Institute for Biomedical engineering, Materials Science and Application (BMSA)

ASSESSMENT OF RESEARCH QUALITY 1997-2002

RuG

Rijksuniversiteit Groningen

Assessment of Research Quality

Institute for Biomedical engineering, Materials Science and Application (BMSA) 1997-2002

University of Groningen

RuG

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Design Dorèl en anderen, Groningen

Photography Elmer Spaargaren, Groningen

Printing PlantijnCasparie, Groningen

Date June 2005

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4

Contents

General information

1 1 Introduction

1 1 1 National system for assessing the quality of research

In 2003, the Dutch system for assessing the quality of research underwent a major change. The system of national, external assessments of individual disciplines, co-ordinated by the office of the Association of Dutch Universities (VSNU), was discontinued. In its place, the Executive Boards of the universities now determine the design and organisation of the research quality evaluations. They are bound by the "Standard Evaluation Protocol 2003-2009"(SEP),[1] which is approved not only by VSNU but also by the Netherlands Organisation for Scientific Research (NWO), the Royal Netherlands Academy of Arts and Sciences (KNAW) and the Dutch ministry of education and science.

The three main aims of the Standard Evaluation Protocol are improving the quality of research, improving research management and direction and improving accountability, both internal (by the unit to its immediate superiors within the university) and external (by the university to government and society). The SEP is based on two fundaments:

- an external assessment once every six years (by a peer review committee conducting a site visit)
- a self-evaluation once every three years (one in preparation for the external assessment and one intermediate evaluation three years later, the 'mid-term review').

The SEP requires the committee members to evaluate the research institute or school as a whole and the relevant parts of the institute (research programmes) individually, on four main aspects, namely:

- Quality (international recognition and innovative potential)
- Productivity (scientific output)
- Relevance (scientific and socio-economic impact)
- Vitality and feasibility (flexibility, management, and leadership)

The most important conclusions of the external assessment committee, the reaction to these by the assessed unit and the final conclusions with regard to the future applied to them by the Executive Board will all be published.
An independent meta committee, set up by the KNAW, NWO and VSNU, will check the design and implementation of the new system by the various institutions and publishes its findings annually.

[1] This can be downloaded from: *http://www.qanu.nl/?contentid=144.*

112 Outline of the RUG Protocol

The SEP provides a framework to guarantee -as far as possible- comparable procedures and criteria. Within this, it provides room for specific input by the universities. Subsequently, the RUG developed the so-called "Protocol for Quality Assurance at the University of Groningen".

The following principles underlie the RUG protocol:

a *There is a close connection with the RUG quality policy*
b *There is a clear division of tasks and responsibilities*
c *The external assessment is transparent, authoritative and is relevant for both internal policy and external accounting*
d *The aim is professionalisation and minimal workload for researchers.*

Re a) RUG quality policy with regard to research

The RUG regards quality improvement as the dominant principle in its research policy. A crucial part is played by the peer reviews, external assessments by independent, objective researchers with expertise in the disciplines of the unit to be assessed. The peer reviewers should preferably be recognised international authorities and base their assessment not only on the self-evaluation of the unit but also on actual knowledge of the most important output, where possible supplemented by quantitative and qualitative indicators.
Further, external research assessments should concentrate on:

- providing direct feedback from the peer reviewers on the position of the research, measured against national and international standards for quality, productivity, relevance and vitality;
- assessing both past performance and future expectations, the ambitions and the scientific and social impact of the research;
- evaluating the management and the academic leadership of the unit in relation to the mission and ambitions;
- the context of the research unit, for example how the unit is embedded in the faculty and/or the university as a whole, its national and international context, as well as its disciplinary and interdisciplinary contacts.

Before formal acceptance of the findings of the peer review committee as laid down in the assessment report, the Executive Board of the university will apply the principle of hearing both sides of the case.

Re c) Usefulness

The results of an assessment must be sufficiently informative to serve as the basis for policy decisions. Therefore, the possibility of adding a lower aggregation level -compared to the aggregation level referred to in the SEP- exists. In practice, the aggregation levels of research programs may vary strongly. However, if a research program is believed to be too large to receive an adequate judgement on all research covered by this programme, the Executive Board of the university may request for a supplementary evaluation at a lower aggregation level.
The external assessment at this lowest level can, if desired, remain confidential. The SEP provides for this eventuality in the management letter: 'Matters of personnel policy and

sensitive decisions are generally treated in the confidential management letter to the Board and do not form part of the public report.'

Re d) Minimal assessment

Institutes at the RUG are organised on a disciplinary and local level. Within the previous national system, an Institute was assessed simultaneously with comparable research groups at other Dutch universities. In the current system national, disciplinary visitation is no longer compulsory but still an option, provided that the relevant Executive Boards approve. The RUG is determined to keep the option for national co-operation open, particularly because of the increased comparability of the assessments and the more efficient use of peer reviewers.
An alternative for national co-operation would be to allow a single Peer Review Committee (PRC) to assess several Groningen Institutes. This option is offered to faculties aiming to cluster their multidisciplinary research institutes.

Review of the Institute for Biomedical engineering, Materials Science and Application (BMSA)

2

2 1 The review committee

The peer review committee members for the research assessment of BMSA were appointed by the Executive Board of the University of Groningen, after a thorough selection procedure assuring an authoritative, critical and independent assessment of the research institute (see: Appendix B).
The committee consisted of:
Prof.dr. A. van Nieuw Amerongen, *Oral Biochemistry, the Netherlands*
Prof.dr.med.dr.h.c. (mult.) H. Klinkmann, *Internal Medicine and Nephrology, Germany*
Prof.dr. D.W. Grainger, *Chemistry, USA*
Prof.dr. G. Reid, *Microbiology and Immunology, Canada*

Dr. C. Streefland, *Department of Academic Affairs, University of Groningen*, was appointed secretary of the review committee.

All members of the Committee signed a declaration and disclosure form to safeguard that:

- the panel members judge without bias, personal preference or personal interest, and
- the judgement is made without undue influence from the institute, the program or other stakeholders.
- Additional information on the committee members and their curriculum vitae can be found in appendix C.

2 2 Scope of the assessment, assignment to the committee

The review committee was asked to evaluate the BMSA as a whole as well as its four research programs, with the emphasis on strategy and organisational aspects for the institute assessment and the focus on the results and quality of the scientific research and on the future for the programme assessments. In their task the PRC had to take into account the general rules laid down in the Standard Evaluation Protocol.

The committee based its assessments on the self-evaluation report of BMSA and on discussions with the program leaders and other members of the BMSA. Within the BMSA assessment, the following four research programs were presented to the PRC for evaluation:

1 Artificial Organs and Diagnostic Instrumentation (BMSA-1)
2 Bioadhesion, Biocompatibility and Infection (BMSA-2)
3 Clinical Evaluation of Biomaterials Application (BMSA-3)
4 Tissue Engineering and Scaffold Materials (BMSA-4)

2 3 Input for the research assessment

Prior to the site visit the committee received the following documentation:

- the SEP and a summary thereof
- the self-evaluation report of BMSA "For *the Restoration of Function (1997-2002)*" (cf. SEP format, including a SWOT analysis, tables with input and output at Institute and program levels, publication lists and full text copies of key publications)

The input for the research assessment consisted of a self-evaluation describing the research conducted by the BMSA of the University of Groningen between 1997 and 2002. It reports the institute's mission, describes the research programs, gives an overview of input in terms of research time and money, an overview of scientific output in different forms, an analysis of the institute's impact both in and outside scientific circles and, finally, its plans for the future. The self-evaluation report was written in accordance with the directives of the SEP and contains two main parts. The first part comprises information on research at the aggregation level of the institute; in the second part the individual research programs are described in detail. Together with the site visit (including interviews with the BMSA staff), the report formed the basis for the assessment of research quality by the peer review committee.

