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Scientific Advisory Board Report 2021

Scientific (and Artistic) Advisory Board Members

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[The scientific and artistic advisory boards are asked to provide a critical, forward looking review with recommendations. The review report is narrative text without grades, compiled into one S(A)AB report by Aalto University. The compilation is published on the intranet of Aalto University and is accessible to personnel and students.]

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1 Summary and key recommendations to the School of Chemical Engineering

The **School of Chemical Engineering (CHEM)** is one of internationally leading research units in sustainability-related chemistry, biomaterial science and engineering. It represents an exemplarily well-organized research institution with clearly formulated future strategy, vision and mission. The dedicated staff and an inspiring research and teaching atmosphere are two important factors that enable its obvious success. It is certainly one of the key drivers of the “Shaping the future” strategy of Aalto University.
Excellence is evident in many areas, as is the determination to maintain this leadership position and to build up excellence in other new areas.
Both fundamental research and application-related research are on a very high level, and there is generally a very high and well balanced scientific and societal impact of the work in general. This is linked to the very timely topics the research at the CHEM is focusing on.
Teaching loads are high - with increasing numbers of students and dwindling financial teaching support at the same time.
The school is particularly successful in acquiring research funds from both industrial partners as well as national and international research funding bodies, among those projects being prestigious ERC grants and large research consortia and flagship projects (FinnCERES Flagship, BATCircle, Bioinnovation Center, Neste strategic project). These remarkably large amounts of acquired external funds are unfortunately by no means matched with internal funding from the Aalto University side.

To further promote research excellence at Aalto University, the SAB recommends the school (or Aalto University):
Recommendation 1: **Increase collaboration between CMAT, BIO2 and CMET** to maximize synergies and interdisciplinarity, thus increasing research power in areas of excellence and of strategic focus. Use the big flagship projects as promotors of inter-departmental cooperation, which would ensure that cooperation gets more and more strategic rather than organized ad hoc.
Recommendation 2: the future research plan lists eight **tenure track positions for the period 2021-2025**. All of these are very well accounted for, with carefully set scopes and dedication areas, and are absolutely necessary for reaching the ambitious development goals at school and department level. Aalto University should definitely approve implementation of these positions by all means.
Recommendation 3: **Define overarching themes for research**. Modelling / computational chemistry / digitalization seems to be such an overarching theme. Consider promoting cooperation between BIO2, CMAT and CMET through modelling at multiple scales.
Recommendation 4: The **awareness of school and department identity** as well as cooperation between the individual research groups can be further strengthened, especially for young researchers (PhD / postdoc level and researchers earlier in their career), by simple means to better familiarize themselves with their institutions and their colleagues.

1.1 Review of the school's strategic plans and roadmap in the light of Aalto's strategy objectives for research and impact

The CHEM school has defined four research focus areas in which future activities will be centered:

- *Biomass refining and advanced lignocellulosic materials*
- *Molecular bioscience and Industrial biotechnology*
- *Chemistry for renewable energy and functional materials*
- *Chemical engineering and circular processes.*

This selection appears very timely, logically resulting from the strengths of the school and fully plausible on all levels, from international drivers (SDGs) down to national (Finnish Bioeconomy strategy) and university-level strategies.
Future research centers around **driving excellence**, with the well-formulated aim to provide sustainable chemical engineering for bioeconomies and circular economies of the future. There is certainly a good foundation for that, considering the high number of acquired ERC grants, flagship projects and documented research success (acquired funding, publication record). The general goal thus appears very ambitious, yet logical and achievable at the same time.
Three "development actions" (general strategic ways) to fill the research vision "Driving Excellence" with life were also identified:

- attracting and fostering talents,
- developing selected research infrastructures, and
- new collaboration across fields.

Some recommendations of the SAB will exactly address these three strategic measures, adding also some thoughts to the tactical approaches (see also subchapter 1.3).

Future-led learning was selected as the main theme for coming teaching developments, with the vision to educate chemical engineers for the sustainable future. This nicely demonstrates that the unity of research and teaching is also reflected in the CHEM school´s general goals.

Plans regarding the **future impact of the school** are summarized by "Inspiring ecosystem", i.e., endeavors to renew the society by generating new knowledge, educating experts and enhancing innovations. Again, **three development actions** towards this impact objective were identified:

- Cultivating an environment of innovation,
- developing global and local networks, and
- building a sustainable and thriving campus.

Aalto University has also defined three "crosscutting themes", which can be conceived as underlying philosophies or guiding principles for future developments:
"solutions for sustainability",
"radical creativity" and
"entrepreneurial mindset".

