., protein phosphorylation, siRNAs at the level of the ribosomal protein synthesis)
- new experimental design features that are needed for Systems Biology (e.g. one of the recommendations of an earlier ESF workshop was to generate libraries of reference molecules that can be spiked in by everyone, to provide a common reference)
- standard samples, standard protocols, standard experimental strategies
- standardised description of genotypes, prehistory, experimental conditions and treatments
- new ways of model driven experimentation (e.g. robot scientist)
- more of capacities should be used for controls, standards and spiking

Wet laboratory technologies

- quantitative high-throughput measurements of different types of molecular interactions that are needed to produce quantifiable networks that rely on interactions and not just correlations (e.g. methods to measure at high throughput and to quantify functional properties of proteins, and context-dependent changes in the properties).
- experimental techniques to measure the position of molecules in space and time:
    - genome wide to address the question which molecules are in which cells, located in which sub-cellular compartments.
    - 10 nm level for molecules relative to each other; which molecules are physically located together in transient structures.

- Techniques to measure the dynamics cellular networks such as of the protein-protein interactions and protein-metabolite interactions in the cell, with a suitably high temporal resolution
- single cell measurement for all cells in a heterogeneous population
- looking at cells in the context of living tissue or biofilm
- measuring the dynamic structural states of proteins, RNA, DNA
- measure rates (rate constants) of synthesis and degradation in vivo for all systems components
- measuring concentrations of all components more accurately than 10 % and in absolute sense
- high speed, multi-aspect generic quantitative phenotyping at many aspects of cell physiology; relating this to epidemiology
- ability to measure different organs
- ability to measure and model fluid dynamics

Methodology for theoretical analysis (dry)

- the various types of networks that exist concurrently in the cells, especially the interactions of the different types of network (e.g. connect protein-DNA interaction with protein–protein and protein–small molecule interaction data); this may involve fundamental mathematical issues
- new modelling technologies are needed to deal with spatiotemporal distributions of proteins; multiscale space, time, chemistry modelling
- stochastic modelling
- inverse modelling; reconstruct networks (protein, RNA, metabolic simultaneously) from time-series or perturbation studies
- new computational modelling for new ways of understanding the functioning of pathways (alternatives to differential equations); this in a way that integrates the relevant experimental data
- new concepts and theories for Systems Biology (e.g. robustness, control analysis, modularisation), also in terms of handling the data
- charting the possibilities of ensemble averaging
- use patient oriented data in connection with bioinformatics, e.g. vis-à-vis predictive medicine

Once all these technologies would be available it should become possible to:

- understand risk factors, including environmental, SNPs, and oncogene activation
- modify an organism to produce a predictable phenotype, such that it becomes a robust cell factory
- identify new, dynamic and topological drug targets
- target networks differentially with multi-factorial therapies

Underpinning action RESEARCH: Two strong, fully-funded integral research programmes addressing Systems Biotechnology and Multi-factorial Diseases

Systems Biotechnology in single cell and multi cell systems

There is growing acceptance among the general public that our production methods should become more sustainable or even 'self-sustaining'. One central aspect of this shift will be the development of a 'Knowledge-based Bio-Economy' (KBBE). This change in production methods will be of crucial importance for Europe, and for the remainder of the world. In economies of the future, biotechnology will make many major contributions including the generation of bioenergy, production of fine chemicals, pharmaceuticals and enzymes, food processing, waste-processing and bioremediation, and bio-sensing. It will use many different sorts of organisms, from bacteria and fungi to animal cells and plants. Realising the vast potential in biotechnology will require that diverse life forms can be engineered to perform a myriad of specific tasks in a cost-effective, energy-efficient, reliable, robust and environmentally-acceptable manner. The challenges faced by biotechnology thus include the field of metabolic engineering, but go far beyond it. Importantly, progress towards these ambitious goals depends on a deep understanding of the regulatory networks that determine the rate of growth, stress tolerance and durability of different organisms.

The challenge is to develop an adequate and predictive understanding of complex systems, which will allow us to efficiently and robustly modify and control a wide range of different organisms and life forms. This will require new technologies such as those described above that are able measure many different sorts of parameters and variables, and generic methods to handle data and model networks. There will be many commonalities and synergies to be gained from a shared approach to biotechnology that allows us to address questions related to the KBBE; developing technologies and conceptual frameworks that support quantitative and predictive science, and which can be extended across species borders.