2 4 Working procedure of the Committee

In order to guarantee an independent assessment the PRC members individually pre-assessed all four programs prior to the site-visit and used these as a starting point for their assessment. Furthermore specific questions were raised to be asked during the coming site visit. On the first day of the site visit the PRC requested (and was provided with) an overview of the BMSA scientific publication output from 2002 to september 2004, in order to get an idea of the producitivity of the institute after the period that had to be assessed (1997-2002)

2 5 The site visit

A site visit of the PRC was scheduled on 27and 28 september 2004. At the start of the site visit, the peer review committee was welcomed by the Vice-Chancellor of the University of Groningen (Prof.dr. F. Zwarts), the dean of the Faculty of Medical Sciences (Prof. dr. S. Poppema) and the scientific director of the BMSA (Prof. dr. H. Busscher). Both the Vice-Chancellor and the Dean were questioned by the PRC on the research policy of the University and the faculty of medical sciences respectively and, more specifically on the upcoming research assessment, thereby specifying its scope.

The first day of the site visit was primarily dedicated to the four different BMSA progams: Artificial Organs and Diagnostic Instrumentation, Bioadhesion, Biocompatibility and Infection, Clinical Evaluation of Biomaterials Application and Tissue Engineering and Scaffold Materials.

Meetings with the four different program leaders were held in the presence of the full PRC and secretary and consisted of an introduction (ten minutes) by the program leader, followed by forty minutes questioning by and discussion with the committee members. The meetings were followed by a fifteen minutes break to enable the PRC to confidentially exchange impressions on the program.

Apart from the above mentioned meetings the committee made a tour throughout the Institute, enabling them to discuss the research programs in more detail with the different program members and to get an impression of the BMSA laboratories and the different facilities it has to offer. The second day the program included a poster session, where PhD students presented their research and were questioned by the committee members.

The two-day site visit was concluded with an oral feedback of the findings of the committee to the scientific director of the BMSA in the presence of the program leaders.

2 6 Assessment criteria and Ratings

Assessment criteria

The judgements of the evaluators refered to the BMSA as a whole, and to the four research programmes of the BMSA. The main criteria were always reviewed in relation to the mission of the BMSA. The committee acted upon the description of the SEP (see below), concerning the interpretation of the four main assessment criteria.

Description of the four criteria according to the SEP and interpretation by the PRC

Quality is to be seen as a measure of excellence and excitement. It refers to the eminence of a group's research activities, its abilities to perform at the highest level and its achievements in the international scientific community. It rests on the proficiency and rigour of research concepts and conduct; it shows in the success of the group at the forefront of scientific development. The members of the peer review committee judged quality both relying on their own knowledge and expertise and on discussions with the group leaders and other members, and on various kinds of systematic information. When an institute provides high quality state of the art facilities to the research community this can be considered as a measure of excellence.

Productivity refers to the total output of the group; that is, the variegated ways in which results of research and knowledge development are publicised. Productivity was evaluated based on the information provided, all data (bibliometrics, technometrics, sociometrics) were considered and related to the size of the various groups (both in total fte and composition of staff) taking into account the specific characteristics of the various subspecialties represented in the health sciences field (i.e. psychology, sociology, medicine, epidemiology, administrative sciences).

Relevance is a criterion that covers both the scientific and the technical and socio-economic impact of the work. Emphasis was put on both scientific and societal impact. The applied character of a large part of the health sciences research justifies a balanced valuing of both scientific and societal impact. The interpretation of relevance by the PRC was, amongst others, fed by the debates on societal impact of research within the Royal Dutch Academy of Sciences (KNAW).

Vitality and feasibility This dual criterion refers to the internal and external dynamics of the group in relation to the choices made and the success rate of projects. On the one hand, this criterion measures the flexibility of a group, which appears in its ability to close research lines that have no future and to initiate new venture projects. On the other hand, it measures the capacity of the management to run projects in a professional way. Assessment of policy decisions is at stake, as well as assessment of project management, including cost-benefit analysis. The questions to be answered with these assessments concern both the research institute and the research programmes. These questions are:

For past performance:

- What are the quality and relevance of the institute?
- What is the quality of the leadership, management, strategy and research programmes of the institute, its (human) resources, organisation and infrastructure and how can they be improved?
- To what extent has the institute/research programme achieved its mission and goals formulated for the period under review?

For future plans:

- Is the mission of the institute well chosen and phrased in view of the actual developments in the relevant research field(s)?
- How do you assess the institute's research plans and is there sufficient coherence in the research portfolio of the institute?
- What is the quality of the leadership, management and strategy of the institute, its (human) resources, organisation and infrastructure and how can they be improved?
- Which of these aspects has room for improvement and how could that be accomplished?

Ratings

The PRC presents its assessment on quality, productivity, relevance and vitality/feasibility according to a five-point scale for each aspect. It should be noted that it will not always be feasible or satisfactory to measure on such a scale; in which case the verbal commentaries can supply more information.

The scores used within the assessment are *excellent* (5), *very good* (4), *good* (3), *satisfactory* (2), and *unsatisfactory* (1). It should be noted that these ratings, which are specified in the SEP, differ from the ratings specified in the previously applied VSNU-Protocol (valid until 2003). The 'old' VSNU-protocol ratings were *excellent* (5), *good* (4), *satisfactory* (3), *unsatisfactory* (2) and *poor* (1). From 2003 on, a new rating '*very good*' was added between 'excellent' and 'good', while the rating 'poor' was omitted. When comparing scores this must be taken into account very carefully.

VSNU 1992-2002	SEP 2003-2009
5 Excellent	5 Excellent
	4 Very good
4 Good	3 Good
3 Satisfactory	2 Satisfactory
2 Unsatisfactory	1 Unsatisfactory
1 Poor	

The extended description of the five point scale is as follows:

Excellent Work that is at the forefront internationally, and which most likely will have an important and substantial impact in the field. Institute is considered an international leader.

Very good Work that is internationally competitive and is expected to make a significant contribution; nationally speaking at the forefront in the field. Institute is considered international player, national leader.

Good Work that competitive at the national level and will probably make a valuable contribution in the international field. Institute is considered internationally visible and a national player.

Satisfactory Work that is solid but not exciting, will add to our understanding and is in principle worthy of support. It is considered of less priority than work in the above categories. Institute is nationally visible.

Unsatisfactory Work that is neither solid nor exciting, flawed in the scientific and or technical approach, repetitions of other work, etc. Work not worthy of pursuing.

