

Research Programme on Biological Functions Life 2000

EVALUATION REPORT



Research Programme on Biological Functions Life 2000 EVALUATION REPORT

Evaluation Panel:

Professor Jan Bjaalie
University of Oslo,
Oslo, Norway

Professor Rudi Balling
German Research Centre for Biotechnology,
Braunschweig, Germany

Dr Rüdiger Klein
Max Planck Institute of Neurobiology,
Munich, Germany

Professor Alex Mauron
Université de Genève,
Geneva, Switzerland

Jan Rydman
Federation of Finnish Learned Societies,
Helsinki, Finland

Professor Shoshana Wodak
The Hospital for Sick Children,
Toronto, Canada

Academy of Finland in brief

The Academy's mission is to finance high-quality scientific research, act as a science and science policy expert and strengthen the position of science and research. The Academy's operations cover all scientific disciplines.

The main focus of the Academy's development activities is on improving opportunities for professional careers in research, providing resources and facilities for high-profile research environments and making the best possible use of international opportunities in all fields of research, research funding, and science policy.

The Academy has a number of funding instruments for various purposes.

The Academy's annual research funding amounts more than 200 million euros, which represents some 13 per cent of the Finnish government's total R&D spending.

Each year Academy-funded projects account for some 3,000 researcher-years at universities and research institutes.

The wide range of high-level basic research funded by the Academy generates new knowledge. The Academy of Finland operates within the administrative sector of the Ministry of Education and is funded through the state budget

For more information on the Academy of Finland, go to www.aka.fi/eng

Layout: PixPoint ky

ISBN 951-715-512-3 (print)

ISBN 951-715-513-1 (pdf)

ISSN 0358-9153

Painopörssi Oy, Helsinki, Finland 2004

Kuvailulehti

Julkaisija	Suomen Akatemia	Päivämäärä	15.10.2004
Tekijä(t)	Loppuarviointipaneeli		
Julkaisun nimi	Research Programme on Biological Functions, Life 2000. Evaluation Report		
Tiivistelmä	<p>Suomen Akatemia käynnisti vuonna 2000 Life 2000 -tutkimusohjelman, jonka tarkoituksena oli tukea funktionaalista genomitutkimusta sekä bioinformatiikan, kehitysbiologian ja neurotieteiden tutkimusta. Life 2000 -tutkimusohjelma nähtiin tärkeänä välineenä korkeatehoisen tekniikan soveltamisessa ja tieteidenvälisten yhteyksien luomisessa suomalaisen biotieteiden tutkimuksen kansainvälisen kilpailukyvyyn kohottamiseksi. Life 2000 oli sekä laajuudeltaan että budjetiltaan kunnianhimoisin Suomen Akatemian siihen mennessä käynnistämistä tutkimusohjelmista. Edellisistä ohjelmista poiketen sen linjaukset suosivat tieteidenvälisiä hankkeita. Ohjelman uutuuksena oli myös bioeettisten ja yhteiskunnallisten vaikutusten huomioinnon ottaminen. Lisäksi siinä korostettiin tieteellisten tulosten välittämistä suurelle yleisölle.</p> <p>Ohjelma toteutettiin vuosina 2000-2003. Vuonna 2004 Suomen Akatemia toteutti ohjelman arvioinnin ja asetti arviointia varten kansainvälisen paneelin, johon kuuluivat seuraavat henkilöt:</p> <ul style="list-style-type: none"> - Jan Bjaalie, University of Oslo, Oslo, Norja - Rudi Balling, German Research Centre for Biotechnology, Braunschweig, Saksa - Rüdiger Klein, Max Planck Institute of Neurobiology, München, Saksa - Alex Mauron, Université de Genève, Geneve, Sveitsi - Jan Rydman, Tieteellisten seurain valtuuskunta, Helsinki, Suomi - Shoshana Wodak, The Hospital for Sick Children, Toronto, Kanada <p>Loppuraportissaan arviointipaneeli totesi, että Life 2000 -ohjelmalle asetetut erityistavoitteet – suomalaisen tutkimuksen laadun nostaminen, tieteidenvälisyyden ja yhteistyön lisääminen suomalaisten tutkijoiden kesken, geeniteknologian soveltamisen ja kehittämisen tukeminen biolääketieteellisen tutkimuksen edistämiseksi sekä biotieteiden ja yhteiskunnan välisten suhteiden vahvistaminen – oli saavutettu. Arviointipaneeli kiitti erityisesti Suomen Akatemian kaukonäköisyyttä käynnistää ohjelmaa, joka korosti suurempaa tieteidenvälisyyttä ja yhteistyötä tutkijoiden kesken.</p> <p>Paneeli korosti yhteenvedossaan, että Life 2000 onnistui hyvin tehtävässään edistää suomalaista biotieteiden tutkimusta. Ohjelma oli tärkeä edistysaskel suomalaisen biotieteellisen tutkimuksen valmistamisessa tulevaisuuden haasteisiin. Se edisti tieteidenvälisyyttä ja suomalaisten tutkijoiden välistä yhteistyötä erittäin tehokkaasti. Life 2000 –tutkimusohjelma käytti juuri oikeita keinoja näiden päämäärien saavuttamiseksi.</p>		
Asiasanat	tutkimusohjelmat, loppuarviointi, funktionaalinen genomitutkimus, bioinformatiikka, kehitysbiologia, neurotieteet		
Julkaisusarjan nimi ja numero	Suomen Akatemian julkaisuja 4/04		
ISSN	0358-9153		
ISBN	Painetulle kirjalle annettu tunnus 951-715-512-3	Pdf-versiolle annettu tunnus 951-715-513-1	
Sivumäärä	18		
Julkaisun jakaja	Suomen Akatemia, PL 99, 00501 Helsinki, viestinta@aka.fi		
Julkaisun kustantaja	Suomen Akatemia		
Painopaikka ja -aika	Helsinki 2004		
Muut tiedot			