Multi-factorial Diseases

More than 90 % of the diseases that plague European society today are multi-factorial, network diseases. There is genuine reason to expect that implementation of Systems Biology will improve diagnosis, stratification and ultimately management of these diseases.

The Forward Look Policy Briefing mentions two sets of examples of possible targets for a Europe-wide Systems Biology action, i.e. a full molecular Systems Biology understanding of three living cells (*L. lactis*, *S. cerevisiae* and the human liver cell), and a Systems Biology understanding of metabolic syndromes. In the latter category, the Forward Look Report examines diabetes, Alzheimer's disease, and cancer. Although traditionally these diseases and the biotechnologies have been regarded as entirely separate issues, they have in fact much in common: networks digressing from optimal behaviour (from health to disease, from designed process to failing process) and the human interest in bringing the network (back) to optimal functioning (therapy

and biotechnology). Indeed, the intracellular networks that are being studied in cancer, type 2 diabetes, and arthritis research, overlap strongly with each other and have many issues in common with the intracellular networks in cells used for biotechnology. From the Systems Biology perspective therefore, it is possible to have a strong focus on both the failure of these networks (such as is typical for multifactorial diseases), and on the possible ways of steering them towards improved functionality (relating to drug design, therapy and engineering).

Recommendation of the Task Force:

The Task Force recommends aiming for a unitary strongly funded research programme with two sub-themes, Systems-Biotechnology and Multifactorial Aspects of Health, with a general focus on measuring, simulating and eventually understanding the processes of living cells in differentially perturbed states. The overall topic of the two research programmes could be called **'Networks Working for Life: The multifactorial basis of Systems Biotechnology and diseases'.**

This focus might at first seem to be too broad. Too many research programmes appear to fall into this focus, e.g. any programme addressing cancer, or metabolic engineering. However, what will distinguish the activities in the proposed programme from concurrent (and potentially complementary) other research activities in the respective fields is their focus on the generic aspects of dynamic molecular networks that constitute the processes of life. The two sub-programmes should work towards a complete dynamic 'map' of the intracellular and paracellular networks of living cells.

It will be important that the research programme be substantial and connected to, if not incorporating the existing major Systems Biology research programmes in Europe.

Underpinning action TRAINING: A coordinated massive training initiative

In industry and academia alike, there is an immense shortage of biologists who know to handle equations and of physical chemists and mathematicians who know to handle experimental biology. Training in interdisciplinary and trans-disciplinary research is highly important for the development of Systems Biology. At the moment the market of suitable human capital for new Systems Biology projects is already small, and the development of more effective biomedical and biotechnological research might become limited by lack of systems biologists. Training opportunities are set up at various centres throughout Europe, with the UK doctoral training centres on Systems Biology, the German ForSys centres, the Amsterdam MSc Systems Biology and SystemsX.ch, the Swiss initiative for Systems Biology as examples where new teaching methodologies are developed specifically for Systems Biology. These training programmes rely on exchange of students between Systems Biology centres, but the possibilities for such exchange are still limited. There are only few Systems Biology summer schools active, each of which has many more applicants than it can cope with. More support for all these activities is needed.

Underpinning action STANDARDS: European reference laboratories

As detailed in the Forward Look report, a network of European reference laboratories for Systems Biology should be established. This consortium should have the mission to enable any systems biologist to carry out any high quality Systems Biology activity, even if her/his own laboratory does not have the necessary facilities. These laboratories should also maintain Standard Operating Procedures 'live', i.e. for anyone to inspect and learn. They should also generate and distribute standard experimental samples and standard datasets for systems biologists to work on.

Underpinning action THINKTANK: Institutes for Advanced Studies

In a preliminary step, we propose the establishment of ***Institutes of Advanced Studies.*** Such institutes will not be permanent 'standing' institutes but rather act as physical and virtual hosts for focused programmes of fixed, generally short duration, in which researchers from across Europe can participate on a "go in / go out" scheme.

Volume of the Grand Action on Systems Biology

The Task Force proposes that the Grand Action on Systems Biology (GRASB) aims at creating a nucleus programme with which a significant fraction of the private and public European Systems Biology community would associate. Industry for instance could participate in GRASB and then set up its own research programmes where the pre-competitive information make a competitive activity attractive. National funding bodies could attach programmes of national interest to that nucleus programme. A number of System Biology programmes in Europe already serve potentially in a similar capacity and these may serve as examples, or indeed as further nuclei.

