

5. SAB Report of the School of Chemical Technology

Scientific Advisory Board

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- Professor Wout Boerjan, Ghent University, Belgium
- Professor Enrique J. Lavernia, University of California Davis, USA (did not attend the meeting in 2014)
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Introduction

The Scientific Advisory Board (SAB) visited the School of Chemical Technology for the second time, from Monday till Wednesday March 10-12, 2014. The meeting was well prepared, with flawlessly organized logistics, excellent documentation and secretarial support. Owing to this, the meeting was efficient, informative and pleasant. We appreciated the open atmosphere in which the discussions were held. We thank the Dean, Professor Janne Laine, Ms. Eija Zitting, and Dr Greger Lindén for the excellent arrangements and support.

This report has a main section with the most important recommendations, while more detailed comments as well as minutes of the meetings are given in appendices. We present our report to the president and the dean and leave it to their discretion with whom they wish to share the information, and if they wish to edit the report for that purpose.

The seminar with four newly appointed staff followed by a session with posters presented by doctoral students was a highlight of our visit, and a good way to enhance a feeling of corporate spirit among the school community.

For the next visit the SAB recommends

- to have separate sessions with BSc, MSc and PhD students and postdocs, and newly appointed tenure track professors,
- that each department prepares a SWOT analysis, and
- that there is a one-page key info per professor, in the style of the ERC template, providing a summarizing CV with specialism, teaching load, grant history, recent publications, and major management responsibilities.

Aalto University

The SAB is somewhat concerned that too many new professors are, and have been, hired at the same time (big catch – poor fish?); and also wonders how to ensure that all share the new vision and mission of Aalto. The SAB recommends a five-year plan for staffing, investments in equipment, anticipating retirement and replacements to ensure a smooth transition. The leading principle in the plan should be the number of staff needed for teaching and perspectives for research excellence. In order to enhance the spread of the vision

and mission of Aalto and to ensure uniformity and efficiency in administration, Aalto's leadership courses for present and prospective deans and heads of department are of the highest importance.

Multidisciplinarity will fail or be at best superficial without special actions and incentives, and also needs to be a clearly stated requirement for tenure in multidisciplinary fields. Aalto should continue its efforts and support in this. The synergy with the School of Arts, Design and Architecture has so far been incidentally successful, but offers unique possibilities for Aalto to be a leader in a self-created league of design-oriented universities. Aalto should capitalize on the reputation of Helsinki as a design capital of the world.

A few additional recommendations to the university and the president would be to install a special fund for large investments in equipment; to expand the adjunct professor program (and employ more part-time faculty from industry); and to make a program for PhD students to spend a semester abroad. The mentoring plan for young staff in the tenure track system should also be reinforced. Generally, the SAB also heard complaints about the magnitude of the central overhead and the insufficient transparency of how this overhead is spent; clearly there is a need for clarification.

School of Chemical Technology

At the school level, there seems to be a significant imbalance between teaching, research, infrastructure, staffing and funding; apparently, the funding situation is tighter than foreseen. The SAB then recommends the school to abandon the 'formation plans' and make a plan based on minimum staff for teaching requirements and reconsidered research priorities to be delivered by this staff. The school should also make a plan for a unique and upgraded infrastructure and staffing strategy (e.g. concerning the vacancies for "metal processing" that are there mostly for historical reasons).

The school could consider making the organization flatter, and to remove the management layer (of heads) of departments. The remaining structure would be a school, led by a dean and one or two vice-deans (e.g. education; management & administration) and a few program coordinators, which could offer a more flexible organizational and research structure.

The SAB would describe the current departments in a nutshell as follows. The Department of Biotechnology and Chemical Technology and the Department of Forest Products Technology are both on track; the Department of Materials Science and Engineering has much improved since last time; whereas the Department of Chemistry still lacks a comprehensive vision and mission. The involvement of this department in collaboration with other units is weak and not acceptable; both the SAB and an earlier review panel have noted this before. The SAB recommends the department to draw up a plan of action, which should be implemented within one year, followed by an in-depth review by a special external review committee of experts, before new staff is hired.

A general concern for the whole school is that the heavy focus on bio-related areas could be a danger if it occurs at the cost of 'traditional' but indispensable disciplines (e.g., reactor engineering, etc.).