Description

Publisher	The Academy of Finland	Date	15 Oct. 2004
Author(s)	Final evaluation panel		
Title	Research Programme on Biological Functions, Life 2000. Evaluation Report		
Abstract	<p>In 2000, the Academy of Finland launched the Life 2000 Research Programme to support research in the field of functional genomics, bioinformatics, developmental biology and neuroscience. Life 2000 was considered a key instrument for implementing high-throughput technologies and for building the interdisciplinary efforts required to make Finnish research in the life sciences competitive at the international level. Life 2000 was the most ambitious programme ever launched by the Academy of Finland, both in scope and budget. Unlike previous programmes, its guidelines indicated preference for interdisciplinary projects. Another novelty was to include research on bioethical and societal impacts and to put emphasis on the communication of scientific results to the wider public.</p> <p>The programme ran from 2000 to 2003. In 2004 the Academy of Finland undertook the evaluation of this programme. An international review panel was established, consisting of the following scientists:</p> <ul style="list-style-type: none"> · Jan Bjaalie, University of Oslo, Oslo, Norway · Rudi Balling, German Research Centre for Biotechnology, Braunschweig, Germany · Rüdiger Klein, Max Planck Institute of Neurobiology, Munich, Germany · Alex Mauron, Université de Genève, Geneva, Switzerland · Jan Rydman, Federation of Finnish Learned Societies, Helsinki, Finland · Shoshana Wodak, The Hospital for Sick Children, Toronto, Canada <p>As a result of the review, the panel concluded that the specific objectives of Life 2000, namely to improve the quality of science in Finland, to promote interdisciplinarity and cooperation among Finnish scientists, to support the development and application of genomic technologies in order to advance biomedical research and to strengthen interaction between the life sciences and society had been achieved. The evaluation panel especially acknowledged the vision of the Academy of Finland to initiate a programme geared towards a more interdisciplinary and cooperative mode of scientific research.</p> <p>As a summary the panel accentuated that Life 2000 was a very successful programme to promote life sciences in Finland. It represented an important milestone in preparing Finnish life sciences for future challenges. It brought forward interdisciplinarity and cooperation between Finnish scientists in a very effective manner. Life 2000 used exactly the right window of opportunity to reach these goals.</p>		
Key words	research programmes, evaluation, functional genomics, bioinformatics, developmental biology, neurosciences		
Name and number of series	Publications of the Academy of Finland 4/04		
ISSN	0358-9153		
ISBN	Print 951-715-512-3	Pdf 951-715-513-1	
Number of pages	18		
Distributed by	Academy of Finland, POB 99, FI-00501 Helsinki		
Published by	Academy of Finland		
Place and date of printing	Helsinki 2004		
Other information			

