Research Assessment

W.J. Kolff Institute for Biomedical Engineering and Materials (Kolff)

Science University Medical Center Groningen

2015-2021

19 April 2022

Summary SEP assessment of the W.J. Kolff Institute for Biomedical Engineering and Materials Science

The PRC finds the Kolff Institute to have a research portfolio which is strong, attractive to talent, and has great potential for meaningful societal impact. Its high-quality interdisciplinary research and mission to bridge engineering and medical science are particular strengths and make good use of the UMCG-wide expertise. The committee praises the Institute for taking the recommendations of the previous committee and restructuring to achieve a critical mass and an increase in research quality. The fact that 50% of funding comes from competitive and project-related grants demonstrates the recognition of the Institute and is applauded. Societal impact is integral to Kolff's mission, and the collaboration with external partners through the HTRIC is especially praised as excellent practice.

Research quality

- The Institute should be given more influence in the creation of research positions and funding of new collaborations.
- The alignment of program missions is an important goal, as are ensuring productive links with the FSE and further integrating the programs, ROBOTICS and PHT in particular.
- An impact strategy and clear goal for new diagnostic and therapeutic approaches should be developed, along with policies to encourage clinicians to participate in research.

Societal Relevance

- Continue efforts to increase the involvement of end users to new medical technologies.

Viability

- High priority should be given to filling leadership vacancies, ideally with a team of researcher and clinician; leadership should be recognized and rewarded, and roles clearly formulated.
- Reduce average PhD duration and further invest in postdoc support through mentorship.

CONTENTS

Assessment of W.J. Kolff Institute for Biomedical Engineering and Materials Science (Kolff)

1. Introduction to the Institute

The Kolff Institute is a center of expertise within UMCG where researchers and clinicians join forces to work on basic science and applications in the field of biomedical engineering. This includes biomaterials, new diagnostic tools and therapeutic applications aimed at faster and more accurate prevention, diagnosis and treatment of patients. Researchers and clinicians in various departments of UMCG working on biomedical science or materials science meet and collaborate through the network provided by the Kolff Institute.

Participation in Kolff is mainly bottom-up. Researchers and clinicians are appointed in departments organized around their medical specialties. On top of that, they can join a research institute from among the family of institutes within UMCG that they feel best covers their research interests. Members of the Kolff Institute originate from many different departments, ranging from Dentistry to Dermatology and Surgery. The number of researchers associated with Kolff (as of 2020) is 88 tenured staff members, 7 postdocs and 145 PhD students.

Kolff is directed by a management team (MT), consisting of the Scientific Director, three researchers and a staff advisor from UMCG. The MT members are ambassadors for Kolff, and they promote internal and external research collaboration through events, grant support, contributions to PhD education and networking.

Kolff is subdivided into six research programmes:

- MBM (Man, Biomaterials and Microbes)
- REGENERATE (Restoring organ function by means of Regenerative Medicine)
- NANOBIOMED (Nanotechnology & Biophysics in Medicine)
- PHT (Personalized Healthcare Technology)
- ROBOTICS (Robotics and Image guide minimally invasive surgery)
- BRIDGE (Basic and translational Research and Imaging methodology Development in Groningen)

The ROBOTICS and BRIDGE programmes are new additions to Kolff; they were added in 2019 following a major reorganization of the Institute (see chapter 3.5.2). Each programme is coordinated by two or three programme leaders, responsible for community building, organizing regular research meetings for their programmes and creating a research community for (young) researchers to grow and excel. Together with the MT, the programme leaders form the core team of Kolff.

2. Mission and strategy

The mission of Kolff is to establish a centre of expertise for engineering, biomedical technology and biomaterials, with the ultimate aim of improving human health. This mission ranges from basic scientific aspects to actual medical product development and the clinical evaluation of those products. To realize this, Kolff strives to bridge the gap between engineering and medicine by deploying biomedical technology and engineering in health care, for instance for the repair and restoration of impaired human functions due to disease or aging.