The CHEM school nicely has picked up these general thoughts and transferred them perfectly well into concrete actions and direct future plans for the four research focus areas, as seen below. *"Driving excellence"* as the research vision appears well chosen and logical considering the strong position of the school´s research in national and international comparison.

Research focus area 1: Biomass refining and advanced lignocellulosic materials
Driving excellence: ERC grants, FinnCERES Flagship, Bioinnovation Center
Solutions for sustainability: Valorization of lignocellulose materials and solutions with corporates
Radical creativity: 10 years of CHEMARTS
Entrepreneurial mindset: Research to business funding, Ioncell pilot and startups, ERC PoC

Research focus area 2: Molecular bioscience and Industrial biotechnology
*Driving excellence***:** ERC grants, Novo Nordisk Foundation projects
*Solutions for sustainability***:** next generation biocatalysis, processes and materials
Radical creativity: New silk, CHEMARTS
Entrepreneurial mindset: Research to business funding

Research focus area 3: Chemical engineering and circular processes
Driving excellence: Leading role in engineering clusters: BATCircle 2.0, large EU projects
Solutions for sustainability: Neste partnership, BATCircle, catalytic and recycling solutions with corporates
Radical creativity: Profiling professorship for circular chemical engineering
Entrepreneurial mindset: Ioncell pilot plant

Research focus area 4: Chemistry for renewable energy and functional materials
Driving excellence: ERC grants, large EU projects, ALD expertise
Solutions for sustainability: New energy materials and storage
Radical creativity: Virtual laboratory environment
Entrepreneurial mindset: Research to business funding

The **three actions regarding future research**, i.e., a) attracting and fostering talent, b) developing selected research infrastructures, and c) new collaboration across fields, were each corroborated first by a "target state" statement and second by concrete milestones for the next period (2022-2025). Here again, rather general and "fluffy" principles were transferred into touchable plans and measurable actions, both on university and school level. The same applies for the **three actions defined for long-term direction of the impact**, i.e. a) cultivating an environment of innovation, b) developing global and local networks, and c) building a sustainable and thriving campus.

The following **vision for 2025** was listed, giving per-annum goals that seem to be fully realistic based on the current level of performance.

- 50 invention disclosures
- 40 patents applications
- 6 LIC. & Tech. transfers
- 7 direct transfers
- Corporate funding 4.5 M€ (2024)
- BF Funding 3.6 M€ per annum (2024)
- Some tens of companies as partners in projects and steering groups
- 10 active R to B projects
- 3 Commercialization projects
- 5 Start-ups running.

The CHEM school provides sustainable solutions and tackles grand challenges by scientific and engineering excellence in bioeconomy. It contributes to constant renewal of the society by generating new knowledge, enhancing innovations and by educating the experts of the future. The targeted partner industries, forest, pulp and paper, chemical and metal industry cover more than 50% of Finnish exports. The CHEM school has become an acknowledged brand among students, industry and other stakeholders. The graduates are known for their excellent competences in chemical engineering and sustainability, responsibility, and creative thinking.
In general, it seems to be a stronghold of the CHEM school that rather general and wide-ranging principles (from SDGs on an international level over the national bioeconomy plans down to strategies on the university stage) are very well taken up and transformed into tangible research plans, concrete milestones, and eventually measurable outcomes. This is certainly supported by the outstandingly qualified group of leaders, consisting of head and deputies, of the CHEM school.

1.2 A brief overview of the implementation of the RAI 2018 recommendations

The RAI recommendations were:
a) All departments should develop and articulate a longer-term strategy, as well as define measures of performance with annual review.
b) Across the field, more attention needs to be paid to gender balance and equality.
c) Consider combining CMET with CMAT (C MATE?) to reach critical mass targets and to create a new unit with the potential to excel in both excellence and impact.

A real effort has been made to address the recommendations of RAI 2018/19.
1) Clear longer-term strategies were formulated in all three departments (see the CHEM future research areas above and the area listings for BIO2, CMAT and CMET below).
Measures were introduced to address the gender scissors, both at Aalto level (Aalto diversity handbook), at school level (recruitment procedures) and at department level (filling of TT positions).

2) A clear and well-founded decision was made against the proposed CMAT/CMET merger.
3) Launch of an ombudsperson position for PhDs at Aalto level.
4) Platforms for sharing best practice have been established and are running (grant writing support, Bioinnovation Center, industrial visit programme).