Contents

1 Preface	7
2 Introduction	8
3 Results of Evaluation	9
3.1 Strategic Planning of the Programme	9
3.2 Scientific Quality	10
3.3 Organisation	13
3.4 Added Value	14
4 Fulfilment of the Programme Aims	15
5 Conclusions and Recommendations	17

1 Preface

In 2000, the Academy of Finland launched a new Research Programme on Biological Functions, Life 2000, to support research in the field of functional genomics, bioinformatics, developmental biology and neuroscience. Aware of the rapid technological developments taking place in biology and the impetus created by the imminent availability of the human genome sequence, the Academy considered Life 2000 a key instrument for implementing high-throughput technologies and building interdisciplinary efforts required to make Finnish research in the life sciences competitive at the international level. Life 2000 was the most ambitious programme ever launched by the Academy of Finland, both in scope and budget. Unlike previous programmes, its guidelines indicated preference for interdisciplinary projects that would bring together several laboratories with complementary expertise. Another novelty was to include research on bioethical and societal impacts and to put emphasis on the communication of scientific results to the wider public.

The programme ran for three years from 2000 to 2003. In 2004, the Academy of Finland undertook the evaluation of this programme. For the evaluation the principal investigators funded within the programme were asked to produce a written report and to fill out a self-evaluation form. An international review panel was established, consisting of the following scientists:

- Jan Bjaalie, University of Oslo, Oslo, Norway
- Rudi Balling, German Research Centre for Biotechnology, Braunschweig, Germany
- Rüdiger Klein, Max Planck Institute of Neurobiology, Munich, Germany
- Alex Mauron, Université de Genève, Geneva, Switzerland
- Jan Rydman, Federation of Finnish Learned Societies, Helsinki, Finland
- Shoshana Wodak, The Hospital for Sick Children, Toronto, Canada

The review panel met in Helsinki on August 16-18, 2004 to carry out the evaluation. During this meeting, interviews and discussions were conducted with the key participants of the programme. These included the principal investigators funded by the programme, scientists who at the request of the Academy had formulated a written opinion regarding the future prospects of the field, which was provided as background material to the panel, the programme planning committee and the coordinator.

The panel considered the following main aspects when evaluating Life 2000:

- the planning process,
- scientific quality of the research and other results,
- organisation, coordination and communication of the programme.

This document presents the results of the evaluation as well as the recommendations of the review panel.

Helsinki, August 2004
Rudi Balling
Professor, Chair of the Evaluation Panel

2 Introduction

The Life 2000 research programme was planned and implemented during 1999-2000. This was a period when the USA and a number of European countries started to actively engage in large-scale efforts in genome-wide functional genomics research in life sciences. Life 2000 was the Finnish response, intended to ensure that Finland would not be lagging behind the exciting developments in modern-day biology.

Since genome-wide approaches to investigating biological questions require large investments in equipment and rely on a wide variety of different technologies and on the integration of multiple disciplines, cooperation of larger teams is necessary. To make this possible, the Academy of Finland and the National Technology Agency (Tekes) launched Life 2000 with a total budget of 14.5 million euros.