3 Assessment of the BMSA Institute

The Institute for Biomedical engineering, Materials Science and Application (BMSA) was raised on October 8th, 1997 as one of the institutes of the Faculty of Medical Sciences and the University medical Centre Groningen. The institute has as its primary objective to bring together pre-clinical and clinical research groups and upon foundation, its mission statement was formulated as follows:

> *To establish a center of expertise for the entire stage of biomedical materials science and its application involving basic materials science, medical product development and clinical evaluation that will contribute to the long-lasting well-being of patients in need of biomaterials implants and extra-corporal support systems.*

BMSA includes the departments of Biomedical engineering, Pathology and Laboratory Medicine, Medical microbiology, Surgery, Plastic Surgery, Orthopedic Surgery, Cardiology and Thoracic Surgery, Urology, Otorhinolaryngology, Oral and Maxillofacial Surgery, Ophthalmology, Dentistry and Polymer Chemistry (Faculty of Mathematics and Natural Sciences)[2].

3.1 Assessment of the Mission, Strategy, Organisation and Management of the BMSA Institute by the Peer Review Committee

Overriding Review Philosophy

The following critique has been formulated based on the Director's expressed objective that BMSA be recognised as a top-ten international institute in its field.

Perspective

BMSA has emerged in the past six years from remnants of the former RuG Dental School and BMTC. Consolidation, focus, re-organisation, and co-ordination of current BMSA Programs will provide new attractive opportunities to move forward as a premier effort in the future.

[2] From the self evaluation report *"For the Restoration of Function (1997-2002)"*

3 2 General comments on the BMSA managerial structure

- The international Scientific Advisory Board does not seem to have much impact or input, and has not apparently made much effort to provide consistent, structured feedback to the BMSA Director and the senior administrators of the university and the hospital. If they are to continue to function, besides international representation, they should provide meaningful deliverables that are strategically considered.
- The PRC applauds the current Director, who is internationally recognized as a scientist. The PRC believes he is doing an excellent job in pushing BMSA forward.
- To best facilitate essential links between BMSA and the hospital, the Co-Director should continue to be proactively engaged, assertive and aware of contemporary research issues to guide the BMSA.
- If an MD should become BMSA director, then the co-director should be a prominent BMSA PhD scientist (now vice versa) to consistently provide a suitable balance between basic and clinical research leadership.
- The committee very much appreciated that the Rector Magnificus and the Dean fully support the continued growth of the BMSA and its central position in university research Programs Furthermore, the PRC fully appreciates the Dean's assertion to continue to '*recruit outstanding talent*' and to use this opportunity to grow and strengthen BMSA.
- The PRC fully endorses the Dean's approach to install JSM and the MD/PhD Program as an integral part of the curriculum of the medical faculty
- The current consolidation of the university medical research Program and the hospital research effort is seen as a constructive development with exciting opportunities if managed carefully.
- The hospital and clinical departments are to be congratulated for providing outstanding research equipment and facilities in the hospital.
- The PRC strongly recommends that a fixed annual percentage portion of hospital departmental funds be allocated to research efforts at BMSA.
- The PRC supports the BMSA's attempt to extend its international network (as in its connection with the INFA) based on the Bologna protocol
- The PRC fully appreciates the rapid success of the BMSA in bringing together and coordinating a diverse and integrated group of clinical and fundamental investigators in short time.
- The PRC recognises the consistent need across all four BMSA Program areas for increased clinical involvement. This requires careful crafting of prepaid clinical release time for all BMSA clinical investigators.
- The facilities and equipment available to the BMSA are outstanding on an international level.

3 3 Overall Recommendations by the Peer Review Committee

- The merger of BMSA 1 and 4 with re-alignment of their respective missions is strongly recommended.
- The expansion of non-biomaterials related research within BMSA raises the possibility to change the name of the Institute to represent the new focus.
- In support of the Dean's own initiatives, concerted efforts should be made to send the most talented students abroad for further professional development and then to repatriate them to an appropriate tenure- track position at RUG. In addition, it is critical to undergo global search to attract the best scientists to BMSA.
- A system should be put in place to provide an incentive for clinicians to spend more time on research. This can be achieved using a points system where efforts in teaching and research are officially endorsed, encouraged and rewarded with salary bonuses or time freed for research.
- The BMSA should develop or more effectively utilise the university and hospital public relations departments to regularly inform the global community about the achievements of the Institute.
- Concerted efforts should be made to increase R&D partnerships with various industries. The PRC strongly supports continuation of the efforts of BMSA to integrate itself into international academic networks such as INFA.
- It is imperative that the leadership and administrative activities of the BMSA Director are balanced with those of the Co-Director and Program Leaders. The PRC acknowledges that the current Director has to balance his own academic commitments with those of his leadership position in BMSA.

Overall score for the BMSA Institute:	4

Research Programs

4

4.1 Artificial Organs and Diagnostic Instrumentation (BMSA-1)

PROGRAM LEADER:	Dr. G. Rakhorst, Prof.dr. R.J. Ploeg
TENURED STAFF (2002):	1.9 fte
NON-TENURED STAFF (2002):	4.0 fte (including 7 PhD students)

4.1.1 Assessment and Justification

Quality:	4
Productivity:	3
Relevance:	5
Vitality and feasibility:	4

The PRC noted that this Program has gained good international reputation especially via external collaborations. This Program has also had the highest success with spin-off companies. Dr. Rakhorst is an internationally respected scientist. The expansion of the Program to other areas like transplantation is considered a good move. We applaud the move away from completely mechanical implantable devices towards bridging devices and hybrid devices that integrate tissue engineering or physiological, tissue-like components.
However, this Program is short-staffed in human resources, in particular, tenured staff and scientists dedicated to research.
The impacting contributions of Ru-Groningen and BMSA to the EU New Voice Program was recognized.

Technical Aspects

- Coordination and inventory of the voice prosthesis project is needed as the PRC's perception was that the components (the people involved in various aspects of this research and the strategic direction) are disconnected.
- The publication output for BMSA 1 in 2003 was disappointing, although 2004 appears to be better.
- In contrast to the blood pumps, the clinical impact, applicability and availability of the Groningen button to other patients outside Groningen is inferior.
- Much more thought needs to be invested in the bioreactor plans to distinguish both need and performance. Much technical history in this area has been ignored and need not be repeated. Proposed bioreactor work can best be achieved by combining the efforts of BMSA 1 and 4.
- The diagnostic marker studies in transplantation and reconstructive surgery are important and innovative and should be emphasized in the future.

Structure/Directions

- The PRC felt strongly that BMSA 1 should continue to be led in the future by a resident Groningen Faculty member. PRC applauds the consensus-led research strategy and directions, as for example in transplantation, developed in conjunction with the Medical Faculty and the BMSA. Future developments would best be served by this type of interaction.
- Depending upon the future development in organ replacement therapy, BMSA 1 should consider seriously merging with BMSA 4. The two areas have overlap and a consolidation of research efforts and synergistic expertise in general tissue biology would provide a platform to make major international contributions.

Expansion/Resources

- The acquisition of external funding especially from industry has been declining inexplicably.

Personnel/Leadership

- The current Program Leader is commended for achieving high international visibility through his election as President of the European Society for Artificial Organs (ESAO).
- However, the PRC is concerned with the participation level and output of affiliated researchers.

Future Recommendations for BMSA 1

- Continue with the new emphasis on transplantation/artificial organs research.
- Merge BMSA 1 and 4 in due course.
- Make an inventory of projects and disparate components to enhance efficiency and better coordinate strategic research efforts. This is particularly true of the voice prosthesis project.