The school is well aware of fields with ongoing efforts:
1) PhD education and establishment of “true” doctoral schools (specialized curricula etc.).
2) Introduction of an accepted an economically viable recognition – incentives – reward system.
The difficulties of those two aspects cannot be tackled by the school alone, but require support and engagement on the level of Aalto University with general solutions to be broken down to school and department levels.

1.3 Additional recommendations and remarks

Increasing collaboration between CMAT, BIO2 and CMET could further uncover synergies and boost interdisciplinarity, thus increasing research power in areas of excellence and of strategic focus. The SAB encourages reflection on how to promote strategic inter-department cooperation (e.g. seed funding, re-opening of school-funded PhD / postdoc positions…). Such cooperation should be strategic rather than ad hoc. Use the big flagship projects as promotors of inter-departmental cooperation.
National and international projects support national and international cooperation, rather than inter-departmental one, which is a setting that is disadvantageous. Still there clearly is a critical mass for collaboration, which perhaps can be even better used, and a huge internal cooperation potential which could be even more productively tapped. J.W. von Goethe said: Why wander far away when the good is so close? (“Warum in die Ferne schweifen? Sieh, das Gute liegt so nah!”) This might also be a guiding principle for intensified inter-departmental cooperation.

It is obvious that the dwindling funding support from university side, combined with **large, increasing numbers of students**, represents a huge challenge to the CHEM school. The SAB cannot offer a solution, but just stimulate reflection on what would be ways to better convince the university to increase funding of teaching chemistry and chemical engineering, because of the special situation of expensive lab infrastructure, labware and chemicals.

Define overarching themes for research. Modelling / computational chemistry / **digitalization** (artificial intelligence, programming, automatization) cooperation between BIO2, CMAT and CMET through multi-scale modelling, bridging the scales from molecular modelling over soft matter, materials and enzymes to reactors, processes and systems.

Filling positions should be guided by excellence, but also some pragmatism and flexibility are required. Rigid rules, when applied too rigorously, can have a counterproductive effect, and applying the “no-own-PhD people rule” when filling postdoc position too rigidly and overweighing

international experience might result in a negative selection in some cases which can easily be avoided.

A high level of excellence should also guide the **filling of positions for administrative / technical and support staff**.

Allocating a (rather small) part of the basic funding from the university according to research activity / success could be a means to **create an internal "reward system"** and to additionally increase motivation.

Improving career advice opportunities for PhDs and postdocs should center around a celebration and clarification of different career paths, pointing out that the academic path actually is a niche. We educate the experts of tomorrow in all areas of industry and society. Increase the strategic contacts with industry, especially for international students and staff, the numbers of seminars with industry, and opportunities for career advice from industry (fairs, visits). Promote alumni school ideas and related activities of an **alumni organization**.
For the graduates following an academic career path, the **grant application support is excellent and highly appreciated**, especially by young faculty, and should by all means be maintained or even expanded.

The **awareness of department identity** for the individual research groups - and as a consequence the cooperation between them - can be further strengthened, especially for the researchers early in their career (PhDs, postdocs). Following impromptu suggestions could be considered:

- Introduction of a "check-in" procedure on department level that familiarizes new PhDs / postdocs / staff with internal procedures, security issues, organizational matters, but also the groups and new colleagues.
- Introduction of new colleagues by a round-mail (with picture and short background) on department level.
- Photo-boards with all groups and faces at the department (that needs to be present at all sites and needs to be updated continuously to be effective).
- Foster broad interest of PhDs / postdocs beyond their own group and subject would widen their horizons. The introduction / intensification of a seminar series at school AND department level could help to foster contacts, talks and eventually new collaboration, especially also among these younger researchers. Also on school level, this could generate opportunities to discuss and develop research strategies (school meetings, research day).

Attracting international conferences at school and department level will strengthen the profile and further boost international visibility. This, however, would require administrative and financial support from the university.

Using the internationally accepted frameworks of journal impact factors and citations, in addition to the JUFO classification, will be very helpful, in particular for processes that involve international colleagues who are not familiar with the peculiarities of the Finnish JUFO system. In general,

encourage quality of scientific papers over quantity. For future SAB visits or evaluations, consider **benchmarking against schools of similar size and scope** internationally.

2 Department of Bioproducts and Biosystems

2.1 Summary and key recommendations to the department

The department is clearly among the internationally leading institutions in biomaterials and in novel processing and material from wood. There is a very good impact, grounded in scientific excellence, admirable infrastructure and extensive industry collaboration. This ensures excellent future potential. The department Bio2 is having great success with prestigious excellence grants (ERC, Novo Nordisk Foundation) and large consortia and flagship projects (FinnCERES, LIBER, Bioinnovation Center).