In 2019, Kolff completed a major reorganization with the addition of two new programmes (ROBOTICS and BRIDGE) and the restructuring of the four existing programmes. In addition, the PHT programme was renovated to focus on engineering products and clinical applications. The main goal of this reorganization was to increase the research and societal impact of Kolff. The previous accreditation committee felt that Kolff was too small to realize its aims. In addition, the new UMCG Research Strategy required increased cooperation between research groups. The reorganization in response to the suggestions of the previous SEP and the requirements coming from the new UMCG research strategy allowed the Institute to involve more researchers and clinicians in its programmes, increasing opportunities for collaboration and creating impact.

The Kolff Institute summarizes its strategy in the following aims:

1. *Increase the scientific impact of Kolff*. Promote high-impact publications, promote and support joint research projects.
2. *Formalize and intensify inter-faculty and inter-university collaborations.* In particular the collaboration between UMCG and the Faculty of Science and Engineering (FSE), and the Health Technology Research and Innovation Cluster (HTRIC), an ecosystem in which the UMCG, University of Groningen and regional societal and industrial partners collaborate on medical technologies.
3. *Increase the societal impact of Kolff*. Focus on engineering products and clinical applications, by closer cooperation with clinicians and sharing of research results with a broader audience.
4. *Improve the accessibility and subject relevance of the education courses for Kolff PhD students*. Develop subject-specific PhD courses for Kolff and make the existing courses accessible for all Kolff PhD students.

3. Qualitative Evaluation

Research quality

The recent reorganization and expansion of the Kolff Institute has led to an institute with a strong research portfolio, focusing on a large diversity of research fields and topics associated with biomedical engineering. According to the committee, the Institute has a recognizable mission of bridging engineering and medical science to achieve new technical advancements in health care. This vision has been translated in a new portfolio of research programmes that is relevant, well-chosen, and makes good use of the available expertise within UMCG to pursue the mission of the Institute. A particular strength of Kolff is the interdisciplinarity of its research topics: the various programmes and research lines promote collaboration beyond the traditional disciplinary boundaries. The new research programmes have allowed the Institute to attract more researchers and clinicians, resulting in growth and more potential for impact. The committee praises the Institute for taking the recommendations of the previous committee to heart regarding restructuring to achieve a critical mass at Kolff.

The new structure puts the Institute in a good position to pursue societal impact. The Institute houses a diversity of researchers working on research topics that range from very fundamental to directly connected to clinical practice. During the site visit, the committee noted that the Institute has good access to clinicians, and makes use of their expertise and involvement in various programmes.

Based on the documentation provided beforehand, and the presentations and discussions during the site visit, the committee concludes that the researchers associated with each of the six programmes

are involved in high-quality research. They are involved in national and international collaborations, resulting in scientific publications in well-recognized journals within the respective fields. The recognition of the Institute is also demonstrated in the external funding that the associated researchers attract. Approximately 50% of the research funding comes from competitive research grants (e.g. NWO, ZonMW, EU) and project-related financing (private institutions, governmental organizations, industry). Major funding includes 2 Veni grants, 4 Vidi grants, a Vici grant related to nanoparticles for drug delivery to the brain (Inge Zuhorn, 2021), EU COFUND on tailor-made antimicrobials (7 PhD students, 2016), The Abel Tasman Talent programme (20 PhD students together with Nankai University in China), 2 EU Starting Grants and 1 EU Consolidator Grant.

The MBM, REGENERATE and NANOBIOMED programmes are well-established programmes, operating in an interdisciplinary research environment, ranging from fundamental research to clinical applications. The programmes host internationally recognized and established researchers as well as promising young talent, working on a broad selection of relevant research topics. Examples include impressive work on using photothermal nanoparticles to control bacterial infections and transplanting living tissue around dental implants (MBM), epigenetic editing and the mechanisms behind cellular aging and lung fibrosis (REGENERATE), and drug-delivery through the blood-brain barrier and screening cell-material interactions (NANOBIOMED). The PHT programme has been successfully restructured to promote collaboration between engineers and clinicians. The research projects within PHT are patient-oriented and frequently integrate patient views into the studies. This includes research projects on 3D printed implants and prostheses as well as personalized lifestyle advice using AI.