The current investment by the German BMBF alone in the topic exceeds 130 million €, much of which could leverage GRASB. Similarly the UK investment of more than 100 million € helps estimate the required and realistic volume of the GRASB programme: The Board considers that a volume of at least 1 billion € (for ten years) will be necessary for this programme to become a nucleus further attracting additional activities. This is readily achievable.

Management of the programme by a dedicated consortium

The challenge that Systems Biology offers has already been noted by a number of national funding agencies, by the European Commission, by learned societies, by Universities and by a number of major industries. This has led to a number of investments, some of which would and will fit well into the Grand Action on Systems Biology (GRASB). Indeed GRASB should be funded largely on the basis of already existing funding mechanisms, with likely extra bonus funding on the basis of promise and then success.

Much of the activities necessary for putting a successful GRASB together will therefore consist of ensuring that the Systems Biology activities of the partners involved in GRASB create the maximum synergy. This will involve an opening up of national research projects to scientists in other GRASB countries, and similarly to

industrial scientists in GRASB (IP generated in GRASB will remain in GRASB so as to benefit the further development of the programme).

Accordingly, the best way of defining and then executing GRASB is to have a committee of representatives of all investors in GRASB with voting rights proportional to their contribution.

At the moment and on the basis of previous or anticipated willingness to invest in GRASB-like activities, the Task Force recommends to inviting a limited number of prime movers who are willing to show commitment in an open process allowing the extension at all time. Exemplary, organisations committing to this consortium for GRASB are listed below:

> **Industry:** AstraZeneca, Unilever, DSM, Roche, Degussa, Novartis, Pfizer, GSK, Philips
> **Government(-related):** EC-DGXII, BMBF, BBSRC, DFG, NWO-NGI, MEC.es, Bm:bwk, Research Council of Norway, ANR, Helmholtz Foundation, Max Planck Society, EPSRC, UK DTI, CNRS.
> **Foundations, societies, charities:**
> FEBS, ESF, EMBO, Wellcome Trust, Wallenberg Foundation

Funding mechanisms should include national programmes according to existing schemes, where the coordination between nations may be organised through the ERANET ERASysBio, a Super EUROCORES organised by ESF, and various funding schemes in FP7, FEBS Advanced courses and EMBO workshops, and contributions from industry. The consortium should examine whether a new form of public-private partnership can be found here, keeping in mind that investment by industry is special here because of the longer than usual cycle of return on investment.

It is also recommended that the consortium engages European governments so as to directly fund GRASB, as the programme will greatly benefit innovation, health and economic growth. Indeed, GRASB addresses an area where European science should be able to hold or extend its lead vis-à-vis the younger economies of Asia.

In terms of phasing it is recommended that the consortium hold its first meeting at the beginning of 2008. It should then establish a European Systems Biology office that should support the activity of the task force. This office should employ (i) a full time coordination officer, (ii) a high-level senior science policy executive who should contact all relevant government agencies, industrial and academic organisations at the highest level, as well as (iii) the corresponding secretarial staff. Part of this office may already be established prior to the first official meeting of the consortium.

At its first meeting, the consortium should formulate a set of calls for proposals for research programs linking up major existing Systems Biology activities of consortium members in line with the common programme 'Networks for Life; addressing multifactorial biotechnology and disease' and of some of the other planned actions. For some actions there may first be a round of calls for expressions of interest, the results of which should then be put together by the task force into blueprints of GRASB. The consortium should publish an agenda announcing dates of the calls for proposals that together aim at putting in place the Grand Action Programme before

2010 (e.g., calls spring of 2008, evaluation September 2008, programs beginning early 2009, and expression of interest February 2008, blueprint July 2008, calls for proposals November 2008, evaluation 2009, funding beginning January 2010).

Proposed role of the ESF

The Task Force proposes that the ESF continues to coordinate the establishment of the consortium and also furnishes much of the support for the ESBO. ESF should contact the proposed members of the consortium. ESF should offer to host ESBO. With ESBO, ESF should then organise the meetings of the Task Force. It should also help carry out the activities proposed by the consortium, which will include contact with the science funding organisations in Europe [including the FP7 programme management, FEBS, and EMBO].

As one of the players in the task force then, the ESF should commit to organise a large research programme using the EUROCORES Scheme as a blueprint so as to host part of the underpinning actions mentioned above. It should also make available other of its instruments, all in consultations with the other members in the consortium.

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