To further promote research excellence, the SAB recommends the department:

Recommendation 1: BIO2 is a very multidisciplinary department with more than just a critical mass. **Strengthening biotechnology and related fields** would even more fortify the department as a whole and help in bridging the biotechnology and the bioproducts side.

Recommendation 2: **Full replacement / extension of empty chair positions** (e.g. O. Rojas, H. Sixta) is essential to keep the high level of research and teaching at the BIO2 department and its general impact, and full support of Aalto University for these replacements need to be sought.

2.2 Review of the department's strategic plans and roadmaps in the light of school's / Aalto's strategy objectives for research and impact

The department formulates a future aim that is as short as it is simple: to be a world leader in bioeconomy. It is a compliment in itself that this aim does not appear megalomaniac and exaggerated, but attainable and realistic based on the development to date and its previous achievements. The department has achieved scientific and engineering excellence in several aspects, and is aware of the fact that excellence is not an unchangeable state, but needs constant efforts and permanent renewal.

BIO2 focuses on five scientific areas:

- advanced lignocellulosic materials,
- sustainable processing and biomass refining,
- molecular bioscience and biotechnology,
- wood science and
- textile chemistry.

This selection appears very timely, logically resulting from the strengths of the department and fully plausible on all levels, from school stage over Aalto University level to national strategies.

The department offers a unique combination of bioproducts and biotechnology, the research spanning fundamental research and development of (nano)materials and biomaterials to industrial applications. This generates long-lasting impact for industry and society.
BIO2 continuously and successfully integrates new research aspects from synthetic biology, artificial intelligence, computer-aided simulation, green chemistry methods and sustainable materials technology research efforts.

2.3 A brief overview of the implementation of the RAI 2018 recommendations

The RAI recommendations were:
a) Articulate strategy for future development (several different aspects)
b) Co-localization should be seriously considered
c) Infrastructures could be developed further as meeting places to promote networking
d) More PhD courses desirable, international PhD profile
e) Gender balance and equality need to be addressed (recruitment procedures)
f) Multidisciplinarity as an asset: BIO2 is already heavily involved in the Materials Platform and more engagement in the Energy Platform is recommended.

A real effort has been made to address the recommendations of RAI 2018.
1) A clear strategy for further development was formulated, containing five key areas for research (see above).
2) The aspect of co-localization was clarified as not feasible.
3) Measures to promote networking were introduced (Bioeconomy infra, Bioinnovation Center…)
4) The number of PhD courses was increased (Bio2future summer school, FinnCERES go global)
5) Aalto Networking Platform and a tenure track position “Sustainable Bioproduct Innovation”, as a collaboration between all Aalto Schools, are already attracting more multidisciplinary project proposals.

The department is also well aware of fields with ongoing efforts:
1) While the gender balance has been improved on all other levels (PhD, postdoc, lecturer, staff scientists), it is still insufficient on the professor level (17:1 for tenure track professors).
2) PhD education and establishment of “true” doctoral schools.

2.4 Additional recommendations and remarks

BIO2 is a very multidisciplinary department with more than just a critical mass. **Strengthening biotechnology and related fields** would even more fortify the department as a whole and help in bridging the biotechnology and the bioproducts side.

Endeavors towards a **renewal of "biomass refining" and "wood science"** is to be commended. The wood, pulp and paper industry, as one of the most important economic mainstays in Finland also in the future, will continue to need qualified experts.

Cellulose topics are very well developed and represented at the BIO2 department. The **increasing importance of lignin**, with regard to science, ecology and economy, appears to indicate that it needs to catch up a bit and get on equal footing with cellulose. Also other biosources could be increasingly considered to become more "comprehensive" in terms of bioproduct starting materials.

Full replacement / extension of empty chair positions (e.g. O. Rojas, H. Sixta) is essential to keep the high level of research and teaching at the BIO2 department and its general impact.

3 Department of Chemistry and Materials Science

3.1 Summary and key recommendations to the department

Research and education of the CMAT department is based on expertise in chemistry (organic, inorganic and analytical), and in science of functional materials, nano-materials, surfaces and thin films. The approaches cover the whole scale hierarchy from molecules over materials to systems. Research and engineering excellence is evident, with four ERC grants during past 5 years as an example, and high international visibility. CMAT centrally supports the CHEM school´s focus on chemistry for renewable energy and functional materials.