The ROBOTICS programme has only recently started. It is in the process of connecting engineers and clinicians to investigate the use of robotics in surgery, such as 3D vision, augmented reality and image-guided surgery. The programme already shows synergy between engineers and clinical practice, demonstrating that the programme is making a strong start. The BRIDGE programme has successfully attracted a wide range of researchers working on imaging techniques, including physicists, chemists and biologists. It has the potential to generate many new collaborations, allowing researchers to use each other's expertise and equipment. It is already showing several examples of this, such as research on photopharmacology and new CT scan techniques.

The committee recognizes that the ROBOTICS and BRIDGE programmes, and to some extent also PHT, are new, and still working on developing a network organization that connects researchers in a shared mission. The committee supports these efforts, and recommends that the Institute keeps working on the development of the programmes. Not all new programmes are equally integrated in the Institute: the committee had the impression that in particular the ROBOTICS and PHT programme are to some extent self-contained and not as well connected to other programmes as the other programmes within Kolff. It recommends working on a better integration of these new programmes within Kolff.

The committee noticed that the six programmes each have their own interpretation of the mission of Kolff, ranging from achieving impact through collaboration within UMCG or RUG, to collaboration with societal partners or the international academic community. The committee recommends ensuring that these missions and strategies of the programmes remain consistent and aligned with each other and with the overall mission and strategy of Kolff. To achieve this, the mission and strategy of Kolff should be further developed into Institute-wide strategic goals. The Institute should consider benchmarking itself against institutes with similar missions to set ambitious yet realistic goals.

A particular point of attention during the site visit was the collaboration between UMCG and the Faculty of Science and Engineering (FSE) of the University of Groningen. Kolff has many ties with FSE

researchers, in particular with the research groups in biomedical engineering. The committee understood that, while collaboration usually functions well within actual research projects, the formal structures could better facilitate this. It is often hard for researchers appointed at FSE to formally participate in Kolff programmes and dedicate time to UMCG research projects. The committee considers these collaborations to be essential to the success of Kolff, and the committee recommends that FSE and UMCG remove administrative obstacles to collaborations wherever possible.

Societal relevance

Societal impact is an integral part of Kolff's mission; the Institute aims to connect engineering and medicine in order to contribute to long-term human health. The committee noticed during the site visit that synergy between research and clinical practice is already strong in several research lines, for instance in surgery robots and 3D printing of implants and prostheses. Particularly the health-care technology projects are very patient-oriented and often work with patient communities to integrate patient views directly into their studies. Furthermore, the committee understood that UMCG / University of Groningen is developing a cross-disciplinary educational platform between science, engineering and medicine, focusing on educational activities that combine these fields. The committee considers this to be a promising development which can further catalyze collaborative research.

The committee found that a pipeline to commercialize innovations, for instance through patents and spin-off companies, is available through UMCG. In recent years, Kolff researchers were involved in three spin-off companies on wearable infusion systems (IV Medical), an in-bed muscle training system (Geriamove) and biologically enhanced implants (BiomACS). Collaboration with external partners is further promoted through the HTRIC platform that connects researchers from UMCG and RUG with societal and industrial partners interested in health care technologies. The committee considers this an excellent platform to promote application and commercialization of research as well as to enhance the recognition of Kolff research.

Some of the research in Kolff is of a more fundamental nature. The Institute creates synergy between basic researchers, for instance in biology or chemistry, and clinicians to develop new diagnostic and therapeutic approaches. According to the committee, bringing such technologies to clinical application needs a more complex pipeline. The committee recommends articulating an impact strategy for such technologies and determining what the end goal of the Institute is regarding clinical applications. This end goal could be the actual use of these technologies or clinical studies that demonstrate patient benefits. This impact strategy should also determine what evidence should be used to measure success.