To prepare the programme the Academy of Finland organised exploratory workshops with scientists from a wide range of disciplines. Following the decision of the Academy of Finland Board to launch Life 2000, a two-stage application procedure was established. In the first stage, applicants sent plans of intent to the Academy. The Academy received 329 proposals, 87 of which were recommended for the second stage. These applications were then reviewed by an international panel. The final funding decision was made by the Life 2000 Board. In all 39 projects were selected to receive funding from the programme. The total amount of funding was 13.8 million euros. Individual projects received funding between 34,000 and 200,000 euros. Of the 39 projects selected to receive funding, 13 were research projects of individual groups or departments from a single institution, whereas 26 were research projects of consortia comprising laboratories from different institutions.

The specific objectives of Life 2000 were to

- improve the quality of life sciences in Finland,
- promote interdisciplinarity and cooperation among Finnish scientists,
- support the development and application of genomic technologies in order to advance biomedical research, and
- strengthen interaction between life sciences and society.

3 Results of Evaluation

3.1 Strategic Planning of the Programme

A transparent planning process was achieved through participation of scientists in exploratory workshops and through involvement of international experts. One of the challenges in setting up the programme was to determine its scope. The choice was made between covering a range of different areas of biology or focusing on a few areas only. Initially a focus on neuroscience was apparently considered. At a later stage the scope of the programme was expanded to include developmental biology, bioinformatics and functional genomics. This was estimated by some scientists to result in a much less focused programme, “not very different from the basic science support programme by the Academy”. On the other hand, others suggested that “Finland is not large enough to warrant highly focused, theme-oriented programmes”. Although this is clearly a debatable issue, the evaluation panel concludes that in 2000 the decision to widen the programme’s scope with priority given to technology building and interdisciplinarity was a good and timely decision for the following reasons:

- Integration of different disciplines allowed building a critical mass of labs with a common interest in using genome-wide high-throughput technologies.
- It was far from clear in 2000 which areas of biology were the ripest for genome-wide approaches. Thus, casting a broader net and giving priority to scientific quality was a wise strategy.
- Collaboration between different disciplines being a key issue, the programme was well poised to enable this important aspect. The implementation of Life 2000 therefore came just in time for Finnish science to remain internationally competitive.

Life 2000 did not include mechanisms for funding infrastructure and equipment. Several grantees expressed the opinion that this was a setback, as the programme fell somewhat short of providing the appropriate means for building the necessary technology platforms and infra-structure facilities required to meet the specific needs of functional genome research. It appears that several sources of funding, including the Academy, were available for this purpose, but that the timing was somewhat out of synchrony with the Life 2000 programme. Nevertheless, scientists funded within the programme were allowed to use their funds in a flexible manner. This was regarded as a marked advantage that allowed scientists to make the most efficient use of their resources.

Questions related to bioethics, social implications and communications had so far not played a major role in the research programmes of the Academy of Finland. With Life 2000, a comprehensive effort was made for the first time to integrate these issues into a bioscientific research programme. Discussions with the interviewed scientists and amongst the evaluation panellists clearly showed that this was a good decision. However, the programme planning process apparently did not establish specific criteria for selecting projects that would truly cross the boundaries between the natural sciences and the humanities. Furthermore, no clear criteria

were established to measure the success of projects in bioethics, societal aspects and communications.

3.2 Scientific Quality

The majority of the funds of Life 2000 were granted to research in two fields: neurosciences and functional genomics. Developmental biology, a field in which Finland had traditionally been strong, represented a relatively small proportion of the funded projects. In addition to these larger areas, the programme included projects in the fields of structural biology and biophysics, as well as specific projects in bioinformatics. Bioethics and the social sciences were another minor area of focus of the programme.

Examination of the research reports and corresponding lists of publications led the panel to conclude that, overall, the research carried out by the researchers funded by the programme was of a high quality. However, the material provided was not always adequate to allow an in-depth evaluation of the quality of the research conducted by individual grantees. The reports often contained lengthy descriptions of results without a focus on particular highlights and breakthroughs. Some grantees had not completed their reports before the evaluation.