4.2 Bioadhesion, Biocompatibility and Infection (BMSA-2)

PROGRAM LEADER:	Prof.dr. H.C. van der Mei and Prof.dr. J.E. Degener
TENURED STAFF (2002):	1.5 fte
NON-TENURED STAFF (2002):	6.0 fte (including 8 PhD students)

4.2.1 Assessment and Justification

Quality:	5
Productivity:	5
Relevance:	4
Vitality and feasibility:	4

This is clearly the central, most visible and most productive core Program of BMSA. Professors Busscher and Van der Mei are outstanding, world-recognized, and competent scientists in this Program.

The medical input towards clinical application of the research could be strengthened considerably. It was disappointing to note the lack of activity from, for example, Urology. It is important that the past emphasis on more basic, in vitro flow cell and surface thermodynamic research be translated into studies that are relevant clinically. There is good evidence of progress towards this goal, and this translational research must continue. In addition, while producing significant publications in the primary bacterial and surface adhesion literature, the studies to date have actually not had a major impact on the understanding of or ability to prevent clinical infections of biomaterials, forcing a new direction for the program at the point of review (detachment focus). The question of which basic investigative strategies pursued in vitro actually contribute to mitigating clinical aspects of infection should really be aggressively addressed conceptually and practically.

Technical Aspects

For the PRC, it was a surprise to note the change from adhesion to detachment as a means of preventing infection. Time will tell if this is indeed clinically significant.
The traditional strength in interfacial biophysical chemistry is evident; weakness is perceived in materials chemistry, particularly polymer expertise and mentorship of students involved with polymers and their surfaces.
The proposed addition of a molecular microbiologist staff member is long overdue and an excellent step. However, the PRC encourages BMSA to make sure that any recruitment process is worldwide in its scope, to ensure fresh intellectual blood and a new perspective.

Structure/Directions

The PRC cannot make an accurate judgement on how the most significant, recent change in direction will eventually shape out; namely, the emphasis on detachment as a means to prevent or treat biofilm-related diseases. Based on the BMSA's previous record, this seems like a rational move and one with strengths.
The biomaterials' scientific emphasis is missing and comes across as a survey of commercial materials. Where is the novel science and how will current studies impact the biomaterials field in clinical practice?

Expansion/Resources

A need for a new AFM has been expressed and, in practical terms, it is required due to the large numbers of users of the present system. However, care must be taken in interpreting the clinical applicability of AFM data. The PRC suggests that the output of the current AFM work should be reviewed to ensure that priority is given to research that can be published in high impact journals and that the data is new and relevant, and contributes directly to scientific (as opposed to phenomenological or correlative) mechanistic understanding of elements of bacteria-surface relationships.

Personnel/Leadership

The PRC questioned why this Program is less successful in recruiting MDs.
Professors Van der Mei and Busscher are internationally recognized.
The appointment of Professor Norde is applauded. However, it is not clear the extent to which

he is mentoring students or students are paying particular attention to the significance of his work at BMSA.
The new faculty appointment in polymer chemistry is applauded as being highly needed and should become a strategic person and resource in BMSA 2 and 4.

Future Recommendations for BMSA 2

We would like to see a full time clinical researcher in this Program area. This could be achieved with the Dean's support and buying out research time for the appropriate expert.
The studies on microbial ecology and preferential colonization of surfaces by non-virulent organisms should continue to be pursued.
Ties should be strengthened with clinicians at the patient interface in terms of device usage and infectious problems, to ensure that bench projects focus on the real-life problems.

4 3 Clinical Evaluation of Biomaterials Application (BMSA-3)

PROGRAM LEADER:	Prof.dr. R.R.M. Bos and Dr. R. van Weissenbruch
TENURED STAFF (2002):	1.0 fte
NON-TENURED STAFF (2002):	3.4 fte (including 8 PhD students)

4 3 3 Assessment and Justification

Quality:	3
Productivity:	4
Relevance:	5
Vitality and feasibility:	3

This translational research Program could become a flagship to attract industrial support, perform valuable clinical trials and help develop new diagnostic, treatment and preventive products from BMSA and other sites. Thus, expansion beyond the oral cavity should be a priority. Clinical release (buy-out of time) and appointment of a full-time Program Leader is essential to optimize the potential of this group and 'officially' recognize the clinical importance of effort expended in this role.

It was apparent that hospital-based funding for this important activity was not disclosed, has no governing policy and is at the mercy of department chairs. The PRC strongly recommends transparency on this issue and that a fixed annual percentage portion of each hospital department's funds (including industry overhead) allocated to appropriate research efforts at BMSA.

Technical Aspects

The operational structure for all the projects is not clear. Coordination among all investigators for similar goals is not evident.

Structure/Directions

Programs of this nature are highly desired in most countries, serving to bridge bench R&D into clinical application, then onto commercialization. If managed properly, this Program should serve an important role and unique resource locally and internationally.

Expansion/Resources

The present personnel pool and time expended on projects (fte) is insufficient to exploit this resource optimally. This limits its visibility and impact.

Personnel/Leadership

Despite the presence of highly qualified and motivated leaders, their current fte does not allow them to spend sufficient time on this important initiative.
There are a number of faculty members apparently involved in BMSA 3, but their contributions are not clear.

Future Recommendations for BMSA 3

Subsidized clinical release time is essential.
Addition of a full time project coordinator to oversee all activities is recommended strongly.
Expansion beyond the oral facial cavity in this translational area is highly recommended.

4 4 Tissue Engineering and Scaffold materials (BMSA-4)

PROGRAM LEADER:	Dr. M.J.A. van Luyn and Dr. T.G. van Kooten
TENURED STAFF (2002):	1.6 fte
NON-TENURED STAFF (2002):	1.8 fte (including 3 PhD students)

4 4 1 Assessment and Justification

Overall Scores

Quality:	3[3] (based upon prior work in basic cell biology, not emerging science)
Productivity:	3[3] (just beginning to emerge)
Relevance:	4
Vitality and feasibility:	4

[3] Please note that while the University places a lot of merit on scores, it must recognize that in the case of BMSA 4, the program is young and cannot be properly ranked compared to long established groups. Thus, the scores of 3 should not be used to unfairly penalise the program.

Tissue engineering is a young field with many current challenges being addressed worldwide with remarkably similar approaches. This means that for this current Program to make significant impact, it must distinquish both methods and strategies from the status quo to provide innovation and new results.

This is obviously a new Program with most activity occurring through networking. The core scientific efforts are visible, impacting and productive but have not yet developed or focused sufficiently to specifically address the stated mission and focus of this particular Program. Hence, the PRC has found it difficult to assign numeric scores to the required four categories at this preliminary stage of new development.

Since the research programs are basically just starting, it is difficult to assess their quality. However, we would like to point out that, for example, based on the content of the two poster presentations, it is obvious to the PCR that more attention should be paid to analysis of substantial previous international work in the areas of scaffolds and small vessels grafts and innovative methods to improve upon history and distinguish BMSA efforts in these areas.