Evaluation of the School of Chemical Technology

Since the SAB's last visit in 2012 there is clear improvement in publication productivity and to some extent graduate studies. Also, select faculty is exhibiting international-level research and impact.

Some weaknesses are still to be remedied. To some extent, the research visions of the departments are weak and too broad and need be refocused. The departments' research missions need to be described with quantifiable parameters. There is also a lack of clearly focused strategic plans, which is truly concerning

given the planned faculty hiring. There seems to be little evidence of synergism of individual faculty research efforts.

The school and the departments should definitely make up a plan to address equipment renewal and strategic capital equipment purchases.

The school and the departments have taken some of the recommendations of the previous SAB review into account but a truly effective response is lacking. The issues and challenges raised in 2012 still exist and should be dealt with. The current management team is new and seems uncertain of all the challenges and what to do.

Education; PhD funding and training

Teaching is the first priority of any university. The SAB notes that the training of undergraduates has been tackled effectively. A strong recommendation of the SAB is for the school to turn its attention to the training of PhD students.

In view of the bio-related focus, the SAB recommends biology and cell wall biology as areas to be included in a general course in the PhD program. In addition, when it comes to the PhD training, there appear to be several PhD students enrolled on one-year funding contracts, with the students responsible for raising their own funding for each year of continuation. The research topics appear to be determined by individual students with their funders, and are not restricted to the major themes of fundamental research that the school is developing¹. There also appears to be no formal induction or training of PhD students, and there is little formal administrative support within the department/school that addresses the need of the PhD student community. There is no representation of PhD (or postdoc) communities at department/school level. The current structures may leave PhD students isolated in individual research groups and do not create a multidisciplinary environment in which they meet regularly with their peers to discuss science.

The SAB strongly recommends that best practices from doctoral training networks in the EU are adopted to raise the training and connectivity of the PhD researchers. The following elements of PhD training need to be considered explicitly:

- **Research projects:** Relevance to school/department themes; all results to be publishable in the thesis; must create an original contribution to the research area.
- **Specialist scientific skills** required to deliver a high-grade research project (attending summer schools, international conferences, international lab visits; receiving in-house specialist lecture courses from research leaders).
- **Transferable skills:** Training in project management, team working, time management, literature searching, writing research papers, presentation skills, ethical and societal issues that drive research policies in academia/industry, and issues of technology transfer, IPR, innovation and commercial exploitation.
- **Building a research community:** weekly school/department seminars from external and internal research experts followed by 'mixer' discussions; journal clubs; end-of-year symposium/poster day where all students present their research.

¹ According to the school, the students are dependent on *the professors' effort to raise money* (not on their own efforts), and the research topics are determined *by the professors together* with individual students and their funders. (Note added by wish of the school.)

Departments

Department of Biotechnology and Chemical Technology

The strengths of the department include a broad but encompassing mission focused on process technology, biotechnology as well as biomaterials science that leverages VTT's capabilities. As examples of some recent success at the department, an infrastructure alliance together with VTT for excellence in sustainable biomass refining called Bioeconomy was included in the national research infrastructure strategy and roadmap of 2014. This promises future funding and contribution to a key national research focus that is relevant to global biorefining efforts. The focus on innovative microbial oil technology also indicates that translational research is being done in the department. In general, the department has responded positively to the review and recommendations of the SAB in 2012. The actions taken include hosting an upcoming conference on biotechnology and increasing both publication impact and quantity over the past two years.

There are, however, also some reasons for concern. There seems to be little contribution of the department to Aalto's vision and mission on design and business. There also seems to be a lack of cooperation between the areas of chemical technology and biotechnology; the faculty on both sides should be encouraged to produce joint publications, to have joint projects and also share students. The department must also identify the critical needs when it comes to equipment as well as tenure track hires. To avoid unexpected financial crises in the future, there should be a management plan to handle changes in funding.

Department of Chemistry

As a highlight and indicator of the quality of research done at the department, Professor Maarit Karppinen has recently received an ERC Advanced Grant in the area of molecular-layer-engineered inorganic-organic hybrid materials. Both the quality and the quantity of publications of the department have increased since the last visit of the SAB. On the teaching side, a more streamlined structure has evolved.