Several of the projects involved either large individual groups, or consortia, in which several groups received substantial funding from other sources, making it difficult to assess the contribution attributable to Life 2000 as such. Likewise, the provided lists of publications in many cases also involved papers relating to work funded from other sources. This should not, however, be seen as a shortcoming, but rather as an indication that Life 2000 was well integrated into on-going activities that helped contribute to its success. Some of these consortia involved groups of younger PI's who were able to develop new areas such as bioinformatics, genome-wide profiling and cellular imaging. The impact of these developments will be felt gradually, as publications of these groups will come out soon including reports on research results.

Neurosciences: There were 12 projects in this category. At least two-thirds of them were of a multidisciplinary character. Only one-third used new technologies such as genome-scale DNA and protein expression profiling or functional imaging. More than half of the projects were clearly of high international standards.

Development biology: This category included a total of four projects, which were of a high quality overall. Most of the projects were interdisciplinary and used genome scale expression techniques and new methods for knock-out and gene disruption.

Functional genomics: Projects under this category numbered 13. More than half of the projects in this area were of high international standards. Most had an essentially multidisciplinary character. More than half of the projects introduced genome scale techniques, mainly expressions profiling, and a few projects developed and applied proteomics methods. Others involved structure-function analyses. Several of those combined structure determination of biologically relevant proteins with site-directed mutagenesis studies.

Biophysics and Bioinformatics: There were a total of seven projects in this combined category. Five of these were in the area of bioinformatics and two in biophysics. The bioinformatics projects included analyses of biologically important protein families, which combined site directed mutagenesis with pharmacological studies. Other efforts went to the implementation of methods for the analysis of gene expression profiles. The projects in biophysics included use of different biophysical techniques, including X-ray diffraction to elucidate assembly of supramolecular structures and structure-function relationships.

Measuring the success of Life 2000 by publications: Overall, the 26 consortia produced a total of more than 276 papers, of which 115 were joint papers with more than one consortium member as co-author. The evaluation panel was particularly impressed by the number of publications co-authored by different PIs within Life 2000. On average, 4.4 joint papers were published per consortium, with three consortia producing no joint papers. In summary, the publication record of the programme was considered to reflect a high productivity of the research teams participating in Life 2000, and that most consortia represented genuine collaborative agreements.

Ethical and Societal Impacts

The published output of the bioethics and social science studies was impressive, reflecting the fact that it came from productive and well established researchers. The activities did not fully reflect the interdisciplinary nature of the programme, which was understandable, since this was not very clearly formulated as a goal during the planning stage.

Life 2000 was more ambitious than the previous programmes in addressing issues of an ethical and regulatory nature, as well as in integrating social science questions, i.e. science and technology studies or technology assessment. Even though these aspects were not articulated in much detail at the beginning, they did have an important didactic impact, especially on younger natural scientists who participated with great interest in the ethics seminars. There was also a strong willingness to foster public understanding of and debate on biomedical research, and at the same time a belief that the Finnish public is basically 'science-friendly'.

Although the scientific output of the social science and bioethics projects was remarkable, there has not been, yet, deeper interdisciplinary engagement of these disciplines with the 'hard' sciences. This may be linked to the very broad biological theme of Life 2000. Nevertheless, it was one of the merits of Life 2000 to provide ethicists and social scientists with access to natural scientists and a means to raise awareness of aspiring natural scientists of the viewpoints of social sciences and the humanities.

It is certainly premature to assess the impact of this kind of programme on the general public. It will always be difficult to distinguish the impact of a particular programme on the public perception of life science research in society. Yet in an unassuming but persistent way, Life 2000 managed to create the participating scientists several opportunities for public exposure. This is a long-term effort that deserves continuous support and professional attention.

Technological Impact

Although the main focus of Life 2000 was on basic research, the programme offered ample opportunities for facilitating and encouraging the application of technology. This is shown by the high number of patents and by interaction of participants with biotech companies.

Internationality

Many individual researchers who received funding through Life 2000 were engaged in international collaboration. However, this collaboration did not involve formalised interaction with non-Finnish partners within consortia. Whether or not external collaboration had been essential for the success of the research was not assessed. The evaluation panel felt that the programme could have benefited from a more visible and formalised international component.