Technical Aspects

The rapid evolution of this field and changing priorities should be vigilantly monitored and the direction of BMSA 4 refocused accordingly. Tissue engineering is a highly applied bioengineering field where impact is seen primarily in context of tissue regeneration mechanisms in biomaterials by integrating many biomedical engineering, cell and molecular biological principles. This is rapidly moving now to a newer field called "regenerative medicine". Hence, the core research must dynamically shift to embrace the new knowledge integration across fields rapidly with publications that impact the field, or otherwise rename the program to a focus consistent with the expertise and productivity currently demonstrated.
The collaborative project with Medtronic is viewed positively.
Given the small size of the expert core, a strategic liaison with clinical strengths in the hospital in only certain selected areas should be pursued.
The current molecular based expertise should be complemented by collaborations with organ-specific or tissue-specific or systems biology approaches from the clinical side.

Structure/Directions

Organisation and leadership across all interdisciplinary components spanning basic cellular and molecular biosciences through clinical applications will require constant attention and skilful management for optimal results.

Expansion/Resources

Since this new Program is expected to expand rapidly, both additional human resources and space for facilities will be required in due course.

Personnel/Leadership

Dr. van Luyn appears a good choice as Program Leader.
Any new Chair appointments should be additional to the existing scientific staff to preserve all present positions in this Program.
The absence of proper visible polymer chemistry mentorship is obvious to the PRC, hurting the ability of students to become trained in this area effectively in the proper biomaterials context. This negatively impacts upon other BMSA Programs that require materials innovation.

Future Recommendations for BMSA 4

The structure of this group, and potentially its merger with BMSA 1 should be a high priority of the Institute. BMSA certainly needs tissue engineering and regenerative medicine prominence if it is to grow and attain international recognition in this area. However, structurally, a separate division is not needed. Rather, the key is to integrate the efforts of tissue engineers into other programs, and align the main focus with BMSA-1 to provide mutual strengths.
Vigilant monitoring of the current dynamic international scene in this area is required, and this should lead to the group being highly flexible and able to move into new areas.
The Program would benefit from being actively involved in international collaborations and attracting scientists with recognised international standing.

5 General Conclusions

The PRC rates the quality of the different BMSA-programs from 'good' to 'excellent', stating that there is a difference in quality between groups. Taken together with the above-mentioned, the BMSA Institute receives an overall score of 'very good'.

Reaction Management BMSA

The Peer Review Committee (PRC) passed a very positive judgement on various aspects related to BMSA. Overall, the PRC rated the institute as 'very good'.
Obviously, we are very pleased with this outcome. Nevertheless we would like to comment briefly on the assessment of the various programs, and indicate how we intend to manage the points for attention raised by the PRC.

The PRC assessed one program that is relatively novel compared to the other programs.
The PRC praised the achievements of this program and future plans but was critical towards its past performance. We think that with increased input and efforts BMSA 4 will do better next time.

The program BMSA 3 needed a more common goal and operational structure. BMSA management agrees with this and will focus the program on biodegradable materials and longitudinal evaluation of biomaterials.

BMSA 2 was judged best as a program and the management will continue to enforce molecular biological approaches, as suggested.

BMSA 1 was also evaluated quite well (score 'good') and the move away from completely mechanical implantable devices was applauded. Collaboration with BMSA 4 will be stimulated by the management, as suggested.

In conclusion, we are very satisfied with the outcome of the research assessment. We consider both the self-evaluation process and the audit very helpful in planning the future of the institute. The open atmosphere, the focus on the content of our work and the feedback, given informally during the visit and formally afterwards, are of great value.

Appendix A

Quality assurance at the University of Groningen

National system for assessing the quality of research

In 2003, the Dutch system for assessing the quality of research was changed radically. The system of national, external assessments of individual disciplines, co-ordinated by the office of the Association of Dutch Universities (VSNU), was discontinued. In its place, the Executive Boards of the universities now determine the design and organization of the research quality evaluations. They are bound by the "Standard Evaluation Protocol 2003-2009"(SEP),[4] which is endorsed not only by VSNU but also by the Netherlands Organisation for Scientific Research (NWO) and the Royal the Netherlands Academy of Arts and Sciences (KNAW).

The most important elements of the new system, set out in the SEP, are:

- Three main aims:
  - improving the quality of research;
  - improving research management and direction;
  - improving accountability;
  - internally – by the unit to be assessed to its immediate superiors within the RUG, and externally – by the RUG to government and society.

- Based on two fundaments:
  - an external assessment once every six years (by a peer review committee which conducts a site visit);
  - self-evaluation once every three years (one in preparation for the external assessment and one intermediate evaluation three years later, the 'mid-term review').

- An independent meta committee, set up by the KNAW, NWO and VSNU, will check the design and implementation of the new system by the various institutions and publish its findings annually.

To this end, the Executive Board of the University of Groningen (CvB) will draw up a schedule for all the units to be assessed and ensure that all the research is evaluated.

[4] This can be downoaded from: *http://www.qanu.nl/?contentid=144.*

The most important conclusions of the external assessment committee, the reaction to these by the assessed unit and the final conclusions with regard to the future applied to them by the Executive Board will all be published.

The SEP provides a framework to guarantee as far as possible comparable procedures and criteria. Within this, it provides room for specific input by the own institution, which the RUG has set out in the "Protocol for Quality Assurance at the University of Groningen", known as the RUG Protocol. With regard to the instructions for peer reviewers before they are appointed by the CvB, the text below explains the most important points in the SEP and the RUG Protocol.

SEP – outline of the main points

1 General

The evaluation applies to:

- the quality of research according to the standards of the relevant academic disciplines
- the way that the research results are reported to the academic world.

Depending on the mission of the unit to be assessed, the evaluation also examines:

- socioeconomic aims
- technological or infrastructural aims
- cross-disciplinary aims.

The evaluation will be both retrospective and prospective. The results are intended to assist the research organization, the management of the research units and the individual researchers in decision-making about future research, research policy and research management.

The three central concepts in the SEP are:

Board: the Executive Boards (CvB's) of the universities and the boards of KNAW and NWO are responsible for the organization and procedural processing of the evaluation of the 'institutes' which fall under their responsibility.

Institute: the unit to be assessed is referred to in the SEP as '(research) institute' and defined as follows: 'An institute may be defined as "a group of researchers with an articulated shared mission operating under the same management". Each "institute" will have a director, board and/or research leader(s) with a final responsibility. Throughout this document they will be referred to as "the management".'

Research programme: this is the unit to be assessed, for which there is no specific definition in the SEP. Each programme should submit a title, programme leaders, research field and mission, as well as the research capacity of the academic staff, the share of the research resources within the unit to be assessed and the research output.

The peer review committee (PRC) reports to the Board (CvB). The CvB will make policy decisions concerning the Institute based on this report and the discussions about it with the Institute. The decisions of the CvB and the evaluation report together form the results of the evaluation. These results will be reported to the Minister of Education, Culture and Science (OC&W) via the normal channels (annual reports).

2 Assessment criteria

The evaluations will differ per institute and per programme:

- per institute: the emphasis is on strategic and organizational aspects
- per programme: the emphasis is on results, quality and the future of the research.

The main criteria are:

QUALITY:	international recognition and innovative power
PRODUCTIVITY:	scientific output
RELEVANCE:	scientific and socioeconomic impact
FEASIBILITY:	flexibility, management, leadership.