To further promote research excellence, the SAB recommends the department:
Recommendation 1: **Tenure-track positions in soft functional materials and molecular modelling** / computational chemistry would significantly strengthen the department and school profile, and the university should definitely support these strategic planning. Search for people that are able and willing to bridge modelling scales.

3.2 Review of the department's strategic plans and roadmaps in the light of school's / Aalto's strategy objectives for research and impact

The department clearly formulates future goals and has the ambitious, yet realistic vision to become an internationally leader in the four focus areas (see below) in the time period until 2030. Based on the development to date and the department´s previous achievements, this goal appears achievable and realistic. The department has achieved scientific excellence in several aspects, and is very successfully exploiting the balance between topical diversity and focus areas.

The CMAT department has identified **four main future research fields**:

- renewable energy storage and conversion;
- soft functional materials;
- inorganic silicon-based functional materials and
- molecular modelling.

This selection appears very timely, and agrees with the relevant strategies on all levels, from school stage over Aalto University level to national strategies. The focus shift from engineering materials to soft functional materials is logically resulting from the strengths of the department and seems fully plausible.

Four ERC grants represent an exceptional level of achievement for the department. It plays a leading international role in the focus areas, in particular renewable energy research: carbon nanomaterials (fuel cells, catalysts), inorganic functional materials (thin films ALD/MLD) and functional soft materials and molecular modelling approaches well complimented with the experimental side. CMAT has healthy industry links and there is a good output of patents, with some having progressed up the innovation ladder. Also the high quality of theses is a particular feature. The competitive funding has significantly grown over the past years.
The department has significantly improved its gender balance, also on the professor level.

3.3 A brief overview of the implementation of the RAI 2018 recommendations

The RAI recommendations were:
a) Department should identify future focus areas to develop, to build critical mass and to stand out internationally among the “mega trends”
b) Develop strategy for better integration of modelling and experiment
c) Define industrial partnership targets, create an industrial/societal advisory board at the department level
d) Actively introduce young faculty into industry networks
e) Consider balance between lecturers and research faculty
f) Enhance PhD course offerings

A real effort has been made to address the recommendations of RAI 2018.
1) Focus areas for research have been identified and are continuously developed (renewable energy research, soft materials)
2) Better integration of modelling and experiments: joint TT position with BIO2 (soft material modelling)
3) Interactions of young faculty with industry has increased.

The department is well aware of fields with ongoing efforts:

1) Particularly foreign young tenure-track researchers lack original contacts to Finnish industry, which requires additional support from industrial advisory boards to better introduce them to companies.
2) It is essential to have a sufficient number of lecturers to manage the rapidly increasing number of students.

3.4 Additional recommendations and remarks

There is a quite **good connectivity and collaboration** between researchers within the department, with very good infrastructure, shared without problems. CMAT is centered in chemistry and has both enough depths and enough variety to deliver their themes across chemistry. The gender balance is good at postdoctoral and lecturer levels, a 24% female representation at the professorial level is to be commended.

CMAT will benefit from further expanding number and broadness of connections with stakeholder networks, which could act as a driver of inter-departmental and academic-external partnerships.

CMAT delivers **a big teaching effort in chemistry**. An increase in the number of lecturers might be helpful. However, rationalization in the BSc/MSc teaching program to deliver a more efficient use of lecturer / professorial time might be equally supportive, as might be even better balancing of the teaching load.

There is awareness that a **further increase of collaboration with the industry** is beneficial.

4 Department of Chemical and Metallurgical Engineering

4.1 Summary and key recommendations to the department

The Department of Chemical and Metallurgical Engineering (CMET) is at the core of engineering within the CHEM school. It focuses on sustainable utilization of raw materials and on designing and developing more efficient processes for new materials and products. There is a very good impact, grounded in engineering excellence and extensive industry collaboration. This ensures excellent future potential. There is a continuously very high project volume in industrial collaborations in all represented research fields. A particular feature is the very successful pairing of industrially relevant research with fundamental science.
To further promote research excellence, the SAB recommends:
Recommendation 1: **Tenure-track positions** in “Circular and sustainable chemical engineering” and in “Process systems engineering” are a logical extension of previous research developments which agree perfectly with the development strategy and will further sharpen the research profile of CMET department and CHEM school.