The integration of Finnish activities into EU programmes was discussed. The participating scientists considered participation in EU programmes essential for the future but were concerned about the excess of political influence on research themes and the level of bureaucracy. The panel felt that Life 2000 would turn out to be instrumental in preparing Finnish scientists to effectively compete for EU funding.

Cooperation within the Programme

The scientists regarded interdisciplinary cooperation within the consortia as very useful. Life 2000 gave scientists the necessary impetus to new cooperation, e.g. between biophysics, informatics and computing sciences on the one hand, and wet biology on the other. Some scientists warned, however, that expensive programmes such as Life 2000 might cause reallocation of funds, away from mainstream research to artificial consortia that would carry a high risk of failure. The evaluation panel felt that considering all aspects, Life 2000 served as a useful mechanism for promoting cooperation between distant fields.

As to bioethics and the social sciences, collaboration among ethicists and social scientists was absent. The bioethics consortium was an 'artificial' entity in this regard. On the other hand, interaction took place between the ethics/social science researchers and the natural scientists. This was mainly limited to well received seminars, but did not lead to interdisciplinary research efforts.

Inter- and transdisciplinarity

Life 2000 was launched as a response to the need to meet the challenges of the post-genomic era. In particular, it was considered important to provide the Finnish life science community with an appropriate framework for developing interdisciplinary research and state-of-the-art high-throughput techniques. Life 2000, though rather broad in its coverage of topics, favoured applications from consortia of laboratories. These involved groups from different disciplines with complementary expertise. It was expected that this type of collaborative research would create added value and

strengthen disciplines such as bioinformatics, biophysics and functional genomics in Finland, thus preparing the Finnish scientific community for future challenges in biology. However, the condition of forming consortia was not a strict requirement. Rather, the scientific quality of applications was given priority, which led to acceptance of a fair, though smaller number of applications from individual groups.

Based on interviews with individual scientists involved in the programme, with Academy officials and the programme coordinator, and partly on analysis of the research report, the panel could ascertain that the goal of interdisciplinarity was essentially reached. This seems to be partly due to the fact that the programme was launched at just the right time, as commented by many scientists. As a result, the Finnish scientific community has become more competitive internationally and has been able to build up the critical mass needed in more focused programmes in essentially interdisciplinary fields of research, such as systems biology and bioinformatics.

3.3 Organisation

Coordination

Life 2000 was one of the largest programmes ever launched by the Academy of Finland. Coordination was therefore considered a key component. A dedicated coordination team was appointed for the programme. This team was responsible for disseminating key information between the Academy and the research groups participating in the programme, helping the scientists to organise workshops and meetings and making the whole programme visible to the general public.

The coordinator of Life 2000 and his staff were appointed by the Institute of Biotechnology and were based in the Viikki Biocentre in Helsinki. The coordinator and a scientific secretary were hired full-time. A part-time assistant, responsible for supporting several activities at the Institute of Biotechnology, was also assigned to programme coordination. The scientific secretary assisted primarily with internal and external communication and with the planning of meetings and workshops.

During the establishment and launching of the programme, the scientists on the advisory panels recommended that regular reporting and other requirements by the programme coordination be limited to a minimum. The attitude taken by the programme coordinator was, therefore, to provide support when needed but to avoid extensive reporting. It was confirmed in the self-evaluations, and clearly expressed during the interviews of individual scientists, that the coordination of the programme was highly successful in this respect. It was also pointed out that the coordinating office provided valuable assistance in the organisation of workshops and meetings, and that the scientific events for interaction and dissemination were well organized. The number of meetings that brought together the scientists funded by the programme was substantial. Since the meetings were repeatedly held in the Helsinki region, the lack of a larger travel budget apparently posed a problem for groups that had to travel long distances. It was reported that often these groups could not afford to bring all of the relevant persons to meetings.

The coordination received excellent marks from the end-users. The evaluation panel considers that the coordinating office has fully accomplished its mission, and compliments it on finding the right middle ground to provide scientists with the necessary assistance whenever requested, while avoiding burdening them with unnecessary administrative chores.