Five new tenure track positions (of which two are joint positions with other departments in the school) have been made available; one of them has so far been filled in inorganic chemistry by Professor Shiv Halasyamani. These new positions strengthen the possibilities to collaborate within the school, where all chemistry research currently maps onto an active and functional materials theme. Within this covering theme there is computational chemistry, a new and important capability. The SAB would, however, recommend that there is alignment of computational research with existing experimental work at Aalto University to deliver high impact science for the whole university. The new streamlined BSc and MSc course structure should enable the professors to deliver all lecture courses, with lab classes delivered by a greatly reduced number of teachers. This should allow the departmental staffing structure to be reorganized away from teaching-only contracts towards research.

There are still areas of concern. There is no clear vision and strategic plan to identify the flagship areas of the department and develop research excellence in them. Although chemistry is a central scientific discipline in the school, the department's interaction and overlap with the rest of the school is limited and falls short of realizing its potential as a truly underpinning science. A structured brainstorm at the departmental and school level is required to address this. Concerning the remaining open four tenure track positions still to be filled, there is such a high level of investment involved that it should only go ahead once a clear vision is articulated (see points above). Head-hunting of high-calibre candidates is recommended.

Talented research staff on fixed-term contract should also be mentored and nurtured toward tenure-track positions.

We repeat that the Department of Chemistry should very urgently make a plan of action, which should be implemented within one year, followed by an in-depth review by a special external review committee of experts. Hiring of additional staff should await the outcome of this review.

Department of Materials Science and Engineering

The department has a clear vision and strategy, with areas of focus that align well with the school and the university priority themes. The department has altogether developed significantly since the last visit of the SAB. External research funding increased from 2011 to 2013, with major research project funding brought in through industrial partnerships, but also with a significant increase of funding from the Academy of Finland. There has been a 45% increase in ISI publications in two years. There is clear evidence of interaction with other departments in the school. The number of foreign PhD students has increased from 24% (2011) to 43% (2013), and new BSc and MSc programs have been developed. All research in the department falls under two themes: metal and minerals processing and functional materials. The former theme maps onto EU's strategic area of resource scarcity.

The SAB saw some areas of concern. A significant number of professors will retire between 2014 and 2017. Furthermore, when someone retires, the professor position is returned to the university. Therefore, a clear succession plan needs to be put in place by the school and the department to enable recruitment of 'new blood' into key areas to occur in a smooth way. Head-hunting of high-calibre candidates is recommended. The infrastructure that will enable research to be conducted at the highest level in the field of functional materials needs to be identified and a strategy put in place to acquire these key facilities. The SAB would have wished also to visit the laboratories of the department, but cannot now comment on them.

Department of Forest Products Technology

Overall the management team presented a high performance departmental research and educational team that is well focused on the forest biorefinery concept leveraged with wood science and bio-based materials. For example, the hiring of Professor Orlando Rojas is a testimony to the dynamic promising future of the department. The number of publications and their impact has significantly improved during the last few years along with grantmanship, and the department contributes to the research mission and vision of Aalto. The department tour also illustrated new promising cellulose spinning facilities and the department is a role model for other departments.

The main concern is that the department still needs to find a good partner school in green chemistry. Further, the department would need to find a faculty member with expertise in lignin to take the department to the next level.

Response to the SAB's recommendations in 2012

The SAB report of February 9, 2012 contained a number of recommendations. During the visit in March 2014, the SAB received responses to the recommendations at different levels of the organization.

The president agreed that the so-called 65/25/10 scheme for research contracts with industry would be helpful to ensure the balance between an applied and a basic approach to solving problems, but there had not been time to implement it. The same was true for the strong need for a fund to finance large investments for truly unique equipment, enabling a step-up in scientific performance.

The dean and the department heads responded positively to many of the recommendations. The Department of Biotechnology and Chemical Technology has arranged for joint preparation for “green chemistry” and has improved the number of publications in “visible journals”. The Department of Materials Science and Engineering has started more joint activities with other departments and demonstrated more focus in research. The Department of Forest Products Technology has aimed at more funding from academic sources such as the Academy of Finland and ERC and has established more collaboration with the University of Helsinki. The Department of Chemistry is still working on formulating a strategy.

The School of Chemical Technology still needs to respond to two key recommendations:

1. to do more to spread the vision of the Aalto University at all levels, and
2. to reorganize underperforming units and consider the strategic merger of units.