End users, or anticipated potential end users, should be strongly involved to guide the effective translation of these new approaches to practice. To this end, the committee applauds the goal of Kolff to strengthen synergy between researchers and clinicians, as they are important end users of new technology. Their involvement is very important in shaping technologies that are of actual benefit to patients. The committee therefore recommends Kolff to keep working on attracting more clinicians to its research projects (see Viability). To increase the involvement of patients as end users, the committee considers creating awareness for Kolff research and engagement with the general public to be important factors. During the site visit, the committee recognized some examples of impactful outreach such as participation in TED Talks, Open Days and press releases. The Institute should continue and expand these efforts to connect with the general public.

Viability

To evaluate the viability of Kolff, the committee considered the composition of the Kolff research staff, its leadership and the positioning and funding of research.

The committee concludes that, after the reorganization, most programmes have achieved critical mass. An exception is the ROBOTICS programme, which the committee still considers to be subcritical with only four tenured researchers/clinicians. The committee understood that the programme aims for further growth, which the committee supports. These conclusions come with a reservation, as the committee noticed that the size of the research programmes also depends on the criteria for attracting researchers and clinicians to the programme. Some of the larger programmes are mainly networks connecting researchers working on similar topics with varying levels of involvement in collaborations, making it hard to compare the actual volume of research associated with a programme. The committee suggests that the Institute formulates criteria or guidelines for participation in Kolff, making it easier to measure the critical mass and success of each programme.

The committee is very positive on the changes in the leadership structure in the past years, in particular the addition of a Management Team to the Institute. Based on the interviews during the site visit, the MT and programme leaders are engaged and feel responsible for the Institute, and they appear open to new opportunities for future success. During the site visit, the committee noticed that some programmes have vacant leadership positions. It recommends that the Institute gives high priority to filling these vacancies, especially in the light of the need for leadership in the abovementioned strategic developments that are necessary within Kolff. The committee strongly supports the idea of the MT that the ideal leadership team consists of a researcher and a clinician. This underlines the mission of the Institute to bridge engineering and medicine. Furthermore, the committee noted that participation in Kolff leadership is currently voluntary, without compensation or recognition. While it praises the current leadership for their dedication, the committee recommends considering some form of recognition or reward, for instance, by formally allocating time to a role as MT member or programme leader to make it more attractive to take responsibility for an Institute. This could be accompanied by formulating clear criteria and a clear process for appointment and a description of responsibilities of a MT member and programme leader.

During the site visit, the committee discussed with the Institute the influence that Kolff has on the growth of programmes and the undertaking of new research directions. Other than attracting UMCG researchers and clinicians from within the UMCG departments, institutes at UMCG appear to have very limited control on the continuity and development of their research lines. Hiring decisions are currently taken by the departments, without a formal role for the institutes. The committee recommends that the UMCG leadership and Kolff get in touch to discuss the possibility of empowering Kolff with a higher level of influence on the research policy and the associated hiring of new researchers in order to safeguard the continuity and development of its research programmes.

The involvement of clinicians within Kolff research currently faces a similar limitation. The Institute can try to convince clinicians to contribute to the research programmes, but their involvement depends on the willingness of the clinicians, most of whom have very limited time outside of their clinical duties. Hence, the Institute now mainly attracts clinicians only with a clear interest in research. To promote the participation of clinicians in its research programmes, UMCG could consider giving clinicians a mandate to spend time on research. The committee understood during the site visit that there are plans to create a fellowship and/or sabbatical programme where clinicians can formally spend time on research. The committee fully supports this, and it recommends that work should continue to develop specific mechanisms that provide sufficient time for clinicians to spend on research and initiating research collaborations. In addition, UMCG could

consider giving the Institute resources to allow for seeding of new research initiatives and collaborations. For instance, collaborations between researchers could be more proactively promoted and supported by funding joint PhD students that work within two departments.