Training and Education

Life 2000 was very effective in training young researchers. Due to the large number of participating labs, the evaluation panel did not calculate the overall number of PhDs earned within the programme. It was also noted that Life 2000 made it possible to establish new groups headed by junior investigators, something that would not have been possible without this programme.

The incorporation of bioethics and social sciences into Life 2000 had most obviously affected the field of education. The natural scientists who obtained advance training through the programme were exposed to these 'outside' disciplines.

Communications

In Life 2000, emphasis on communication of science to the public was for the first time a major objective. This was accomplished by a wide variety of efforts, e.g. websites, newsletters, press conferences, science breakfasts, electronic newsletters and to a certain extent training programmes for the popularisation of science. Whereas Finnish scientists in general prefer a modest approach in addressing the public, it is increasingly realised that reaching out to the public is very important for a positive long-term relationship between science and society.

Although it is still too early to assess the impact of Life 2000, the programme can even now be considered a great success. In the course of the programme an increasing number of scientists got involved in communication activities. As was to be expected, individual groups used the communication tools provided by the coordinator with different intensity. Despite the progress made, a professional concept for communication and for supporting public understanding of science still needs to be developed. This should involve a commitment by the Academy of Finland to provide the coordinator with the necessary resources and to integrate the communication strategies of different programmes.

3.4 Added Value

The specific added value of Life 2000 was the successful establishment of interdisciplinary cooperation among Finnish scientists. The interaction between disciplines, such as bioinformatics, developmental biology and neuroscience, provided a fertile ground for truly integrative biomedical research in Finland. Furthermore, the bioethical research components of Life 2000 had a pilot function in building bridges between the natural sciences and humanities. Life 2000 also raised the awareness of scientists to disseminate their results to the general public. Although still at an early stage, this aspect will be very important in the long run.

4 Fulfilment of the Programme Aims

The key aim of Life 2000, i.e. to promote multidisciplinary approaches and collaboration between groups with complementary expertise as well as to build bridges with the social sciences, was certainly reached. In this respect, the programme helped to establish a research environment where the use of high-throughput technologies became a routine component of genome research. It also facilitated access of smaller labs to major infrastructure and equipment. Life 2000 had an important catalysing role in removing some of the communication barriers between different disciplines.

Although equipment required for genome-scale analysis was made available as a result of the flexible use of funding resources, a major bottleneck was the lack of available infrastructure for carrying out mouse work. Whereas some of the major centres have sufficient capacity for doing mouse experiments, a number of scientists involved in Life 2000 reported a lack of sufficient mouse capacity. Presently, there is no truly interdisciplinary cooperation among scientists in the area of mouse genetics. Most research institutions operate on stand-alone, poorly integrated animal facilities.

Life 2000 clearly promoted cooperation among different institutions and disciplines. With the exception of a few groups, this cooperation was largely based on a national rather than international level. Many scientists involved in Life 2000 raised concerns about being forced to opportunistic international cooperation with too much bureaucracy and a lack of scientific quality, and they appreciated the freedom Life 2000 gave them in this respect. However, programmes such as Life 2000 could improve the competitiveness of Finnish scientists in European research programmes. As far as the review panel can tell, the potential of Life 2000 was not fully exploited in this context. This is also reflected in the poor visibility of Life 2000 internationally.

Life 2000 was an important component in providing Finnish researchers with the necessary resources to carry out competitive research. In this sense the programme was a timely and well-spent investment. Life 2000 was also a strong stimulus to cooperative and interdisciplinary interaction. It remains open whether this objective would also have been achieved through the normal granting scheme.

Although the major emphasis of Life 2000 was placed on interdisciplinarity and competitiveness in the area of functional genomics, the programme also facilitated the translation of scientific results into practical applications. Life 2000 projects generated a number of patents and cooperation with biotech industry was an integral part of the programme.