4.2 Review of the department's strategic plans and roadmaps in the light of school's / Aalto's strategy objectives for research and impact

The department clearly formulates future goals and has the ambitious, yet realistic vision to centrally contribute to the future society with sustainable processes enabling circular economy and bioeconomy. This appears both ambitious and fully realistic based on the previous development of CMET and its close interactions with industry and stakeholders. The department has achieved engineering excellence in several fields, and is very successfully exploiting the balance between industrial relevance and fundamental scientific research. The department is in a key position in research related to chemical engineering, materials technology, metals processing, efficient energy technologies and related digitalization approaches, with core competences in unit operations and processes, hydrometallurgy and pyrometallurgy, catalytic processes and materials, polymer engineering, process control and process systems engineering.

CMET´s two main strategic research areas have been clearly formulated:

- Chemical engineering and
- Circular processes.

This selection appears very timely, and agrees with the relevant strategies on all levels, from school stage over Aalto University level to national strategies.

CMET has extensive contacts with industry and a high level of interaction with stakeholders. It acts as the engineering hub within the CHEM school, succeeding in the reconciliation of education, collaboration with industry and high-quality scientific output. There is impressive stakeholder engagement, consistent with Finland's leading position in wood products and metals. The circular economy of metals and bio-based polymers are the areas of special strength. A particular feature of CMET is the very high number of MSc graduates.
The department has significantly improved its gender balance, also on the professor level (28% female representation).

4.3 A brief overview of the implementation of the RAI 2018 recommendations

The RAI recommendations were:
a) Develop a longer-term departmental vision and plan, develop department specific performance targets and measure progress against these (agree on key departmental targets such as the number of PhD students, peer reviewed publications, funding etc...)
b) Polymers has only one professor continued recognition of polymer expertise at the departmental level will require more younger faculty.
c) The establishment of a process control group is encouraged, but it needs a critical mass to have an impact
d) Enhance PhD course offerings, create a departmental level "PhD program" to increase quality of research output.

A real effort has been made to address the recommendations of RAI 2018.
1) A clear longer-term department vision with well-defined future research areas (see above) was formulated.
2) A “Polymer engineering” tenure-track position was opened, others in “Circular chemical engineering” and “Process systems engineering” are planned.
3) A good balance between fundamental research and industrial relevance was established and is documented by high numbers of industrial projects and high-quality scientific publications at the same time.

The department is well aware of fields with ongoing efforts:
1) Efforts in increasing PhD course offerings need to be continued towards ”true” doctoral schools.
2) Key performance indicators should reflect research excellence in both dimensions: fundamental science and industrial relevance as well.

4.4 Additional recommendations and remarks

Training of users of infrastructure is often the rate-determining step for the progress of experimental work. **High-level permanent technical staff** is needed to increase the performance level and remove this bottleneck (recruitment procedure / evaluation / training / staff management).

CMET will benefit from a **check-in procedure for junior faculty members**. Clear information on departmental research strategy and how it connects to educational vision would allow an even higher contribution to the key performance indicators right from the start of the position.

5 Specific themes to be reviewed on Aalto University level

The university should be aware – and should continuously be reminded – of the fact that **teaching in chemical and engineering sciences** is very cost-intensive, more than in most other scientific and artistic fields. A higher funding for teaching at CHEM school is needed. In addition, basic funding goes down while the number of students goes up, which counteracts this demand instead of better meeting it. A situation in which teaching is increasingly financed by research funds and not by university would be a threat to maintaining high quality in both teaching and research.

A **reward and recognition system for excellent work** and for additional motivation would be recommendable (use of overhead funds?).

There seems to be a lack of knowledge – and perhaps transparency – **where the overhead money goes**, how this important funding source is used and how the schools could more directly benefit from it. Parts of this overhead could be advantageously used to "strengthen strengths", i.e., to support organically growing, successful groups and areas with strong impact.

There need to be clear, openly communicated and **transparent rules** for job descriptions (staff scientists), PhD salaries and bench-fee regulations in laboratories.

PhD schools on school level with dedicated curricula, replacing the cancelled AoF doc-school initiative, would mean even better education and even better job chances for the PhDs. This can only be implemented and financed on university level. Doctoral education should be a central agenda of the university and not be offloaded onto the shoulders of stakeholders.

6 Appendix / List of material used

All the material used before and during the SAB visit can be found here:
https://aaltofi.sharepoint.com/sites/AaltoSAAB2021/SitePages/School-of-Chemical-Engineering.aspx
Material used includes:

- School's and departments' pre-material, including key figures, implementation of the RAI recommendations, strategic plans
- RAI 2018 reports for the Field 3a and the departments
- Aalto Research Portal
- School's and departments' web sites
- Notes from interviews during the SAB visit