The funding position of Kolff researchers is appropriate. Researchers are able to attract competitive funding to supplement the basic (first stream) funding. The committee thinks that there it still some room for improvement with regard to third-party funding and international (EU) funding. The Kolff Institute could consider acting as a platform to promote external and international collaborations, something that the committee understood Kolff is currently not pursuing as vigorously as it might. During the site visit and in the documentation, the committee noticed that Kolff mainly focuses on promoting internal collaboration between UMCG/FSE researchers and clinicians. In terms of external branding, Kolff researchers associate themselves with UMCG and their academic department rather than specifically with Kolff. The committee thinks that this is a missed opportunity. The Kolff 'brand' could also be used to present the UMCG's biomedical engineering research as a coherent programme to external partners.

The diversity in terms of gender, with 30% female researchers, is comparable with the gender balance within the field. The panel noted an imbalance in the diversity in terms of senior and junior staff positions. The Institute has a very low number of postdoctoral researchers (7 in total on 88 tenured staff members) associated with the programmes, and a very variable number of PhD students per faculty member throughout the programmes, ranging from a 1:1 to a 4:1 distribution. It recommends the Institute to investigate whether the composition of the programmes is optimal for achieving its aims, in particular regarding the participating number of junior staff members.

The Institute could also consider investing in the support of postdoctoral researchers. While Kolff has several support mechanisms in place for PhD students, such as courses, mentorship and personal development plans, support for postdocs is limited. The committee suggests that the Institute should invest in this by, for instance, offering mentorship programmes for postdoctoral researchers and junior staff members. A point of attention regarding the junior staff is the amount of time needed for PhD students to graduate. The average duration of a PhD within Kolff is 5 years, which the committee deems rather high, particularly when these students appear to often be self-funded during the final stages of the PhD programme. The committee understands that this 5-year average is comparable to the UMCG-wide average, and the committee recommends reflecting on improvements on the level of UMCG.

4. Recommendations

Research quality

- Empower the Institute and increase the strategic instruments that Kolff has at its disposal to realize its aims and to safeguard the continuity and development of its research programmes. This empowerment could include giving the Institute more influence on the creation of new research positions and providing the Institute with seed funding to proactively fund new collaborations, for instance in the form of PhD students shared between two departments.
- Keep working on the development of the new research programmes, in particular on achieving critical mass in the ROBOTICS programme, and connecting ROBOTICS and PHT with the other programmes in Kolff.
- Ensure that the missions and strategies of the programmes remain aligned with each other and with the overall mission and strategy of Kolff. To set ambitious and realistic goals, this mission and strategy should be benchmarked against Institutes with similar missions

- Remove any administrative obstacles that can hinder research collaborations between UMCG and FSE.
- Formulate an impact strategy for new diagnostic and therapeutic approaches and determine what the end goal is with regard to clinical applications.
- Keep working on attracting clinicians to the research programmes. Consider creating incentives such as fellowship or sabbatical programmes to provide sufficient time for clinicians to participate in research.

Societal Relevance

- Continue efforts to connect with the general public with the aim of increasing the involvement of end users to new medical technologies.

Viability

- Formulate criteria or guidelines for participation in Kolff research programmes to make it easier to evaluate the critical mass and success of each programme.
- Give high priority to filling leadership vacancies, ideally with a team consisting of a researcher and a clinician.
- Create some form of recognition for participating in the leadership of the Institute, for instance by formally allocating time to this task. Accompany the formal allocation of release time for Kolff leadership efforts by formulating clear expectations of the role and responsibilities of a programme leader and MT member.
- Try to increase third-party funding and international (EU) funding.
- Consider using the Kolff brand in external communication to present UMCG's biomedical engineering research and use the Institute as a platform for external (international) collaboration.
- Reflect on the composition of the research staff, in particular regarding the participation of junior staff members (PhD students and postdocs).
- Invest in the support of postdocs, for instance by offering mentorship programmes to junior staff members.
- Work on reducing the average duration of a PhD trajectory.