As to bioethics and societal impact, it is somewhat difficult to assess the results against the set programme objectives, as these were not very clearly articulated initially. Nevertheless, Life 2000 did have significant effects. First, it provided trainees in the natural sciences with significant exposure to these disciplines. In addition, it

probably had some structuring effect on these disciplines: for instance, it gave a voice to science and technology studies in a broader context, beyond the more traditional field of environmental issues. It also offered avenues of increased contacts between bioethicists and the life sciences research community. Some of these contacts could generate truly interdisciplinary work in the future, but this is clearly that kind of cultural evolution that takes time and needs careful long-term nurturing.

5 Conclusions and Recommendations

As a result of the review, the panel concludes that the specific objectives of Life 2000, namely

- To improve the quality of science in Finland,
- To promote interdisciplinarity and cooperation among Finnish scientists,
- To support the development and application of genomic technologies in order to advance biomedical research, and
- To strengthen interaction between life sciences and society have been achieved.

The evaluation panel acknowledges the vision of the Academy of Finland to launch a programme geared towards a more interdisciplinary and cooperative mode of scientific research. The decision to set up a more focused or more broad programme has to be decided from case to case, but should be one of the principal options of the Academy.

The panel concludes that the planning process as well as the implementation of the programme were transparent and guided by the attempt to give scientific quality the highest priority. Nevertheless, there could have been a stronger international component in the programme. As to future programmes, the Academy is encouraged to give internationality a higher priority.

The overall scientific quality of the projects within the programme was high. The panel encourages that the criteria of interdisciplinarity and cooperativeness continue to play an important role in the selection of projects. In order to maximise the benefits from such programmes, the issues of equipment and infrastructure should be taken into consideration and synchronised with other projects simultaneously running or being planned. It is of particular importance that the renewal of large equipment and introduction of new technologies take place in parallel with initiatives that are meant to make use of such resources.

Sufficient mouse capacity is not available for all mouse researchers and might limit international competitiveness in this field. The panel recommends that a national concept for optimising the needs of scientists working with mice as an animal model system be developed.

Not all the groups did manage to submit a final report. The Academy might consider to withhold 10 per cent of the funds until receiving such a report at the end of the project.

Many societal questions and dilemmas relating to biological and medical progress call for deep and scholarly reflection based on interdisciplinary research, in which the natural and social sciences as well as the humanities must be as full partners. If bioethics, law, social sciences and humanities are to be important partners in future projects, they should be involved from the planning stages onwards, so that the expectations towards them can be more explicit.

Although the communication activities of Life 2000 were still of a moderate scale, they played an important role as a pilot project in building bridges between science and the general public. The panel recommends that more emphasis be placed on the development of a professional communication strategy in the future. The aims and planned activities should be clearly communicated to all scientific participants at the very beginning of a programme. The Academy should consider to optimize cooperation between coordinators of future programmes and the Academy's communications unit. It seems absolutely necessary to involve professional communication specialist with a journalistic background in order to strengthen the networking with the media. Therefore, a more intensive cooperation with other Finnish science communication structures might be useful.

In summary, it has to be underlined that Life 2000 was a very successful programme in promoting life sciences in Finland. It represents a major milestone in preparing the Finnish life sciences to meet future challenges. The programme promoted interdisciplinarity and cooperation between Finnish scientists in a very effective manner. Life 2000 used exactly the right window of opportunity to reach these goals.

The Life 2000 Research Programme was launched by the Academy of Finland in 2000 to support research in the fields of functional genomics, bioinformatics, developmental biology and neuroscience. Life 2000 was considered a key instrument for implementing high-throughput technologies and for building the interdisciplinary efforts required to make Finnish research in the life sciences competitive at the international level. Life 2000 was the most ambitious programme ever launched by the Academy of Finland, both in scope and budget.

This report of the international evaluation panel addresses aspects such as the activities and results of Life 2000. It also includes recommendations for the future.

ISBN 951-715-512-3 (print)
ISBN 951-715-513-1 (pdf)
ISSN 0358-9153

Academy of Finland
P.O.Box 99, FI-00501 Helsinki, Finland
Tel. +358 9 7748 8346, Fax +358 9 7748 8372
viestinta@aka.fi
www.aka.fi/eng