These criteria will always be related to the mission of the institute or group, which may, for example, limit itself to national scientific tasks.
The feasibility criterion includes the ability to close dead-end lines of research and start new projects. With regard to management, the criterion includes the ability to implement projects in a professional manner. This covers policy decisions and project management, including an analysis of the costs and benefits.

The questions to be answered include:
Retrospectively:

1 What is the quality and relevance of the Institute?
2 What is the quality of the leadership, the management, the strategy and the research programmes of the institute, the personnel and material resources, the organization and the infrastructure, and how may this be improved?
3 To what extent has the institute or programme realised the mission and goals of the period to be assessed?

Prospectively:

1 Has the mission of the institute been chosen and expressed well, given the current developments in the relevant field of research?
2 How can the research plans of the institute be assessed and is there sufficient coherence in the institute's research portfolio?
3 What is the quality of the leadership, the management, and the strategy of the institute, the personnel and material resources, the organization and the infrastructure, and how may this be improved?
4 Which of these aspects has room for improvement and how may this be realised?

The CvB may ask the PRC to investigate additional questions. These may refer to specific tasks of the institute that are not directly related to research, or to specific circumstances such as major changes to the organization or mission of the institute, or to specific demands from stakeholders who significantly contribute to the financing of the institute. If desired, confidential parts of the assessment can be included in a management letter to the CvB.

3 Documentation for the PRC

In preparation for the site visit, the peer reviewers will be sent a self-study report, the Specific Visitation Protocol and any supplementary questions from the CvB. Further, the chair of the PRC may request supplementary documentation.

Self-study report

Appendix 3 of the SEP states the format of the documentation to be supplied for a self-evaluation. This must serve as the basis for a strength-weakness (SWOT[5]) analysis, as set out in Chapter 4 of the SEP. Together they form the self-study report, which is in principle identical for both the mid-term review and the self-evaluation in preparation for a visitation.

The Specific Visitation Protocol

The SEP must be supplemented by the profile of the PRC, a list of supplementary questions and any supplementary information for the PRC. This enables the protocol to be adapted to the specific wishes of the CvB. Together with the SEP, this comprises the Specific Visitation Protocol for the external assessment in question.

Outline of the RUG Protocol[6]

1 Starting points of RUG policy concerning assessing the quality of research

The following principles inform the RUG protocol:

1 close connection with the RUG quality policy;
2 clear division of tasks and responsibilities;
3 external assessment must be transparent, authoritative and able to be applied to both internal policy and external accounting;
4 the aim is professionalisation and minimum disruption for researchers.

Re a) Quality policy with regard to research

The heart of this policy is that the RUG regards quality improvement as the dominant principle

[4] Analysis of 'Strengths, Weaknesses, Opportunities and Threats'.

[5] The RUG-protocol can be downloaded from *http://www.rug.nl/Corporate/onderzoek/kwaliteitszorg/index*

in its research policy. Quality not only plays an important role in its own policy but also in that of the government.

A crucial part is played by the peer reviews, external assessments by independent, objective researchers with expertise in the disciplines of the unit to be assessed. The peer reviewers should preferably be recognized international authorities and base their assessment not only on the self-evaluation of the unit but also on actual knowledge of the most important output, where possible supplemented by quantitative and qualitative indicators.

The principle of listening to both sides of the case will be applied before an external assessment will be accepted.

Further, external research assessments should concentrate on:

- providing direct, swift feedback from the peer reviewers about the position of the research, measured against national and international standards for quality, productivity, relevance and vitality
- assessing both past performance and future expectations, the ambitions and the scientific and social impact of the research
- evaluating the management and the academic leadership of the unit in relation to the mission and ambitions
- the context of the research unit, for example how the unit is embedded in the faculty, the university as a whole, the national and international context, as well as disciplinary and interdisciplinary contacts with regard to content.

Re c) Usability

The results of an assessment must be sufficiently informative to serve as the basis for policy decisions. This is why the possibility to add a lower aggregation level than that of the programme as referred to in the SEP is deliberately left open. In practice, the aggregation levels of research programmes vary strongly. There may be good reasons for working with larger programmes, something which thus cannot be ruled out in advance. However, if programmes are chosen that are so large that in the opinion of the Executive Board the assessment is not sufficiently usable for internal policy decisions, a supplementary evaluation at a lower aggregation level will be requested. The Faculty Board will itself submit a motivated proposal that must then be approved by the Executive Board.

The external assessment at this lowest level can, if desired, remain confidential. The SEP provides for this eventuality in the management letter: 'Matters of personnel policy and sensitive decisions are generally treated in the confidential management letter to the board and do not form part of the public report.'

Re d) Minimum assessment disruption

All Institutes at the RUG are organized locally and according to discipline. In the old national system, an Institute was assessed at the same time as comparable research groups at other universities by one PRC. In the new system, although the national, disciplinary visitation is no longer compulsory it is certainly still an option. Voluntary co-operation is still possible, on condition that it is approved by the relevant Executive Boards. The RUG is determined to keep the option for national co-operation open, particularly because of the greater comparability of the assessments and the more efficient use of peer reviewers.

An alternative for national co-operation would be to allow a single PRC to assess several Groningen Institutes. This option is offered to faculties aiming to cluster their multidisciplinary research institutes.

2 Composition of a Peer Review Committee (PRC)

The responsibility for appointing PRCs is borne by the Executive Board. The RUG abides by the following guidelines:

- The PRC must comprise nationally or internationally renowned scientists who are experts in the disciplines or subdisciplines of the unit to be assessed.
- The expertise in the PRC as a whole must sufficiently cover all the subfields within the unit to be assessed.
- The peer reviewers must be authoritative but may not be interested parties. In order to guarantee the independence of the peer reviewers, they are obliged to sign a standard declaration of independence before accepting membership of a PRC.
- The Executive Board reserves the right to submit the list of prospective candidates to external experts before they are appointed. The aim is to create a national code of behaviour with regard to this. The KNAW, NWO and VSNU are expected to submit a proposal.

Secretary

The CvB will appoint the secretary of the committee and ensure, after consultation with the Faculty Board, that he/she is properly instructed. The secretary must on the one hand be independent of the research unit; on the other, he/she must be sufficiently familiar with the local situation. In principle, the secretary will be someone from the RUG Office. The secretary will be appointed at the same time as the committee.

3 PRC procedure and reporting method

Instructions for the committee

In consultation with the Faculty Board, the CvB will commission the committee and ensure that it is instructed. Within the framework of the Specific Visitation Protocol, the RUG protocol and the commission, the committee will determine its own procedure.

Programme site visit

Under the responsibility of the Faculty Board, and in consultation with the chair of the PRC, the management of the research unit will design the programme for the site visit, bearing in mind the provisions of the SEP. The Faculty Board will inform the CvB of the programme. The CvB will receive the PRC at the start of the site visit.

Format of the report

With regard to content, the committee will be guided by the SEP and by any supplementary questions posed by the university.

To achieve uniformity in the visitation reports, the secretary of the PRC will use a basic format for the preparation of the final assessment.

Verification of facts

The PRC will present the draft report to the management of the research unit for verification of the *facts* (correction phase).

Report to the CvB and the Faculty Board

After the facts have been verified, the PRC will report its findings simultaneously to the CvB and the Faculty Board in a draft report. If the faculty is the research unit being assessed, the committee will report only to the CvB.

Check of formal requirements

In consultation with the Faculty Board, the CvB will check whether the draft report is complete and consistent with the SEP and the supplementary questions posed by the RUG. If either the CvB or the Faculty Board wish expansion or explanation of the report, the CvB will request the chair of the committee, via the secretary of the committee, to provide these additions or explanations.

Acceptance or rejection of the visitation report

In consultation with the Faculty Board, the CvB will decide whether to accept the visitation report if, in its view, the visitation report conforms with all the requirements in the SEP as well as those set by the RUG.
On occasion, and after consultation with the Faculty Board, the CvB may decide to reject the visitation report. The CvB will make such a decision known to the chair and members of the PRC.

Adoption of the evaluation report

The report by the committee and the reaction of the research unit together form the final evaluation report that will be adopted by the CvB, in consultation with the Faculty Board. With this, the CvB concludes the external evaluation.

Right of response

The draft report will be presented by the Faculty Board to the management of the assessed research unit who will be asked to *comment regarding content* and to react to the findings of the external assessment.

Responsibility of the CvB

The CvB, on the basis of its own conclusions, is responsible for reporting to the Supervisory Board.
The CvB will determine *in general terms* the way in which evaluation reports will be presented and published externally. This includes reports to the Minister of OC&W, VSNU, KNAW, NWO and sister institutions as well as publication on the university's website. External reporting of the managerial implementation of the research assessments will be included in the annual report. The starting point is the conditions set by the SEP for the public evaluation report.

Management letter

In addition to the public evaluation report, the PRC will be asked, if necessary, to submit a confidential management letter to the Faculty Board, with a copy to the CvB. This management letter shall be based on meetings with the management of the research unit and include any sensitive information concerning personnel or company-sensitive information about the current or future position of the research unit. If necessary, the Faculty Board, after discussions with the CvB, will discuss the management letter with the chair of the PRC.
If the faculty is the research unit being assessed, the committee will address the management letter only to the CvB.
During the correction phase and in consultation with the Faculty Board, the management of the unit may ask the PRC to move parts of the report to a management letter in certain circumstances, such as contractual obligations to third parties, restrictions on making things public, etc.

4 Managerial implementation of the visitation report

Managerial assessment and measures

The CvB will ask the Faculty Board for a managerial assessment of the visitation report. In the event of shortcomings revealed by the report, the CvB will ask the Faculty Board, as the responsible and authorized body, which measures the Faculty Board has in mind to effect improvements. The Faculty Board may submit the evaluation report to the advisory board or supervisory board of the research unit and/or to the faculty academic committee(s) and ask for advice. The Faculty Board will inform the CvB of the measures to be taken. The CvB will discuss the measures with the Faculty Board, and testable agreements and how they are to be monitored will be formulated. In line with the Higher Education and Research Act (WHW), the Faculty Board is responsible for the design and the quality of the research.

Conclusions arising from the management letter

If a confidential management letter is submitted, it will be discussed by the CvB with the Dean of the Faculty. The Dean will be asked to give those in charge of the research unit an opportunity to respond. In mutual consultation, the CvB and the Dean of the Faculty will discuss the conclusions and any measures to be taken.

Appendix B

Selection Criteria and Guarantee of Independence for Peer Review Committees

Peer review and quality assurance committees are expected to produce authoritative, critical and independent assessments of the quality of the research schools, institutes or programmes they have been asked to examine. This means that the members must meet high standards with regard to quality.
The authority of the assessment in terms of quality, objectivity and influence stands or falls with the independence of the assessing peers. It is in everyone's interests that such peer review committees be carefully selected in order to guarantee their independence. This appendix lists selection criteria for members of peer review committees as well as instruments to guarantee the independence of these committees.

Contents

1 Guidelines for selecting a Peer Review Committee

When choosing an external peer review committee (PRC) which conforms with the criteria of independence, expertise and academic quality, the following points must be taken into consideration when selecting potential candidates:

- Authoritative scientific expertise in at least one discipline or subdiscipline of the department to be assessed
- National or international authority in the field
- Independence with regard to the department to be assessed and to the researchers within the department
- Insight into, and if possible some expertise in, related disciplines and subdisciplines
- Insight into and an overview of national developments in the field
- Insight into and an overview of international developments in the field
- Insight into relevant interdisciplinary developments
- Some familiarity with how research is organized in the Netherlands.

In order to determine the independence of the potential chairperson and members of the visitation committee, the following issues at least must be considered:

- Excluded from a PRC are:
  - (former) employees or PhD students of the Institute to be assessed,
  - (former) members of an advisory body for the Institute to be assessed (or the associated Research School),
  - co-authors of scientific publications from employees or PhD students of the Institute to be assessed.
- Has the potential candidate ever worked intensively with members of the department to be assessed, for example, long-term participation in alliances, regular participation in PhD assessments?
- Has the potential candidate close links with one or more members of the department to be assessed, for example as the PhD supervisor of a member, or as a member of the same research group, joint editorships?

If one or more of these questions must be answered with yes, then this must be clearly stated by the Institute when proposing the candidate in question. It should also be made clear why the board is of the opinion that the independence of the proposed candidate can be sufficiently guaranteed.

When potential candidates are approached with the request to participate in a PRC, they will be asked to sign a standard declaration of independence, including a brief *code of behaviour* (see below), before accepting. During the final meeting, the members of the committee will be asked to confirm or expand the declaration they signed earlier, and to state that they have actually fulfilled their commitments.

2 Reporting obligation

The list with potential peer review committee members must be presented to the heads of the programmes, research schools and institutes to be assessed before it is sent to the Executive Board. The former are obliged to report any potential conflicts of interest, prejudice or influence on the part of the proposed peer review committee members and must be able to report and substantiate their objections in writing to the Faculty Board.

3 Code of behaviour + declaration of independence for peer review committees

The following will be sent together with the invitation to participate to the individual members of the peer review committee and must be signed and returned before the site visit takes place.

Competence and independence of peer review committee members

1 A member of the peer review committee bases his/her assessment primarily on:
- the Standard Evaluation Protocol 2003-2009 for Public Research Organisations
- the 'specific peer review protocol' ascertained by the Board of the University
- if applicable: additional instructions of the Board of the University

2 In giving a judgement on the quality of research, a member of the peer review committee grounds his/her assessment on the following information:
- the self evaluation report and accompanying documentation
- if applicable: additional information provided on request of the peer review committee
- interviews, lectures and talks carried out within the framework of the assessment

3 A member of the peer review committee meets the generally known quality demands within scientific research, including:
- competence and professionality
- independence and objectivity
- care and consistency
- transparancy and impartiality

4 A member of the peer review committee experiences no personal, scientific, financial or any other potential conflicts of interest in participating in the research assessment of [*name Institute*] and is therefore both qualified and competent to carry out his/her task as an independent assessor.

5 A member of the peer review committee reports any potential conflicts of interest in advance to the chairman of the review committee.

I declare that I have read the above-mentioned and that I will follow these to the best of my ability.

Place and date: .....

Signature: .....

Name: .....

Appendix C

Curricula vitae of the peer review committee

Arie van Nieuw Amerongen (1944) is professor in Oral Biochemistry at the Free University of Amsterdam, The Netherlands. He received his MSc degree in 1970 and finished his PhD in 1974 with a study on "Brain-specific sialoglycoprotein GP-350". Since then he was appointed as assistant-professor in the Dental Faculty, Department of Oral Biochemistry, and from 1978 as associate-professor. From 1984 he was chairman of this department in the combined Dental faculty, ACTA, followed in 1990 by his appointment as full professor in Oral Biochemistry. Van Nieuw Amerongen published over 300 articles in the field of Saliva and Oral Health and owns several patents on artificial saliva and antimicrobial, antifungal and antiviral peptides. He was granted with several awards within the field of Oral Biochemistry and was succesful in aquiring external funding for his research group. Throughout his career Van Nieuw Amerongen was actively involved in the development of new curricula in Dentistry and related fields and served on several (inter)national committees, such as the Society for Biomaterials, and editorial boards within his research field.

Horst Klinkmann (1935) was educated in both Internal Medicine and Nephrology at the Universities of Rostock (Germany), Budapest (Hungary), Lund (Sweden) and Strathclyde (Glasgow, U.K.). During his professional career he was professor and Chairman of the Department of Internal Medicine at the University of Rostock and held up to 36 visiting professorships at universities throughout Europe, Asia, Australia and the United States. Furthermore he served on boards of various Science Academies and professional organisations such as the International Society for Artificial Organs. Klinkmann was granted with more than 50 awards from different countries and institutes and received up to 13 honorary degrees at universities all over the world. His publication number exceeds 600, including books and book chapters. Presently Klinkmann is appointed as tenured professor and dean of the International Faculty for Artificial Organs at Bologna and as honorary professor and director of the Institute for Bioactive Material at the Nankai University in Tianjin (China).

Dave Grainger (1961) is a Professor of Chemistry at Colorado State University (USA). He earned a Bachelor of Arts degree from Dartmouth College in 1983 and went on to earn a PhD in Pharmaceutical Chemistry from the University of Utah in 1987. Grainger participated in a Humboldt Postdoctoral Fellowship at the University of Mainz in Germany from 1988-1989 and subsequently worked as assistant- and associate-professor at the Chemistry Department of the Oregon Graduatye Institute of Science & Technology in Portland (USA).

Grainger was awarded with several wards, such as the Merck Academic Fellow Award, the National Science Foundation Young Investigator Award and received numerous fellowships among which the DuPont Plunkett Fellowship for Innovations with Fluoropolymers and the DuPont Research Fellowship. Grainger is fellow of the American Institute of Medical and Bioengineering (AIBME), holds several committee memberships, such as the Society for Biomaterials and the NIH Surgery and Bioengineering Study Section and has been a reviewer for several journals.

Gregor Reid (1955) is Professor in Microbiology and Immunology and in Surgery at the University of Western Ontario in London, Canada. His laborartory is at the Lawson Health Research Institute where he is director of the Canadian Research and Development Centre for Probiotics, and program leader for Advanced Surgical Technologies. He obtained his BSc (Honours) degree in Microbiology at the Glasgow University in 1978, completed his PhD at Massey University in 1982 and subsequently came to the University of Calgary and then University of Toronto as a post-doctoral fellow. In 1985, he moved to London, Ontario as director of Research Services at the University of Western Ontario. Reid has published 210 peer-reviewed papers, mostly on probiotics and urinary tract infections and holds 23 patents. He has been chair of the United Nations/World Health Organization Expert Consultation and Working Group, and has been a reviewer for several journals and agencies (including NIH, CIHR, Kidney Foundation).

Appendix D

Research input and output of BMSA

Table 1 **Research input (in fte) at institutional level BMSA 1997-2002**

	1997	1998	1999	2000	2001	2002
Tenured staff	4,6	5,7	5,7	6,2	6,2	6,0
Non-tenured staff	0	0,9	0,9	0	0	0,9
PhD students	13,1	13,3	15,0	16,4	12,6	14,3
Total research staff	**17,7**	**19,9**	**21,6**	**22,6**	**18,8**	**21,2**
Supporting staff	14,2	14,2	16,5	14,4	16,8	17,8
Total staff	**31,9**	**34,1**	**38,1**	**37,0**	**35,6**	**39,0**

Note: The following guidelines were followed in the computation of research time: *Tenured staff*, 0.3 of a FTE (full time equivalent) (staff with an appointment at the University hospital: 0.1 of a FTE); *Post docs*, 0.9 of a FTE; *PhD students*, 0.7 of a FTE; Furthermore research input is proportionate to the size of the appointment, and to the part of the year

Table 2 **BMSA Research staff (in fte) at program level**

	1997	1998	1999	2000	2001	2002
BMSA-1						
Tenured staff	1,5	2,0	2,0	2,1	2,0	1,9
Non-tenured staff	0	0	0	0	0	0
PhD students	3,9	4,8	6,2	6,2	3,7	4,0
Total research staff	**5,4**	**6,8**	**8,2**	**8,3**	**5,7**	**5,9**
BMSA-2						
Tenured staff	1,5	1,5	1,2	1,5	1,5	1,5
Non-tenured staff	0	0,9	0,9	0	0	0,9
PhD students	6,3	5,6	5,6	6,5	5,1	5,1
Total research staff	**7,8**	**8,0**	**7,7**	**8,0**	**6,6**	**7,5**
BMSA-3						
Tenured staff	1,7	1,1	1,1	1,2	1,0	1,0
Non-tenured staff	0	0	0	0	0	0
PhD students	2,9	2,9	3,2	3,7	3,8	3,4
Total research staff	**4,6**	**4,0**	**4,3**	**4,9**	**4,8**	**4,4**
BMSA-4						
Tenured staff	-	1,1	1,4	1,4	1,7	1,6
Non-tenured staff	-	0	0	0	0	0
PhD students	-	0	0	0	0	1,8
Total research staff	**-**	**1,1**	**1,4**	**1,4**	**1,7**	**3,4**

Table 3 **Aggregated results of the BMSA Institute**

	1997	1998	1999	2000	2001	2002	Total
Academic publications							
– in refereed journals	46	59	75	92	75	69	416
– in other journals	8	4	4	5	7	8	36
– book chapters	11	13	10	22	12	11	79
Total	**65**	**76**	**89**	**119**	**94**	**88**	**531**
PhD theses	3	7	4	9	8	7	38
Professional Publications and Products	0	4	0	0	2	0	6
Patents	2	2	3	1	1	3	12

Table 4 **Funding and expenditure at institutional level BMSA 1997-2002**

KEuro's	1997	1998	1999	2000	2001	2002
Direct funding	1.279	1.411	1.538	1.774	1.675	1.937
Governmental Funding	0,034	0,012	0,190	0,143	0,190	0,201
Char./Comm. & EU-Funding	0,512	2,632	1,255	0,828	0,521	0,611
Total funding	**1,825**	**4,055**	**3,028**	**2,745**	**2,386**	**2,749**
Percentages						
Direct funding	70%	35%	52%	65%	70%	70%
Research funds and contracts	2%	0%	7%	5%	8%	7%
Char./Comm.& EU funding	28%	65%	41%	30%	22%	23%
Total funding	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

This publication is part of a series on the assessment of research quality at the University of Groningen.

ISBN 90-367-2241-4

Also published in this series:

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